MEASURING WELLBEING IN NEW ZEALAND DURING THE 19TH-EARLY 20TH CENTURIES: A SPATIAL PERSPECTIVE

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Abstract

The overall objective of this thesis is to compare and contrast alternative measures of wellbeing in New Zealand during the 19th -early 20th centuries from a spatial perspective by collecting, collating and analysing new economic, social and anthropometric data. Provincial data was collected from the Statistics New Zealand Annual Reports and New Zealand Census. Anthropometric data was derived from the personnel records of New Zealanders serving in WWI, which only became available to the public in 2005. Time-series tests for convergence and causality have been applied to analyse New Zealand's economic history, where appropriate.

The last quarter of the 19th century in New Zealand was a period of rapid change both in terms of economic and demographic indicators. Prior to the universal convergence of the existing monetrary-based measures of wellbeing across Provinces, there were some apparent disparities in the commodity price and real wage series, as well as urban-rural differences in occupation-specific real wages and infant mortality trends. There was also no single pattern of stature decline across provinces during 1871-1898, or between urban and rural areas, where disparities were particularly apparent. The traditional view of the healthy and wealthy New Zealand could only be established at an aggregate level, during a certain time period and for a certain ethnic group (New Zealand European only).

Using Provincial data for the period 1874-1919 I have been able to show that improvements in real wages and a decrease in education inequality (between females and males) corresponded to lower infant deaths and thus better health outcomes, while increased dwelling density created unfavourable conditions for infants' chances of survival. Anthropometric data was used in conjunction with socio-economic provincial data to establish the relationship between stature, urbanization, real wages and infant mortality. The results showed that dwelling density (overcrowding) and general economic conditions were both important in determining stature outcomes during 1870-1900, while the effect of infant mortaliy on stature was negligble. Most importantly, it has been demonstrated that in New

Zealand stature represents a much more robust measure of living standards than real wages or health indicators on their own, at least during the 1870-1900 period.

Chapter 1

1 Introduction

"Our work must endure and evolve so that our children and every generation thereafter can benefit from the lesson that it took us too long to learn - the world is truly what we make it and how we measure it..."

Hoenig (2010)

It has become the norm, it seems, to measure the economic living standards and material well-being of a population by using Gross Domestic Product (GDP)[1] or GDP per capita. The initial goal of GDP was to make it easier for policy-makers to manage a national economy through crises, for example periods like the Great Depression or wars, without consideration of utility (Kuznets, 1962). However, as pointed out by many scholars (Eisler, 2007; Sen, 1985, 1999; Stiglitz, Sen, & Fitoussi, 2009), GDP was not constructed to measure "well-being". The most commonly identified shortcomings arise from the fact that GDP does not account for inequalities at the individual or societal level (i.e. gender or income inequalities) and is a poor social welfare indicator (de Leon & Boris, 2010).

The need to define wellbeing in a much broader sense has encouraged international organizations, public leaders and agencies to look for alternatives to GDP (Bergheim, 2006; de Leon & Boris, 2010). Development economists have stressed the importance of incorporating health and other social correlates into welfare measures, and proposed alternatives include both aggregate (i.e. combine various health, happiness and other social measures) and single dimensional indicators (i.e. focus on a particular issue or an area of concern). Modern alternatives to GDP

[1] Gross Domestic Product (GDP) is the value of all goods and services produced in a certain country over a specified time. It is often referred to as total output.

include the Human Development Index (HDI) or the Quality of Life Index[2], which combine the levels of life expectancy, education and GDP. Stand-alone indicators represent more narrowly defined categories of wellbeing and include: literacy, unemployment rate, maternal and infant mortality, life expectancy and measures of comparative income etc. These alternative, potentially complementary GDP indicators, do not, however, adequately assess the wellbeing of all segments of society particularly women, children and minorities. Thus, there is no single indicator that is sufficient to capture all aspects of wellbeing. As a result of progress in the technology and organization of data collection, a more comprehensive assessment of wellbeing is possible using new global data sets (such as the World Bank, UNDP, and UNICEF data) and improving research programs worldwide.

Before the modern use of survey and census data, the most commonly used indicators of wellbeing were either income or health. Income has been expressed by GDP or real wages. In the absence of such data, the prices of grain or wheat were used as alternatives (B. Campbell & Ó Gráda, 2011; Casutt & Woitek, 2009; Galloway, 1988; R. Lee, 1981). Indicators of health have included: measures of life expectancy, maternal or infant mortality, death rates and morbidity. Traditionally, income measures have been of interest to economic historians, and health measures of interest to demographers or social scientists.

The search for alternative measures of wellbeing occurred in response to the following factors: limitations of the conventional measures of income, lack of welfare indicators for different segments of society and absence of spatial components. In addition, from approximately 1970, development economists and various international organizations showed interest in anthropometric indicators (i.e. stature, weight adjusted for height) as measures of health and potential measures of biological wellbeing of a population (Steckel, 1995). Findings from developed

[2] Growth-with-equity approach to living standards initiated by international organizations (e.g. United Nations, the World Bank) first led to construction of a Physical Quality Life Index (based on infant mortality rate, literacy and life expectancy) and then HDI (Human Development Index) measures, which identified the importance of incorporating health and other social correlates into welfare measures (Steckel, 1995).

countries (Australia, Canada, Germany, UK, USA) and periods (the 18th and 19th centuries) demonstrate a close relationship between height and other measures of living standards at pre-1950 levels of income in Floud (1984, 1998); John Komlos (1989); Sokoloff (1984); Steckel (1988) and others. However, it remains unclear whether stature acts as a supplement to conventional GDP and real wage indicators, or as an independent indicator that relates to biological welfare (Joerg Baten & Blum, 2012). The more recent anthropometric literature uses adult stature as a measure of health, which is shaped by environmental conditions in early life (Akachi & Canning, 2007, 2010; Bosch, Bozzoli, & Quinatana-Domeque, 2009b; Bozzoli, Deaton, & Quintana-Domeque, 2009a; Hatton & Martin, 2010). The reason for the increased interest in anthropometric measures (John Komlos & Baten, 2004; Moradi & Baten, 2005) is that they encompass the net result from consumption and income benefits, which are discounted by disease, poor health, stress and bad nutrition claims. The distinguishable advantage of anthropometric data as opposed to aggregate alternatives (such as HDI)[3] is that it can be derived at the individual level from a range of sources including: military, hospital, school or prison records. Records often contain information on the place of birth and ethnicity, which subsequently allows for examination of regional or ethnic inequalities. *Using stature to measure living standards of the past, especially where economic indicators are non-existent or unreliable, has become a common practice among economic historians.*

At the population level, wellbeing measures can be categorized into monetary indicators that measure income or aggregate production (i.e. GDP, real wages, prices), health and social welfare (the so-called sustainable indicators), and biological living standards indicators (i.e. stature). Only two of these measures (life expectancy as a measure of "healthiness" and GDP per capita) have been extensively used by scholars to measure wellbeing in New Zealand. In terms of conventional living standards, GDP per capita series in New Zealand were available as early as

[3] As Steckel (1995) pointed out stature measures performance by health history rather than inputs to health.

1859. Hawke's (1975) GDP series was the first published time-series of New Zealand's Gross Domestic Product before 1918, which was re-estimated as a monetary-based approach by Rankin (1992) and then by Greasley and Oxley (2000a), who used a cointegration-based approach to derive their series. There are other series available which commenced at a later date: Maddison (1870-1994), Lineham (1918-1938), Easton (1918-1939) and Lattimore (1960-1990). The only considerable deviation of Greasley and Oxley's (2000a) GDP series from the earlier ones is the upward movement of aggregate production during the 1890s and WW1 and its aftermath, when New Zealand outperformed Australia. New Zealand's GDP per capita growth rates were among the highest in the developed world during 1820-1870, and by 1938 GDP per capita (PPP adjusted) was the highest in the world. GDP is a measure of aggregate production, which only recently became available at the regional level. Real wages have been the only other monetary measure of living standards that can be used to examine inequalities across regions or occupations.

The real wage estimates, however, were subject to less progress in the literature than GDP. Real wages in the published form are only available at the aggregate level and the only publication on the construction of a historical real wage index for New Zealand for the period 1873-1911 in the literature is by Arnold (1982a, 1982b). Apart from that, occasional government reports were published by the *Department of Labour*, for instance, Clinkard (1919) examined the fluctuations of minimum wages across various occupations in New Zealand during 1887-1919. Recently, Greasley and Oxley (2004, 2005) compiled, again only at the aggregate level, wage rental ratios and an unskilled and composite real wage index series to include New Zealand in the debate on the global real wage convergence[4]. In comparative terms, composite real wages in New Zealand were gradually increasing between 1873 and 1913, and moved closely with the real wages in Australia.

It can be stated with some certainty, given the available GDP and real wage data, that New Zealand in the 19th – mid 20th century was a relatively wealthy country.

[4] Williamson's (1995) analysis excluded New Zealand wage estimates for unskilled workers; therefore they were not included in his discussion on real wage convergence. Allen's (1994) analysis of real wages in the English-speaking world (Greasley & Oxley, 2004) also excluded New Zealand.

However, it has not been established whether there were any disparities in monetary measures of living standards across regions. Examination of regional inequalities in New Zealand could shed the light on the issues of commodity or labour market integration. Regional analysis would be able to confirm the widely accepted perception of New Zealand's 'absence of great extremes of wealth and poverty' (Taylor & Parsons, 1904) or perhaps understate the relatively advantageous position of New Zealand in terms of GDP and real wages.

Not only was New Zealand 'considered' wealthy, it was also perceived as being relatively healthy. New Zealand was recognized to have high rankings in terms of social conditions (life expectancy, infant mortality). In particular, New Zealand was famous for its outstandingly low infant mortality rates[5] during the first half of the 20th century and even earlier (J. Gibson, 1971). Reduction in infant mortality was first marked during the 1880s. The analysis of infant mortality and fertility decline originated in the 1950s, in purely demographic-based studies (J. Gibson, 1971; Gilson, 1969, 1970; Gilson(Vosburgh), 1971; Pool, 1982, 1985; Pool, Boddington, & Cheung, 2009; Pool & Cheung, 2003, 2005), with little economic perspective due to data limitations (unavailability of measures of regional income). It should not be forgotten that infant mortality is not only a demographic measure, but it is also widely accepted as a measure of health and well-being of a given population. Infancy has always been one of the most vulnerable periods of human life and the scale of infant mortality itself has important circumstances. Infant mortality has been shown to be associated with social and economic indicators (e.g. income, un-crowded homes and clean environment) (Kalipeni, 1993; C. Lee, 1991; Williamson, 1981). Thus, variation in infant mortality rates across different regions and over time can act as an indicator of economic and social wellbeing inequalities. In New Zealand, however, sub-national analysis of health indicators is also limited. The only publication on regional dynamics that considers sub-national differences in the

[5] Improvement in infant health care was confined to the New Zealand European population, and did not include the indigenous people of New Zealand (Maori). There is no concrete demographic data available on Maori before 1918 or even later, apart from approximate figures based on the observations of contemporaries (Bryder & Dow, 2001; Bryder & Royal New Zealand Plunket, 2003; Dow, 1999).

decline of New Zealand European fertility during the period 1876-1901 is by Pool and Tiong (1991).

In terms of biological living standards, New Zealand did not seem to be as flourishing. As of today, the only existing study on anthropometric history in New Zealand is by Inwood, Oxley, and Roberts (2010) whose paper presented some preliminary results on New Zealand's anthropometric history. Inwood et al. (2010) concluded that the average stature experienced a decline in the late 19th century, which was similar to other Anglo-Saxon settlements. While the average adult stature in North America and Australia had begun to recover after 1900, the average stature in New Zealand did not begin to increase until after WW1. They speculate that a significant decline in stature in the 1890s could be due to slowed growth trajectory in both Australia and New Zealand, which was reflected in slowed growth in real wages and other factors such as urbanization and health-related infrastructure reforms. Most importantly, it still remains unclear what the relationship between the above mentioned economic, health and anthropometric measures was in New Zealand's context, and which one of them represented a more robust indicator of the wellbeing of New Zealanders during the period of rapid changes (i.e. period of demographic changes, rapid urbanization and beginning of the refrigeration era) as was the last quarter of the 19th century.

To summarize, firstly, the available income data shows that New Zealand as a whole was relatively wealthy, however not much is known about provincial inequalities. Secondly, New Zealand had exceptionally low levels of infant mortality, but analysis of health data has been confined mostly to demographic-based studies that have not considered sub-national trends or the effect of socio-economic variables on health measures. It appears that in terms of biological living standards New Zealand was no different from other countries of Anglo-Saxon origin in their common decline in the average stature throughout the last quarter of the 19th century. There are no explanations available to date as to the reasons of this decline.

What I have covered, therefore, is effectively a range of potential indicators of wellbeing for New Zealand: i) GDP and GDP per capita; ii) real wages; iii) health

outcomes, and finally iv) anthropometric measures (stature). What does each say about the dynamics and level of wellbeing in New Zealand in the later 19th and early 20th centuries and to what extent do the stories differ? Is there any expectation of which is 'best in theory' or 'best historiographically' in terms of contemporary documentary support?

This brief background leads me to the main objective of my thesis which is *to compare and contrast alternative measures of wellbeing, during the late 19th and early 20th centuries in New Zealand*. I will construct and collate new data to ascertain whether a consistent picture emerges. This will help fill some of those "missing pieces" in New Zealand historiography. In particular, I will collect regional indicators and analyse new economic, social and anthropometric data that represent various aspects of wellbeing in a New Zealand context. *The first specific objective of my thesis is to analyse and construct monetary indicators of living standards from a spatial perspective*. Monetary measures used will include real wages by occupation and region derived as extensions to the aggregate measures of Greasley and Oxley (2004, 2005); new price indices by region will consider issues related to the changing relative cost of staples. *The second specific objective is to analyse sub-national health measures from the socio-economic perspective*, where health measures will include data on mortality/morbidity rates by region. Finally, anthropometric data (extended data set from Inwood et al. (2010)) will be used alongside traditional monetary and health indicators to answer the major question of interest: *'What was the relationship between socio-economic, health and biological living standards?'*

This thesis contains 7 chapters including an Introduction and Concluding Summary chapters. There is no separate literature review chapter as each chapter in this thesis contains the literature review specific to the question it addresses. The first three Chapters are dedicated to the construction and analysis of monetary measures or indicators of wellbeing. In Chapter 2 a new provincial consumer price series is constructed and is utilized to explore regional dynamics in the commodity price index series (Chapter 3) and to express monetary measures in real terms (Chapters 4, 5 and 6). In Chapter 4 provincial and urban-rural disparities in real wages are

examined. In Chapter 5 I explore the sub-national health trends (i.e. infant mortality) in New Zealand from the socio-economic perspective, using measures of regional income (derived in Chapter 4) and other socio-economic controls. In Chapter 6 I test the relationship between monetary, health and anthropometric measures and estimate the impact of the early childhood environment as expressed by previously derived socio-economic and health measures on adult height outcomes.

Chapter 2

2 Construction of Provincial CPI in New Zealand: 1885-1913

Measuring prices, both in terms of levels and rates of change, plays a fundamentally important role in a wide range of economic applications. Whether individual goods and services or baskets of commodity aggregates are considered, price data enables one to explore changes in 'real' values, as well as measure, estimate and test a wide range of economic hypotheses and relationships including changes in the cost and standards of living, relative price and purchasing power parity. An analysis of living standards (real wages) from a spatial perspective is not possible without an appropriately constructed regional Consumer Price Index (CPI). In this chapter I present the construction of a new CPI for New Zealand, 1885-1913, for the four largest provincial districts (PD): Auckland, Canterbury, Otago and Wellington[6]. The new provincial data on various consumer prices are used to analyse provincial commodity price series in Chapter 3 and to express monetary measures of socio-economic conditions in real terms in Chapters 4, 5 and 6.

2.1 Introduction

Summary measures such as Consumer Price Index (CPI) are based upon the ability to appropriately aggregate weighted combinations of goods and services to provide a summary cost of living measure. In New Zealand, the first cost of living index was created by Fraser in 1915. His estimates were based on the records of people who were engaged in retail trade over the period 1891-1913. In 1982, Margaret Arnold constructed an alternate aggregate CPI by revising the weighting scheme used by

[6] Provinces in this case refer to provincial districts, which represent meaningful geographical divisions formed between 1853 and 1870. Even after the abolishing of the provinces (1876-7), statistical boundaries remained in tact. In terms of the regional boundaries, defined in 2006 Census, Auckland PD inlcuded Northland, Bay of Plenty and most of the Wakaito region, excluding Taranaki. Wellington PD: Manawatu-Wanganui and Wellington regions, excluding Hawke's Bay. Otago PD from 1870 consisted of Southland and Otago regions, while Canterbury PD included only Canterbury region, not including Westland, Nelson or Marlborough. Please see Appendix D Figure D1 for a detailed map of historical boundaries.

Fraser and including additional provincial data, which she extracted from *Statistics New Zealand Annual Reports*.

For many, Arnold's CPI series remains the most reliable for that period. In this chapter I use Arnold's series as a benchmark to reconstruct a New Zealand CPI for the period 1885-1913 from a spatial perspective i.e. disaggregated at the level of the four most populous provincial districts: Auckland, Canterbury, Otago, and Wellington. The starting point coincides with the availability of a district level nominal price series reported in *Statistics New Zealand Annual Reports*. The construction of provincial CPIs is achieved by using average prices for a chosen basket of goods, based on the expenditure weights reported in the Labour Department Household Survey of 1893 (New Zealand. Parliament. House of, 1893)

The chapter is organized as follows. In Section 2.2 I provide a brief overview of the previous work on prices in New Zealand, which is an adjunct to that provided by Briggs (2003). In Section 2.3 I compare New Zealand's expenditure patterns with other countries and discuss the choice of the consumption basket. In Section 2.4 I discuss alternative index formulas for CPI estimation. In Section 2.5 I present the sub-index series and their composition by Province. In Section 2.6 I consider the consistency of the derived CPI with the existing national level CPI.

2.2 New Zealand's historical prices series

2.2.1 McIlraith's series (1861-1910)

The earliest price index for New Zealand (based on wholesale prices) was developed by McIlraith in 1911 in response to heightened inflation prior to the First World War (Nesbitt-Savage, 1993). The objective of that series was to measure changes in the general level of prices from 1860. In particular, McIlraith was interested in examining changes in the purchasing power of money and to ascertain what caused changes in the local price level to occur. McIlraith (1911) did not attempt to weight the commodities used in the series, but rather derived the un-weighted wholesale prices from the import and export schedules, including the prices of non-consumer items (e.g. zinc, lead, bar iron). McIlraith (1911) further assumed that prices would deviate little among the largest centres, mainly upon the assumption that transport

and communication between different commercial centres of New Zealand was frequent and cheap. He therefore adopted Wellington prices for the most commonly imported goods and Christchurch retail prices for agricultural produce items such as cereals and meats. McIlraith (1911) also used the Sauerbeck (1895) and "Economist" series[7] to compare New Zealand and English price levels. He found "a marked coincidence during 1880-89 between the two series" where average prices were falling between 1880 and 1887 in both countries. McIlraith (1911, p.75) also compared his series to the U.S. Falkner series and found that

> …America, like New Zealand, did not experience the wave of inflated prices till 1872.

McIlraith did not always seem to be clear on the sources and references to the price series he used. As noted by Nesbit-Savage (1993), the McIlraith wholesale price index is not an adequate consumer price series and provides only approximate measure of the annual rate of change in retail prices.

2.2.2 Fraser series (1891-1914)

Due to sudden price inflations in the 1890s, the *Department of Statistics* began monitoring relative price movements more closely. In 1915 the Government statistician, Fraser (1915), produced a *Report* on the long-term cost of living index based on the records of people who were engaged in retail trade over the period 1891-1913 (Nesbitt-Savage, 1993). From that point on, regular monthly and quarterly surveys were undertaken to monitor consumer prices.

The expenditure for each individual item (the "mass-unit") was ascertained by taking the average production of each commodity in New Zealand plus or minus the excess of imports over exports, or *vice versa*, all averaged over the past ten years. From 1914 Fraser (1915) used monthly sales for the various grocery items. The relative expenditure shares of the household budgets, collected by the *Department of Labour* in 1911-1912, were used to verify the results. He compiled a cost of living

[7] McIlraith (1911) claimed to derive the series from the *Economist* magazine.

index for each sub-group from prices collected in the four "chief" centers (Auckland, Wellington, Christchurch, and Dunedin) between 1891 and 1914.

Fraser's cost of living index is the first weighted retail price series index for New Zealand, which represents a more appropriate CPI estimate than that of McIlraith. Despite that, Fraser's price series has its limitations. The retail prices for the grocery group in Christchurch were not available prior to 1899. The expenditure weights used by Fraser (1915) only approximate the results obtained by the *Department of Labour* as he did not include certain items of fruit and vegetables (Fraser, 1915). He also omitted the *other items/miscellaneous* section, which according to the *1910 Expenditure Survey* was 40.34 % of the total expenditure in a household (Collins, 1912). Most importantly, as pointed out by Arnold (1982b), Fraser (1915) "neglected" the *Statistics of New Zealand* annual return of retail prices published for each year since 1847, with the number of items expanding from 1885[8]. Fraser's series is therefore restrictive in scope (as it covered only food and rent) and was "further limited because the compliers relied on less than optimum sources" (Arnold, 1982b; Nesbitt-Savage, 1993). Although both McIlraith's and Fraser's price series may be reliable in relation to the general trend, they appear to be less reliable in terms of annual fluctuations (Arnold, 1982b).

2.2.3 Arnold's series (1870-1919)

In order to address problems with the Fraser series (e.g. incomplete or limited expenditure basket and data source reliability), and to extend the series (the Fraser series commenced in 1891), Margaret Arnold developed an aggregate CPI by revising the weighting scheme used by Fraser. To construct the new CPI she extracted annual average returns of prices reported in *Statistics New Zealand* from 1870 to 1919 (Arnold, 1982b) where collection of these prices was apparently undertaken by the Police Force (NZOY, 1910).

[8] Statistics New Zealand expanded the range of prices published since 1885 e.g. farm yard produce (eggs, ham, bacon etc.), garden produce (potatoes, onions, carrots, cabbages etc.), miscellaneous (coal, firewood etc.).

Arnold's long-term series consisted of the five major subgroups of expenditure: Food, Housing, Clothing, Fuel and Light and Miscellaneous items. She collated the prices for individual items for the years 1870-1901 and then linked them to the Fraser series "to provide an adequate overlap with the Fraser series". She constructed the individual series by first taking the midpoint of each range of values given for each Province, then weighting these midpoints by the proportion of population in the Province. To develop her final CPI, she linked the five sub-series together. Although, for her final series she used various weights (Karamea, *Department of Labour*, and Fraser) [9], Arnold (1982b) reports that using different weights "made relatively little impact on the series." Arnold concluded that the five subseries all move together, showing the same U-shape as the general trend. Arnold's CPI series is probably the most commonly used index of changing consumer prices in New Zealand for the 1870-1919 period.

2.2.4 Nesbitt-Savage series (1847-1990)

Nesbitt-Savage (1993) used Arnold's series from 1870 to 1919 as the basic starting point to construct his long run CPI series (1847-1990). Nesbitt-Savage (1993) developed two models to construct (rather than directly measure) a long run CPI from 1847-1992. The first model used an overlap between McIlraith and Arnold to construct the series for 1861-1869. The second model used the correlation between Sauerbeck's (British wholesale Price Index) and Arnold's series to derive an approximation for the 1847-1860 period. The first two models were then linked to Arnold's (1870-1919) and the *Department of Statistics'* (1920-1992) CPI series. The same consumption patterns (unchanged basket of goods) were applied during the 1847-1919 period. Nesbitt-Savage (1993) used simple linear regression techniques to back-cast the series to 1847. The methods he used to generate the long-term CPI series can probably be ameliorated using more sophisticated time series methods now available.

[9] Karamea Store Book, 1875-1876, NP Series 23, Box 5, item 6, Archives New Zealand (ANZ).

2.3 Basket choice

Construction of a CPI generally begins with compilation of average prices of a wide range of commodities and their relative expenditure weights (shares). To gain a perspective on the historical pattern of the consumer basket composition, Table 2-1 reports consumer basket weights for three different time periods for New Zealand and other countries with comparable labour markets (i.e. Australia and Britain). In New Zealand, the proportion of food in the total expenditure declined from 63.05% to 34.13% during the period 1875-1911. The relatively high proportion of expenditure on food in Australia can be observed in the earliest expenditure survey in 1861, which subsequently declined to around 30% by 1911. In both New Zealand and Australia there is a shift from the dominant expenditure on food in the early years before 1900 to correspondingly larger shares spent on miscellaneous items after 1900. Similar to Australia, expenditure share on housing/rent more than doubled in New Zealand between 1875 and 1911. In Australia there is some divergence in the basket weights between the McLean (1999) and Knibbs (1911) series, in particular, Knibbs's basket shows a very small share of income spent on food and correspondingly large share spent on "other things". McLean (1999), however, was sceptical as to the results of the first expenditure survey (Knibbs, 1911), which he indicated was "deemed unsatisfactory." Interestingly, in Britain the expenditure on food had a reverse pattern, where it increased by 24% from 1900 to 1914. Given that the 1914 Shergold's Birmingham survey reported only a relatively small proportion of miscellaneous items in the basket, it is possible that these were included in the food portion of the expenditure, inflating the amount spent on food in the typical worker's budget.

The basket of goods chosen for the construction of the New Zealand Provincial CPIs corresponds to that reported in Arnold (1982b), but with minor changes (i.e. eggs, dried fruits, potatoes and vegetables are included, and fish is omitted from the grocery basket). Arnold (1982b) used three different weighting schemes for different periods: *1875 Karamea weights* (for 1870-1893); *1893 basic expenditure weights* (1885-1919) and *1910 Fraser Budget study weights* (1895-1919). However, Arnold (1982b) noted that the final aggregate series were robust to the use of different

weighting schemes. The Karamea weights were restrictive in representing the total population (the weights came from one store book)[10], and Fraser's weights covered only a portion of the total expenditure. Therefore, for the construction of a provincial CPI, I utilized the 1893 *basic expenditure weights* for the entire 1885-1913 period (the weights for the consumer basket are reported in Table A-1 of Appendix A).

There is limited knowledge as to whether the consumption patterns were different across Provinces, for example, Collins (1912) estimated differences in the cost of living between Christchurch and Auckland using a simple basket (food and rent):

> The figures show an increase of 20 % in the cost of living (food and rent) in Christchurch as against an increase of about 34 % for Auckland. Auckland's budget shows an increase in food by 25 %, while Christchurch indicated an increase of about 21 % by 1910-11.

Based on the *Royal Commission Report*, Collins (1912) included only specific items and not the weight of the whole basket. Furthermore, the expenditure weights were also limited to the two selected provinces. He also commented on the cost of living figures provided by the *Royal Commission* (1912 – H.18, p. xii):

> …the report of the *Royal Commission* represents a rudimentary summary of the statistics on prices in the Dominion at that time.

Due to limited information on different consumption baskets across the Provinces, the same consumption patterns are assumed in all cases.

[10]The goods were bought through only one store in Karamea (rural town, north of Westport), serving approximately 30 families. Housing and miscellaneous expenses were not included. See Arnold (1982b) for details

Table 2-1.Country-specific expenditure weights for consumer price indices (% of total expenditure)

Items of expenditure / Country	New Zealand			Australia				Britain	
Survey year	1893	1910-11	1875	1861	1900	1913	1911	1900	1914
Source	Household survey	Labour Depart.	Karamea weights	McLean(1999)		Knibbs (1911)*		Preston (1954)	Shergold (1982)
Food	52.7	34.13	63.05	45.12	39.40	38.52	32.23	34.9	54.45
Rent (housing)	10.38	20.31	6.14	12.09	15.54	19.43	13.7	11.6	17.65
Clothing	17.52	13.89	14.6	12.09	23.31	21.39	12.72	10	11.95
Fuel and Light	8.08	5.22	2.08				3.46	5.1	5.95
Tobacco							0.63	1.8	
Alcohol	1.16		3.22	14.27	13.46	12.12	0.74	12.8	2.6
Miscellaneous	10.16	26.45	10.91	16.43	11.82	8.54	36.52	23.8	7.4

*Notes and Sources:** Extracted from R. Allen (1994): Australia, Knibbs (1911: 14, 19), food includes non-food groceries and non-alcoholic beverages.

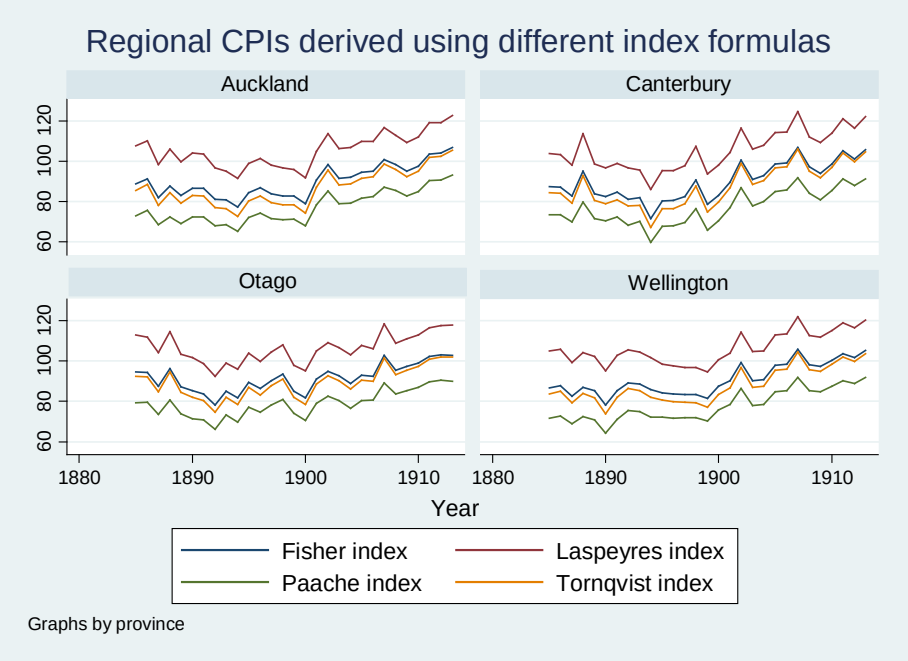
2.4 Index choice and construction

The choice of an appropriate index for the construction of a new regional CPI is constrained by data availability (prior to 1913 only annual data are reported) and the limited information on expenditure patterns across Provinces.

The modern literature on index numbers offers several axiomatic approaches to the choice of a price index. Under the first axiomatic approach the quantities and prices are independent variables (the cross-elasticity of demand is zero). There are approximately twenty tests under which the indices are now evaluated (ILO et al., 2004). The Fisher index satisfies all twenty axioms, while the Young, Laspeyres and Paasche indices fail three time reversal tests. The Walsh index fails four tests, and the Tornqvist index fails nine tests (i.e. the fixed basket test, the quantity and price reversal tests, the mean value test for quantities, four monotonicity tests and the Paashe and Laspeyres bounding test) (ILO et al., 2004). In the case where data follows relatively smooth trends using 'normal' time-series data, the Tornqvist and Fisher indices are expected to approximate each other numerically (ILO et al., 2004). In the second axiomatic approach, in which a price index is defined as a function of the two sets of prices or their ratios and two sets of values, the Tornqvist is the only price index that satisfies all seventeen axioms (e.g. positivity, continuity and identity of constant prices test). This is one of the many reasons why this index is currently favoured by many researchers. Following the general consensus, I chose the Tornqvist index formula for the calculation of the new Provincial CPIs. Alternative index formulas were also considered, although due to limited information available on historical prices and the consumer basket, it is not possible to calculate the exact Tornqvist, Fisher, Laspeyres or Paache indices.

Figure 2-1 shows that the CPI series constructed using alternative index formulas, where all follow a similar pattern, show that some of them are at the higher bound (as predicted by theory), while others are at the lower bound. Estimates derived via the Tornqvist and Fisher index formulae are closely approximated and are in between the lower and the upper bounds.

Figure 2-1. Provincial CPI constructed via alternative index formulas



The coefficient of correlation matrix (Table 2-2) shows that the Tornqvist and Fisher indices are statistically identical. The Tornqvist price index is highly correlated with both the Laspeyres and Paache index estimates. Thus, a provincial CPI is robust to the use of alternative index formulas.

Table 2-2. Correlation coefficient matrix for the four index alternatives

	Laspeyres	Tornqvist	Paache	Fisher
Laspeyres	1.00			
Tornqvist	0.99	1.00		
Paache	0.96	0.99	1.00	
Fisher	0.99	1.00	0.99	1.00

2.5 CPI composition

To construct a CPI for each of the four Provinces, I collected annual retail price data from *Statistics New Zealand Annual Reports* and weighted the series using the 1893 *basic expenditure weights* for the entire 1885-1913 period. The percentage breakdown of expenditure on individual items is presented in Table A1 in the

Appendix. The assigned individual weights for some items, (the ones that imply variety e.g. dried fruits), were derived from consumption expenditure figures for individual items in Fraser (1915). To avoid taking any single year, which could be considered as abnormal, the mean of the 1909-1913 prices was used as the base period. From the discussion in Section 2.4, CPI was constructed using the Tornqvist index.

From approximately 1885, *Statistics New Zealand* published a wider range of retail prices, extending the vegetable and home produce section, as well as prices for fuel and light. Factories and manufacturing production series were also reported from 1885[11]. Prices of other groceries such as jam and dried fruits were taken from the import schedule (1885-1890, until 1899 for Canterbury) and then linked with corresponding items reported in Fraser (1915) (from 1890 for most series). The breakdown of dried fruits into prunes and apricots was converted into a single price series for dried fruits[12] (Fraser, 1915). The fancy biscuit series was omitted since neither the household expenditure survey of 1893, nor Fraser's budget survey included this item. The resulting CPI series consists of 7 sub-groups: *Grocery, Dairy, Meat, Fuel and Light, Clothing, Housing* and *Miscellaneous*.

In this section, I discuss the composition of the new provincial CPI series[13]. Despite the differences in composition and expenditure weights between my sub-series and those of Fraser (1915), I make some comparisons with the Fraser sub-series[14].

Most of the goods included in the *grocery group* are items that were either imported or produced for domestic consumption (e.g. sugar, tea, coffee, potatoes), with only wheat and flour exported to some extent. Frequent fluctuations in the grocery index series, see Figure 2-2, reflect seasonal volatility of bread, potato and flour prices,

[11] The clothing series had to be extracted from that data.

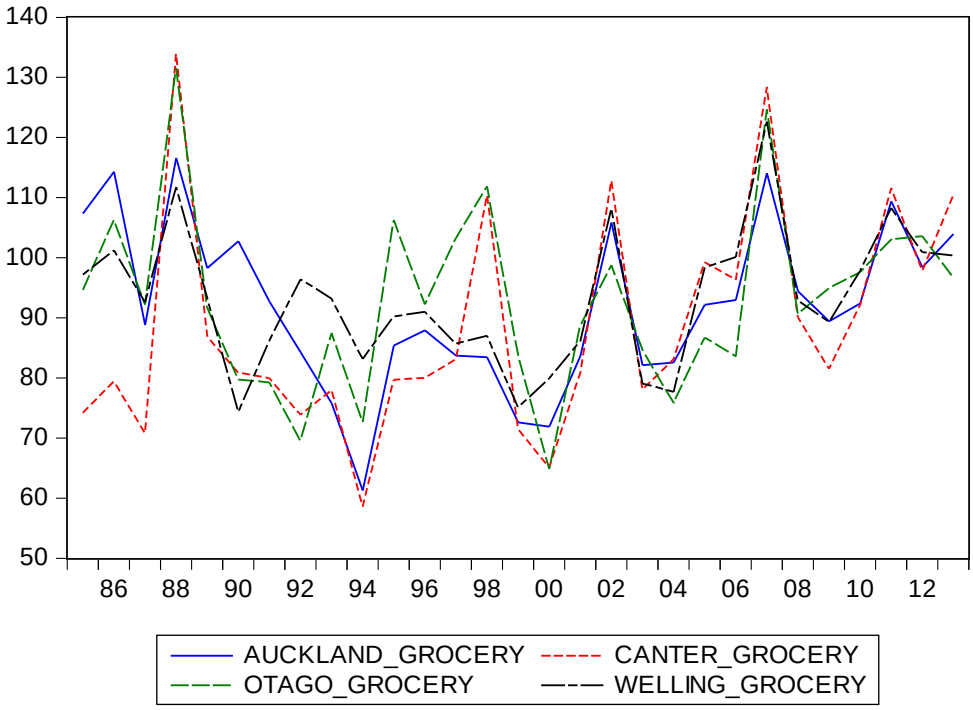
[12] 75% of expenditure was assigned to prunes, and 25% - to apricots

[13] See Appendix A, Tables A5-A11 for the average prices

[14] Fraser (1915) only collected *Grocery, Dairy, Meat, Fuel & Light and Housing* prices, cost of *Clothing* and *Miscellaneous* items were not included in his cost of living index.

which were highly dependent upon the weather and harvest outcomes. Likewise, Fraser (1915) found that the retail prices of home produced items such as bread, flour, oatmeal, potatoes and onions were largely responsible for annual fluctuations in the grocery group. Bread and flour together contributed 10 % to the total expenditure and approximately one third to the grocery basket.

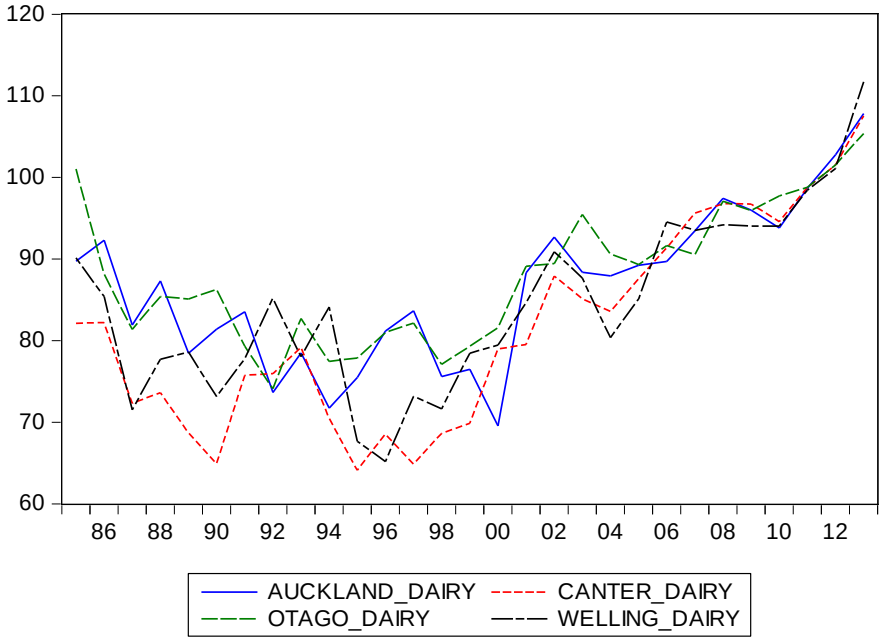
Figure 2-2. Grocery price index series, 1909-13=100



The second sub-group of the CPI is *dairy produce*, which is more homogenous in its composition than the grocery group (Figure 2-3). The *dairy group* consists of butter (salted and unsalted), cheese, and milk. The price of eggs is also included in the *dairy price* index since it was reported in the home produce section (*Statistics New Zealand*). Milk was the highest weighted commodity in the basket (Appendix A, Table A-6), however, this level of milk consumption was only high according to the 1893 *Household Survey*. The value of milk reported in the Karamea store book (1875) was relatively low (less than 1%). Prior to refrigeration, dairy products were mostly consumed locally and many who resided in rural areas had their own supply of milk, with milk factories not appearing until the 1880s (New Zealand Department of Statistics, 1873-1935). Since Karamea was a relatively small rural

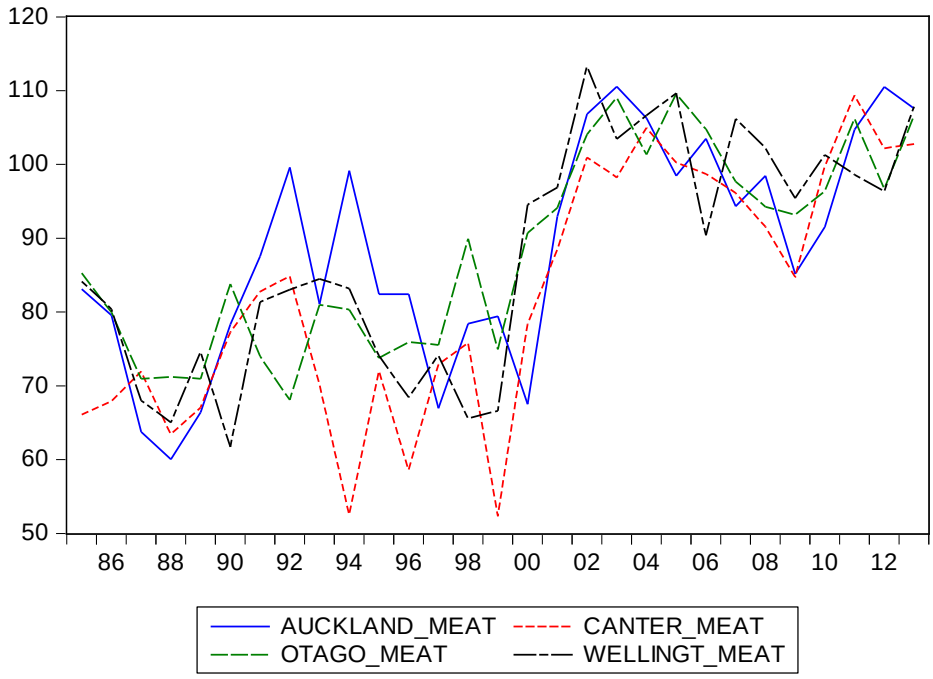
community north of Westport, it is perhaps not surprising the reported sales of milk were low.

Figure 2-3. Dairy price index series, 1909-13=100



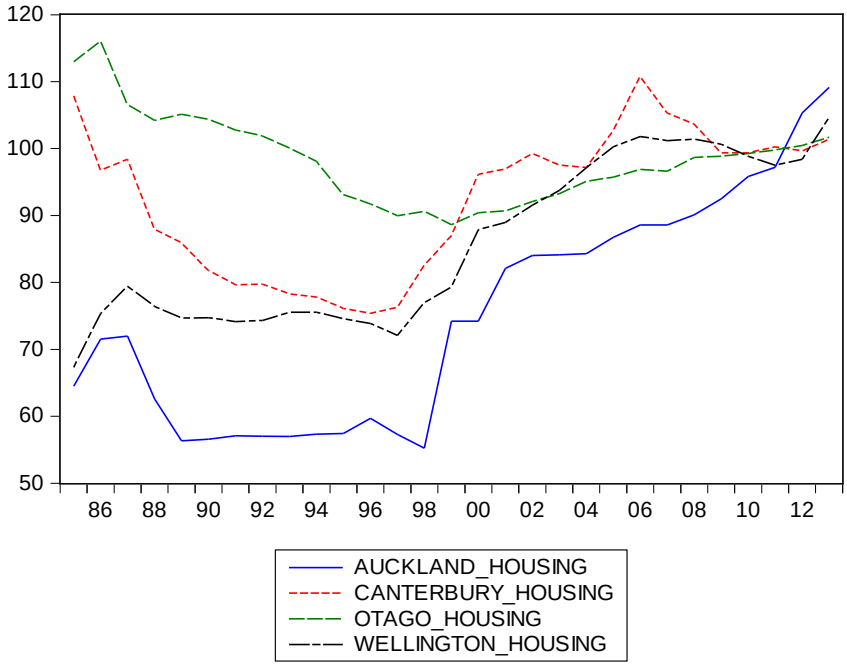
The *frozen meat* price series includes the prices of beef, mutton, pork, lamb and veal. Beef had the highest expenditure share, while mutton and lamb were assigned the same weights. It appears that, between 1892-1900, Canterbury's meat prices were the lowest of the four Provinces. Fraser's series, however, identified prices in Dunedin to be the lowest throughout the period 1891-1914. In both Fraser and the *Department of Statistics* retail price series, meat prices in Auckland were on average higher compared to other regions, particularly during 1889-96, with the world price of meat increasing dramatically in 1895. Fraser (1915) noted that retail prices did not fluctuate according to the variation in export prices and local causes, peculiar to the meat trade, did not have any connection with the variations in the price of dairy produce, for instance. He also found that the local divergence in the 1890s was apparent across the four largest centres, which seems consistent with the results in Figure 2-4.

Figure 2-4. Meat price index series, 1909-13=100



Housing price data were derived from the two sources: *Statistics New Zealand* pre-1902 (calculated from the number of Boroughs and the rental value of rateable property), and the prices reported in Fraser from 1902 to 1913 (rental prices, based on various number of rooms in the house, were assigned different weights and averaged). Expenditure on rent contributed approximately 10% to overall expenditure, which increased subsequently in 1910-11 to approximately 20%. The relative absence of yearly fluctuations was due to fixed term leasing, common for that period (Fraser, 1915). According to Fraser (1915), the movement of rent over time tended to remain conservative, even among those who rented on a weekly tenancy. Post 1898, Fraser (1915) recognized the largest increases in rent in Auckland and Wellington, with his housing index showing that Dunedin experienced the steadiest rent movement, while Christchurch had a boom in 1906, followed by a sharp fall in 1912.

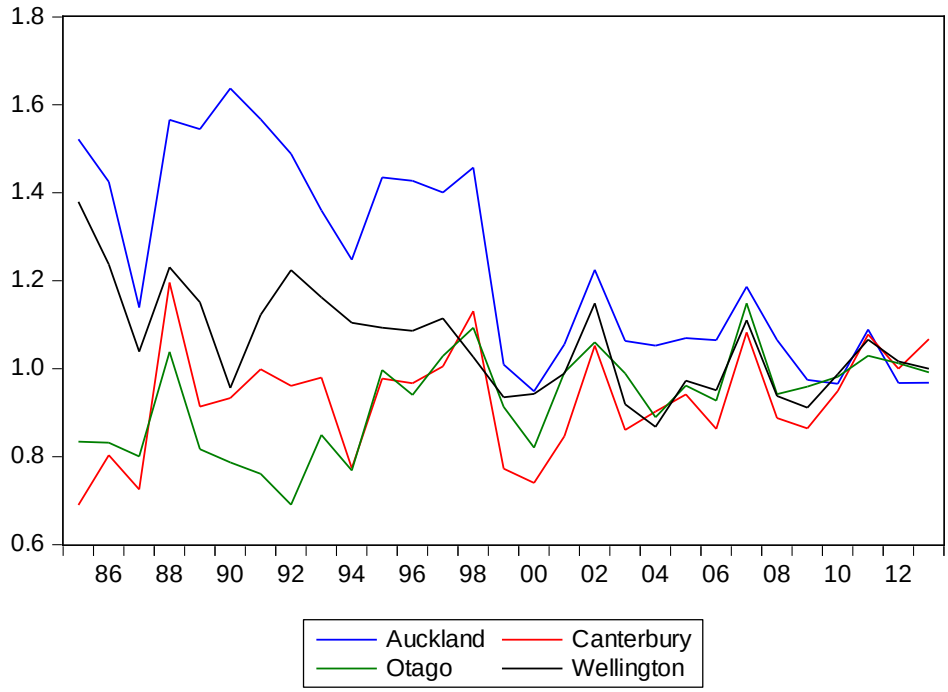
Figure 2-5. Housing price index series, 1909-13=100



From Figure 2-5, it is clear that housing prices declined in Canterbury and Otago and increased in Wellington and Auckland. Dunedin's housing prices appear to be consistently higher than those in other provinces until 1898 (Figure 2-5). My findings differ from those of Fraser (1915), who found that the highest prices existed in Wellington and the lowest in Auckland. The cost of food relative to the cost of housing is seen to be declining in Auckland and Wellington and slightly increasing in Canterbury and Otago (Figure 2-6). As housing prices in Auckland and Wellington were rising, a relatively larger proportion of the budget was spent on paying rent than buying food. The opposite was true for Canterbury and Otago. The relative price effects led to an increase in the housing share, which corresponded to the reported increase in the expenditure on housing and decline on food[15] (see Table 2-1).

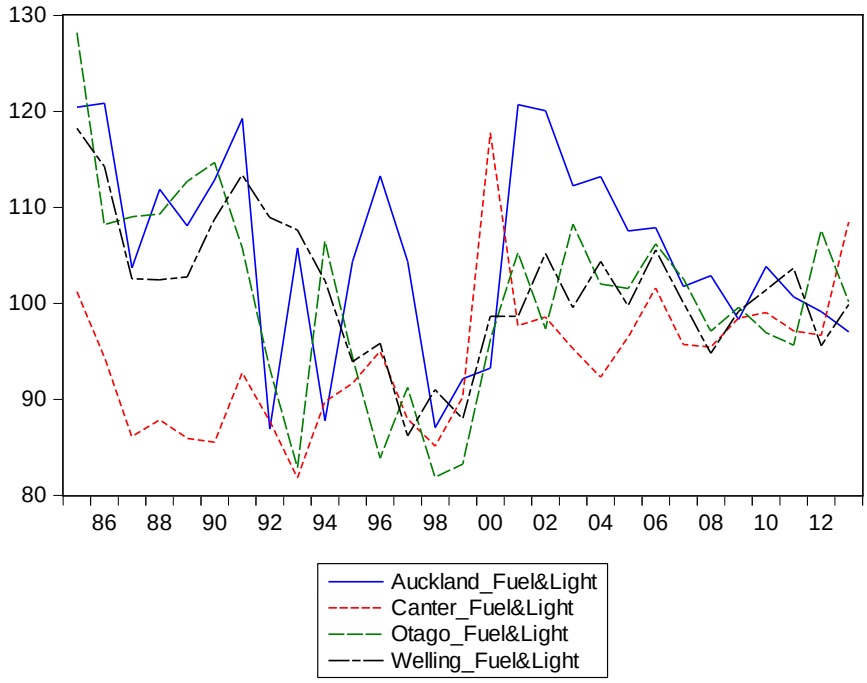
[15] The *food group* consists of three sub-groups: Grocery, Dairy, and Meat.

Figure 2-6. Relative prices, Food to Housing ratio (1885-1913)



Fuel and Light expenses were only 8% of the total expenditure in 1893. With the wider use of electricity, the use of candles as the means of lighting ceased towards the beginning of the 20th century. Apart from candles, the new *Fuel and Light* index includes prices of coal and firewood. While Fraser's *Fuel and Light* series commenced in 1907, the new *Fuel and Light* Provincial series is now available from 1885. Fraser (1915) identified that coal was much cheaper in Dunedin and charges for electricity were the lowest. On average, retail prices of coal and firewood were lower in Otago, and prices for candles were the lowest in Canterbury (Appendix A, Table A9). Between 1885 and 1891 the weighted fuel and light index (candles, coal and firewood) tended to be lower in Canterbury (Figure 2-7). The use of candles and firewood declined over time with the increased use of alternative methods for heating and lighting.

Figure 2-7. Fuel and Light price index series, 1909-13=100



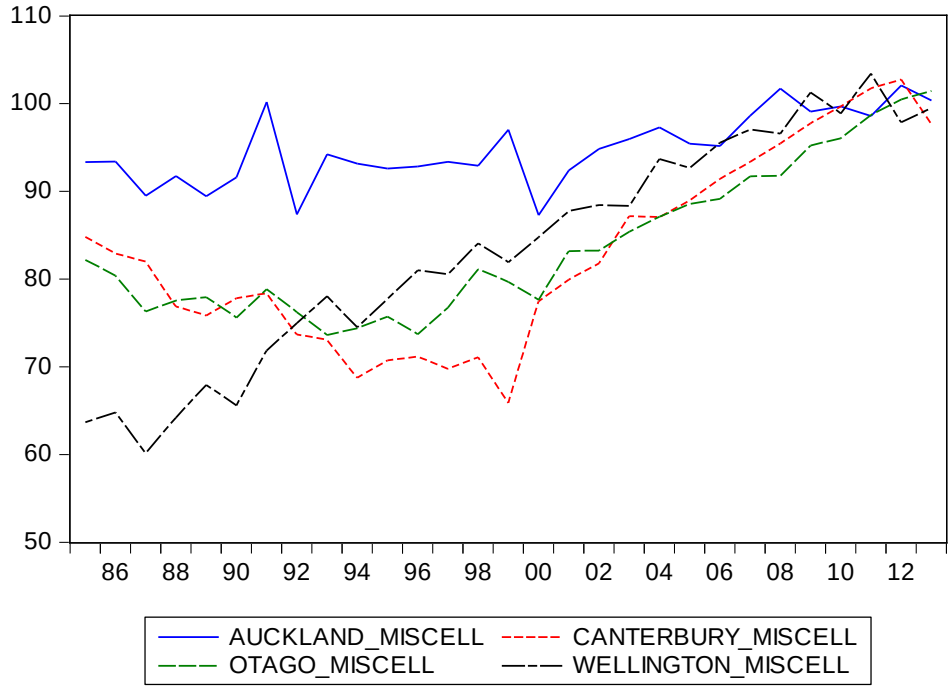
The *Miscellaneous* series, the most heterogeneous in the CPI, included prices of books (income from public libraries in each respective education district); furniture; medical expenses and soap (washing and cleaning). Primary education was free and compulsory from 1877, thus the only expenses on education included the cost of books and other study materials. Arnold (1982b) used the value of imported printing paper to proxy for expenses on books, however, such a measure could be potentially misleading since imported paper was mostly used for printing newspapers and not study books, which were generally imported as final goods. In contrast, I used public libraries subsidy data (income from subscriptions and voluntary contributions, *AJHR*, various years) for each education district to proxy for book expenses. Total income - "entitling subsidy," (received from subscriptions and voluntary contributions)[16] for each education district was divided by the total population of the district at each successive Census.

Furniture prices were estimated by giving equal weights to carpenters' wages (for each Province) and the average price for exported timber (dressed timber). Medical

[16] New Zealand. Parliament. House of (1884)

expenses were estimated using data on hospital receipts. The total amount received from patients was divided by the total number of patients in hospitals in the respective Provinces. The series were then combined and weighted to produce a new '*Miscellaneous'* index series (Figure 2-8).

Figure 2-8. Miscellaneous price index series, 1909-13=100

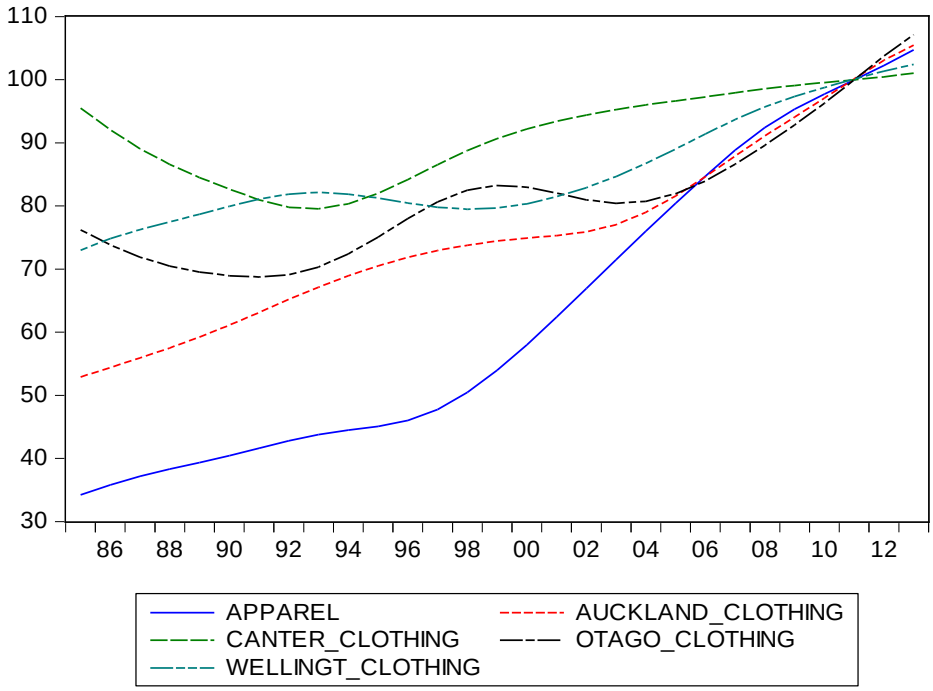


The *Clothing* series was constructed from boots/shoes and clothing prices (derived from the 1885 *Industrial Census*). The clothing series follows relatively smooth trends as the data were linearly interpolated between Census years. The first boot and shoe factories were established in the 1870s and the New Zealand Government imposed a duty of one shilling per pair on imported boots from the 1860s, making them more expensive and therefore promoting domestic production. Boots were generally of a much higher quality after 1900 causing an increase in relative prices. Tariff increases fell most heavily on the price of boots of lower grade (Collins, 1912), with the scale of boot manufacturing greatly increased from 1900[17].

[17] Industrial census reported increase in domestic manufacturing

While boots and shoes were only 4.38% of the total expenditure in 1893, clothing items were around 13%. The first New Zealand clothing factory was established in Dunedin in 1873 where *The New Zealand Clothing Factory* made basic, hardwearing clothing for men and boys. In 1895 the government imposed an extra duty on imported items to protect infant industries, which was consistent with the gradual increase in prices post-1893 (Figure 2-9). Protected by high tariffs, the New Zealand clothing industry boomed and many new clothing factories were established in the North Island (Collins, 1912). The cost of clothing items in Auckland was reported to be the lowest of the four regions (Figure 2-9) and by the end of the 1890s, Auckland became New Zealand's main industrial centre with the most boot and shoe factories (New Zealand Department of Statistics, 1873-1935). Overall, the cost of imported apparel (value of apparel imported in per capita terms) approximated the trend in provincial prices of clothing items per capita (Figure 2-9).

Figure 2-9. Clothing price index series, 1909-13=100

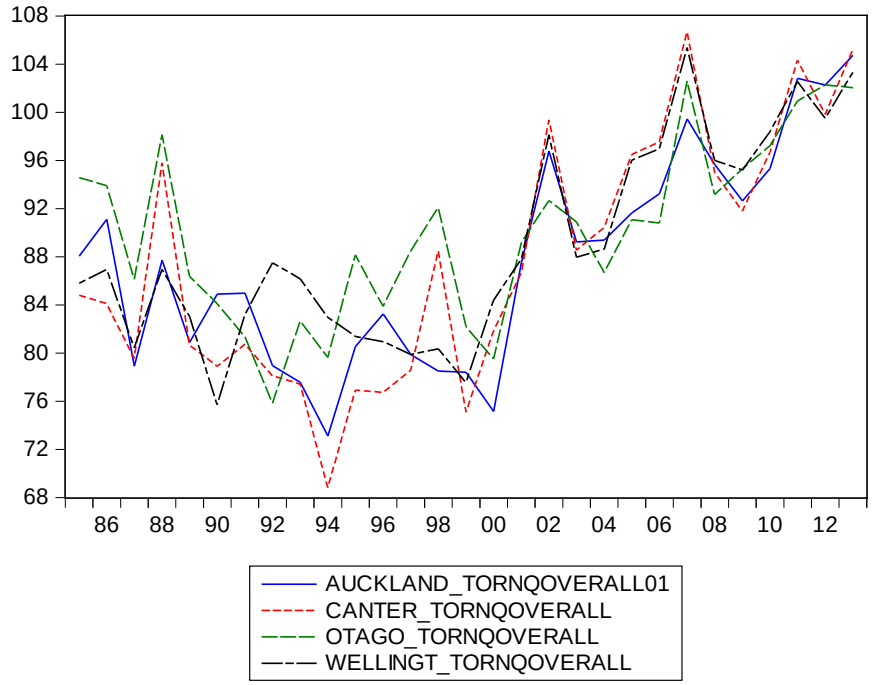


The final sub-series[18] (*Food: Grocery, Meat, Dairy; Fuel and Light; Housing; Clothing and Miscellaneous*) were combined and weighted (according to the 1893

[18] See Appendix A, A-12 for data.

expenditure weights) to produce a new composite Provincial CPI series (Figure 2-10). Food items constituted the largest percentage in the total expenditure such that peaks and falls in the composite series were typically mirroring the fluctuations in the grocery, meat and dairy prices.

Figure 2-10. Composite price index series, 1909-13=100



2.6 CPI Consistency: Aggregate CPI series

Consistency of the new provincial CPI can be assessed by comparing it with the existing national CPIs from Arnold (1982b); McIlraith (1911); Sauerbeck (1895). It is evident from Figure 2-11 that all price indices, including historical price indices for Britain (Sauerbeck, 1895) and Australia (McLean, 1999), move closely and exhibit similar trends. McIlraith's wholesale price index for New Zealand has a similar trend to that of Mclean's Australian CPI, while Sauerbeck's British wholesale price index movements have more in common with Arnold's and the new CPI series. Arnold's CPI was expected to have the highest degree of correlation with the new index by way of construction and data sources used. Table 2-3 shows that fluctuations in the new CPI (Tornqvist index) are only significantly related to the fluctuations in Arnold's CPI. However, potential differences may arise due to different estimation of certain expenditure items in the basket, minor weight changes

within the sub-series and the alternative index formula used for the new CPI calculation. The new CPI exhibits sharper falls and increases than Arnold's CPI, which represented a weighted national average that included most Provinces. Spikes in 1902, 1907 and 1911 could be reflective of certain well documented events in New Zealand history, for example manufacturing and some of the main export commodities were greatly affected by tariff changes in 1903 and 1907. Revision of the *Tariff Act* in 1907 also imposed extra duties on manufactured items and equipment from countries other than Britain, which led to an increase in the cost of production. (Appendix A, A1-Tariff and labour legislation changes).

Figure 2-11. Aggregate price index comparison

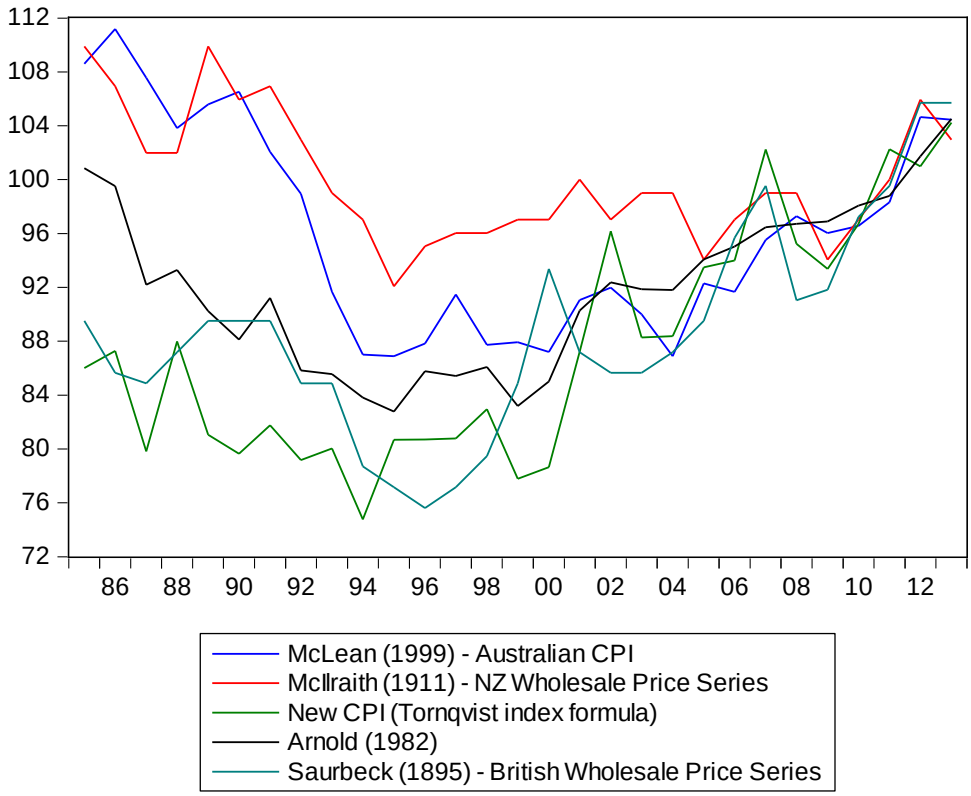


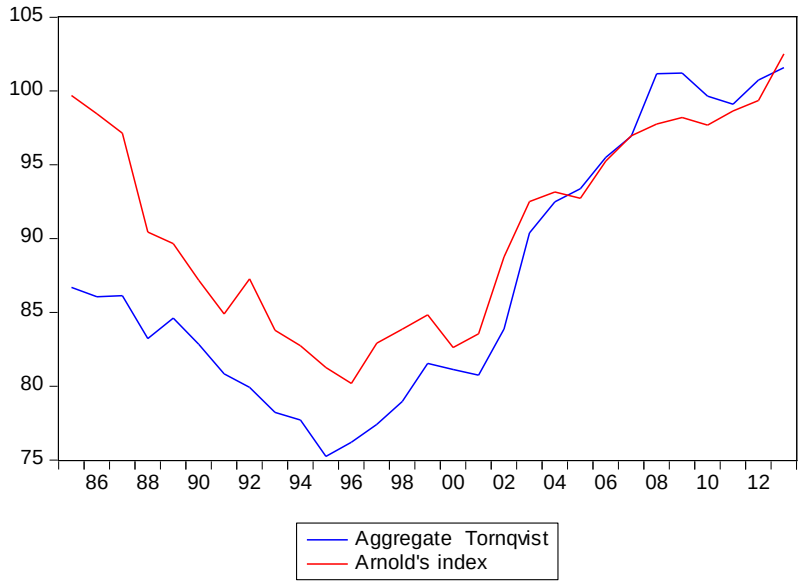
Table 2-3. Correlation coefficient matrix (first differences)

Correlation Probability	Arnold	McLean	Tornqvist	Sauerbeck	McIlraith
Arnold	1.00				
McLean	0.35*	1.00			
p-value	0.07				
Tornqvist	0.63**	0.23	1.00		
p-value	0.00	0.23			
Sauerbeck	0.15	0.13	0.14	1.00	
p-value	0.46	0.49	0.49		
McIlraith	0.33*	0.35*	-0.07	0.36*	1.00
p-value	0.09	0.07	0.73	0.06	

*,** significant at 10 and 5% levels, respectively

Exclusion of other Provinces in the calculation of the new aggregate CPI made the series more volatile due to price fluctuations in grocery and other food items. To smooth the effects of the outliers, I used Holt-Winters (no seasonality with the lowest RMSE) exponential smoothing technique (Holt, 2004), the result is presented in Figure 2-12 below. It appears that the 1880s fall in consumer prices is more pronounced in Arnold's series than in the new CPI series. Apart from that, the two series seem to move together quite closely.

Figure 2-12. Holt-Winters exponential smoothing: the resulting series



2.7 Conclusion

Historical statistics in New Zealand, particularly prior to the 1950s, are largely unavailable in a readily usable form. Compiling and analysing historical data enables a better understanding of the living standards in New Zealand, where data on prices, wages, economic performance and health statistics were relatively consistently collected and published annually by the Department of Statistics for each Province from at least 1860. Prior to the abolition of Provinces in 1876, socio-economic and demographic data covered all New Zealand regions, but after 1876 the scope of data reporting for most indicators was restricted to the four largest (in terms of population) Provinces. The new regional CPI series can be used to address issues such as the degree of integration in commodity price markets in the 19th –early 20th centuries which I will turn to later.

In summary, the construction of each regional index discussed in this chapter, was achieved by collecting prices for each of the four provincial districts (Auckland, Canterbury, Otago and Wellington), and grouping them into seven sub-series. The *Miscellaneous* sub-series deviated the most from earlier work (e.g. I used public library subsidies to proxy for education expenditure and data from hospital receipts to proxy for medical expenses), which can arguably be considered a better series (compared to Arnold (1982)) in terms of representativeness and accuracy. When aggregating the sub-series, I chose the Tornqvist formula as the most appropriate for the type of data used. Provincial CPI series have been seen to be robust to the use of alternative index formulas (Laspeyres, Paache etc.). The aggregate version of the constructed provincial CPI series appears to be highly correlated with the national CPI constructed by Arnold (1982b).

Chapter 3

3 Convergence of Provincial Price Markets in New Zealand: 1885-1913

In the previous chapter I constructed a new Consumer Price Index (CPI) for New Zealand 1885-1913, for the four largest provincial districts: Auckland, Canterbury, Otago and Wellington. In this chapter, I use this new data to explore the degree of integration across the provincial price markets in New Zealand and present possible explanations using historical evidence. The analysis in this chapter is important for this thesis as it addresses the issue of regional inequalities across commodity markets, which may have an effect on the regional variation in stature or living standards at the time.

3.1 Overview

The period 1885-1913 is one of the most controversial and interesting in New Zealand's history, exhibiting a period of depression and price deflation; intensive technological change (introduction of refrigeration technology) and development of railroads and infrastructure. Despite the greater economic integration induced by Vogel's schemes (e.g. abolishing the Provinces in 1876), historians express the view that regional experiences were varied (G. R. Hawke, 1985). In this chapter I aim to identify whether regional prices experienced spatial convergence and suggest possible explanations for the patterns identified. The absence or presence of differentials in the cost of living index across Provinces may be useful in explaining differentials in real wages and stature in the later chapters. Typically, the main reason for the failure of the law of one price within the same country is distance or the cost of transportation between locations (Engel & Rogers, 1996). Slow convergence of regional market prices may also be due to biased technological growth. These are discussed at the end of the chapter as possible impact factors.

Using the consumer price series derived in Chapter 2, it became possible to test for spatial convergence in prices to establish the extent of regional commodity market integration and which of the four Provinces first responded to the price shocks

during that period. I began with a simple coefficient of variation analysis and proceeded with time-series tests for convergence/common trends. The methodology is fairly standard and the use of convergence tests varies depending on the type of data and pre-testing results. The traditional approach to testing for common trends in economic literature includes the standard procedure of testing for unit roots (including Perron-type unit root tests) and then testing these series for cointegration (Bernard & Durlauf, 1995; Johansen, 1988; Levin, Lin, & Chu, 2002). The papers that test for common trends or the existence of a relative and absolute Law Of One Price (LOOP) among the commodity markets generally either analyse trends of the same commodities across different countries (Goldberg & Verboven, 2005; Li, Joyeux, & Ripple, 2010; Sedaghar, 2007; Susanto, Rosson, & Adcock, 2008; Zachmann, 2008) or regional trends within a country (Serletis & Rangel-Ruiz, 2004; Shinoj et al., 2008; Wimanda, 2009). There are others (Kharel & Koirala, 2011; Wimanda, 2009) that also consider integration of aggregate price measures (price indices). Kharel and Koirala (2011) utilize Johansens' bivariate cointegrating approach to test for existence of spatial market integration using intra-regional price indices.

This chapter is organized as follows. In Section 3.2 I present the coefficient of variation analysis of all sub-index series, which is followed by the time-series tests for unit roots, with breaks considered (to account for any structural changes) in Section 3.3.1. In Section 3.3.2, I apply time-series tests for convergence based on the results from Section 3.3.1. In Section 3.4 I consider possible explanations of the convergence/divergence patterns among Provincial price markets. In Section 3.5, I use Granger causality tests to identify which provinces first responded to external shocks in the dairy and meat prices.

3.2 Coefficient of variation analysis

In the previous chapter, I constructed seven sub-index series (comprising of various individual items). Table 3.1 shows the descriptive statistics (number of observations, standard deviation, mean and the coefficient of variation) for each sub-index in each of the four Provinces examined. It is evident that, on average, the lowest index

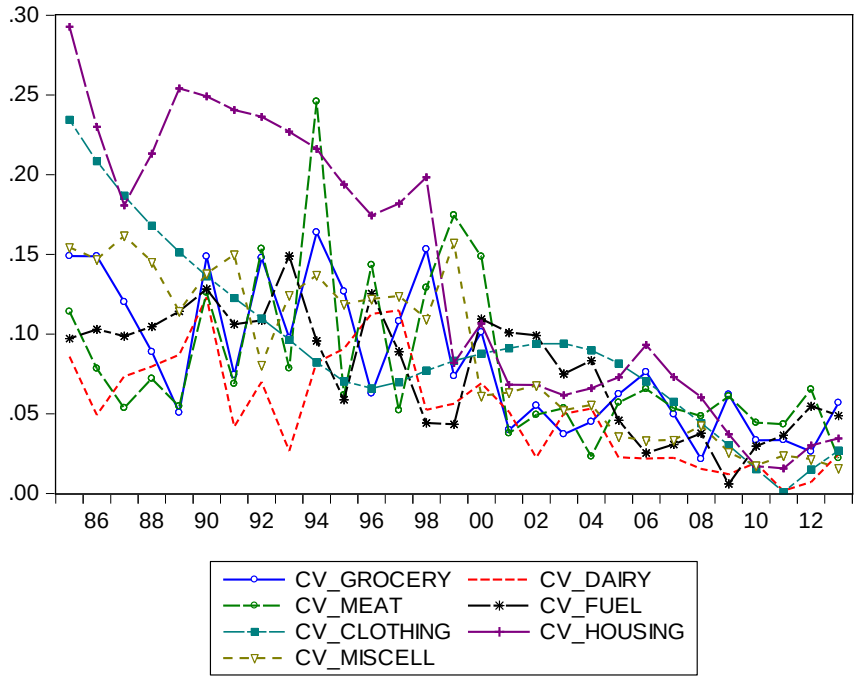
values in grocery, dairy and meat prevailed in Canterbury. Among the four Provinces, housing prices were the highest in Auckland, which was also the most volatile over time (higher than the average standard deviation). It can be observed from Table 3.1 that the lower the mean, the higher the volatility of the price index series over time (particularly evident for housing, grocery, dairy and meat). This is indicative of the presence of possible outliers (unexpected drops or increases in response to shocks) in the series. The coefficient of variation (CV) over time appears to be the highest in Canterbury in the grocery, dairy and meat series.

Table 3-1. Descriptive statistics: sub-index series by province, 1885-1913

Province	Grocery	Dairy	Meat	Housing	Miscellaneous	Fuel & Light	Clothing & Footwear
				Auckland			
N of obs	29	29	29	29	29	29	29
Std dev	13.61	9.49	15.03	16.75	4.05	10.20	14.84
Mean	92.01	86.44	88.50	75.12	94.87	105.42	75.72
CV	0.15	0.11	0.17	0.22	0.04	0.10	0.20
				Canterbury			
N of obs	29	29	29	29	29	29	29
Std dev	18.17	12.30	16.71	10.87	10.91	7.50	7.14
Mean	88.59	81.61	82.49	92.44	82.94	94.26	91.19
CV	0.21	0.15	0.20	0.12	0.13	0.08	0.08
				Otago			
N of obs	29	29	29	29	29	29	29
Std dev	15.06	8.43	13.34	6.74	8.55	10.43	10.57
Mean	93.00	88.02	88.28	98.46	83.78	100.73	81.36
CV	0.16	0.10	0.15	0.07	0.10	0.10	0.13
				Wellington			
N of obs	29	29	29	29	29	29	29
Std dev	11.32	10.77	15.65	12.11	13.04	7.34	8.53
Mean	93.12	84.40	87.50	85.79	83.34	101.46	85.28
CV	0.12	0.13	0.18	0.14	0.16	0.07	0.10
				Total			
N of obs	116	116	116	116	116	116	116
Std dev	14.67	10.49	15.23	14.81	10.83	9.73	11.96
Mean	91.68	85.12	86.69	87.95	86.23	100.47	83.38
CV	0.16	0.12	0.18	0.17	0.13	0.10	0.14

In Figure 3-1, below, the CV across Provinces (calculated as absolute deviation divided by the weighted average) shows that provincial dispersion across all sub-index series was the highest in the 1890s and then markedly diminished by 1900, with a slight increase in 1906-7. It appears that housing prices have the highest mean CV, while dairy have the lowest. A relatively smooth CV for the clothing series is attributed to the fact that these series were interpolated between the Census years. Based on the CV analysis, all the price series exhibit a universal decrease in the level of dispersion post-1900.

Figure 3-1. CV for all sub-index series, 1885-1913



Similar to the Australian experience, New Zealand's economy emerged gradually from the integration of several regional economies, which initially were small and separated by significant transport costs. McLean (1999) suggests that a trend towards a more integrated market arises if disparities in the level of prices of a commodity across regions are reduced, or the fluctuations in prices become more highly (positively) correlated. McLean (1999) conducted pair-wise comparisons for Adelaide, Melbourne and Sydney for two periods: 1865-89 and 1890-1914, and concluded that the anticipated increase in the degree of market integration in Australia was not observed during 1890-1914. I present pair-wise comparisons of the composite CPI series (combined and weighted sub-series) for two periods in

New Zealand: 1885-99 and 1900-13. Table 3-2 below shows a marked increase in the degree of market integration among the Provincial pairs. It is apparent that Auckland became more integrated with other Provinces between 1900 and 1913.[19] Of particular interest is the change in significance of the correlation coefficient between Auckland and Wellington, and Canterbury and Wellington. In New Zealand, 1900-1913 can be identified as the period of very different price experience compared to 1885-1899, which contrasts with what McLean (1999) found in Australia[20].

Table 3-2. Measures of market integration (correlation coefficients)

1885-99				
Correlation	Auckland	Canterbury	Otago	Wellington
Auckland	1.00			
Canterbury	0.63*	1.00		
Otago	0.63*	0.80**	1.00	
Wellington	0.29	0.34	0.20	1.00
1900-13				
Correlation	Auckland	Canterbury	Otago	Wellington
Auckland	1.00			
Canterbury	0.92**	1.00		
Otago	0.94**	0.88**		
Wellington	0.90**	0.98**	0.90**	

*, ** significant at 5% and 1% levels, respectively

From the analysis above, most price series converge or begin to converge by 1900, suggesting (via the coefficient of variation analysis) that the markets became relatively more integrated at the beginning of the 20th century.

3.3 Time-series analysis: unit roots and common trends

3.3.1 Unit root tests

In the section above, I used the *coefficient of variation* as the measure of convergence and by implication, market integration. In this section I consider the

[19] Auckland was quite isolated until 1908 when the main trunk railway was completed connecting Auckland to the other localities in the North Island (New Zealand. Ministry for Culture & Heritage, 2003).

[20] It is worth noting that New Zealand price level had risen to the Australian level by the early 1900s, as demonstrated in Chapter 3, Section 3.6.

important issue of spatial price convergence over time using more sophisticated time series methods which, where appropriate, utilize the non-stationarity of price levels to create powerful time series tests. The 'work-horses' of time series tests of (price) convergence with potentially non-stationary data are based upon the original 'unit root'[21] tests of Dickey and Fuller (1979).

As I am interested in considering the integration of markets over time and space through tests of price convergence, effectively what I have created is a panel data structure where the Provinces represent space, and time is measured in years. Hence, the panel data has large T (number of years) and relatively small N (number of Provinces).

Examination of the time-series properties of the series typically begins with unit root testing to determine whether the series in question is stationary or non-stationary. Basically, stationary series 'never wander far away from its mean' or trend (if trend-stationary), while non-stationary series are characterized by long-term shocks that lead to idiosyncratic behaviour (e.g. the effects of tariff changes could lead to permanent increases in prices). In effect, stationarity means that the regression estimates can be tested according to the well-known properties of a Normal Distribution. Testing for non-stationarity in the variable is synonymous with the unit-root testing, with the Augmented Dickey Fuller (ADF) tests being perhaps the most commonly used individual unit root tests. In the case of structural breaks in the series (change in the direction of the trend or increase in the level of the series), discontinuities may lead to type I errors that will likely bias any further analysis. To account for any structural breaks, I included Perron-type unit root tests (Perron, 1989; Zivot & Andrews, 1992) in the pre-testing stage where appropriate (Table 3-4).

[21] A unit root is an attribute of a statistical model of a time-series, the autoregressive parameter of which is equal to one.

Table 3-3. ADF unit root tests in levels for the sub-series in each Province

Index series by province	Auckland	Canterbury	Otago	Wellington
Grocery	∨	∨	∨	∨
Dairy	××	××	∨∨	××
Meat	××	××	vv	××
Housing	××	××	×	××
Fuel and Light	∨	∨	×	×
Clothing	∨∨	∨∨	×	∨∨
Miscellaneous	∨∨	××	∨∨	∨∨

Note: **"∨"**- the series are stationary or I (0), **"∨∨"** – the series are trend-stationary
"×" – the series are non-stationary without a linear trend, **"××"** – the series are non-stationary with a linear trend

Individual (for each panel separately) unit root tests indicate that Dairy, Meat and Housing are non-stationary for Auckland, Canterbury (including Miscellaneous) and Wellington. Housing, Fuel and Light and Clothing are non-stationary in Otago, (see Table 3-3 above). All other series appear to be stationary. An important result is that the export sectors (meat and dairy) seem to exhibit non-stationarity in the price series for more than one Province, possibly due to the changes in technology of production that came with refrigeration.

To identify whether there are any possible discontinuities in certain sub-series that appear to be making them non-stationary, I utilized the Zivot and Andrews (1992) unit root tests. It is clear from Table 3-4 that the Dairy, Meat and Housing prices remain non-stationary in Auckland and Canterbury. Other sub-index series (i.e. Dairy, Meat and Fuel and Light in Wellington, and Housing, Fuel and Light, and Clothing in Otago) become stationary once the breaks in the series are accounted for.

Table 3-4. ADF unit root tests in levels (breaks considered) and first differences

Index series by province	Auckland	Canterbury	Otago	Wellington
Dairy	××(1895)	×× (1895)		∨∨′(1895)
Meat	×× (1902)	×× (1901)		∨′ (1900)
Housing	×× (1899)	×× (1898)	∨′ (1895)	×× (1900)
Fuel and Light			∨∨′(1900)	∨∨′ (1898)
Clothing			∨∨′(1909)	
Miscellaneous		×× (1900)		

Note: **"××" –** I (1) series (first-difference stationary) with a linear trend in levels **"×"** – I (1) series without a linear trend in levels (constant trend), **"∨"**- I (0) series, stationary with a crash and trend in the data (when the crash and trend in the series are taken into account).

Structural changes in 1895 and 1900 are the most commonly identified breaks and the Provincial dairy series all experienced a structural change in 1895, which had permanent effects in Canterbury and Auckland.

3.3.2 Testing for Convergence in Prices: Bernard and Durlauf (1995)-type tests

The previous section was used to explore the time-series properties of the sub-index series. The most interesting series, identified as non-stationary, are: Dairy, Meat, Housing and Fuel and Light. In this section, I consider the possibility of convergence or common trends (suggesting market integration) in these price series using time-series methods. Earlier, the coefficient of variation and simple correlation analysis showed that New Zealand markets became relatively more integrated during 1900-1913 than in 1885-1900. This tendency was mirrored in most of the Provincial sub-series.

However, the coefficient of variation analysis is limited and serves only as a guide to changes in variation among regions over time. Economically, investigation of issues such as the Law of One Price (LOOP), via time-series tests, can be useful in understanding the disparities across specific regional markets and determining how integrated they had become by the beginning of the 20th century. The Law of one Price is more likely to occur for homogeneous, traded goods prices and it is on these goods that I concentrate. Tests for convergence typically differ depending on the time-series properties of the data, therefore I drew upon the results from the previous section to guide the choice of tests employed.

As discussed in Section 3.3.1, nonstationarity gives rise to several econometric problems, but most importantly, nonstationarity in the levels of variables implies that a stable long-run relationship is not possible. However, if both variables are integrated of order one (stationary in their differences) there may exist a linear combination of them that is stationary (the two variables are "cointegrated"). Thus, if variables are cointegrated, they tend to move together and (statistical) convergence may occur faster than is the case for a stationary series.

I tested for cointegration by applying unit root tests to the bivariate differences of Provincial prices, paired one at a time, following the Bernard and Durlauf (1995) approach. On the basis of the results (Table 3-5), the convergence hypothesis is not rejected[22] in both the Dairy and Meat series for the Canterbury-Auckland pair, and the Housing series for the Canterbury-Wellington pair.

Table 3-5. Unit root test on the difference between each pair of provinces (without discontinuities) for the period 1885-1913

$y_{i,t+k} - y_{j,t+k}$	Dairy		Meat		Housing		Fuel & Light	
Provinces	ADF (2)	LM (SC)	ADF(0)	LM(SC)	ADF(0)	LM (SC)	ADF(0)	LM (SC)
Canterbury-Auckland	-4.66* (T)	1.92476	-4.779*	0.2646	-3.6287	1.194		
Canterbury-Wellington					-6.79*	0.0417		
Auckland-Wellington					2.4891	5.4307*		
Otago-Wellington							-3.486	0.225

*t-statistics denotes significance at the 5% level based on MacKinnon (1991), ADF (2) and ADF (0) indicate the number of lagged differences of the variables (based on SIC criterion). (T) relates to trend significance at the 5 %. LM test is a test for serial correlation: H_0 (null hypothesis) implies no serial correlation.

It is also possible to test for convergence in a multivariate setting utilizing either panel-based unit root testing techniques or cointegration methods for example, those of Phillips and Ouliaris (1990) and Johansen (1988). Given that there are no more than two Provinces that exhibit non-stationarity for each price index, bivariate

[22] The Bernard and Durlauf approach treats non-convergence as the null hypothesis (nh), such that convergence occurs when the nh (non-convergence) is rejected.

testing is appropriate in this case. To check the robustness of the above results, I included estimates of the bivariate Johansen (1988) test for cointegration (Table 3-6), which confirmed that both the Dairy and Meat series for the Canterbury-Auckland pair each exhibit one significant cointegrating relationship. With the Johansen approach it is also possible to impose restrictions on the coefficients to identify if the series exhibits 'absolute' or 'relative' convergence (Bernard & Durlauf, 1995). The likelihood ratio (LR) test for binding restrictions for the Dairy series suggests that Auckland and Canterbury share a common trend, but do not converge to common steady state equilibrium. The results for the Meat series indicate the opposite: the Auckland and Canterbury Meat series converge in a Bernard and Durlauf sense.

Table 3-6. Cointegration results: Auckland-Canterbury pair, Johansen estimates, 1885-1913

(Unrestricted intercepts and trends in levels)

Number of cointegrated relations		Dairy (VAR=3) Lag intervals: 2		Meat (VAR=1) Lag intervals: 0	
H0	H1	Trace	Max Eigenvalue	Trace	Max Eigenvalue
r=0	r=1	21.25*	21*	23.07*	21.107*
r≤1	r=2	0.24	0.24	1.962	1.962

Note: *indicates the rejection of the null hypothesis of no cointegrating relationship at the 5% level. Lags selected were determined by prior estimation of an unrestricted VAR model in levels for each system of equations.

I next considered housing prices, where Johansen's bivariate test validated the Bernard and Durlauf (1995) convergence result, with the Canterbury-Wellington pair exhibiting a "cointegrating" relationship. The implied restrictions for convergence suggest that Canterbury and Wellington experience long-run convergence implying that the long run effect of shocks to housing prices impacted Canterbury and Wellington in a similar manner (Table 3-7).

Table 3-7. Housing index series: Bivariate Cointegration results, Johansen estimates, 1885-1913

(Unrestricted intercepts and linear trends in levels)

Hypotheses		Auckland-Canterbury		Canterbury-Wellington		Auckland-Wellington	
H0	H1	Trace	Max Eigenvalue	Trace	Max Eigenvalue	Trace	Max Eigenvalue
r=0	r=1	21.25	21.009	23.07*	21.107*	13.643	13.289
r≤1	r=2	0.2416	0.2416	1.962	1.962	0.354	0.354

3.4 Possible interpretations

In Chapter 2, I presented regional price data on various grouped commodities where some common features, for example the general direction of trends in sub-series, mirrored the national trends in consumer prices. Statistical evidence on the CV analysis (Section 3.2) showed that there were some sharp Provincial inequalities in the 1890s, but that they diminished substantially across all sub-index series by 1900. Time-series tests also showed rapid convergence in meat, dairy and housing prices for some Provincial pairs (Auckland and Canterbury, and Canterbury and Wellington).

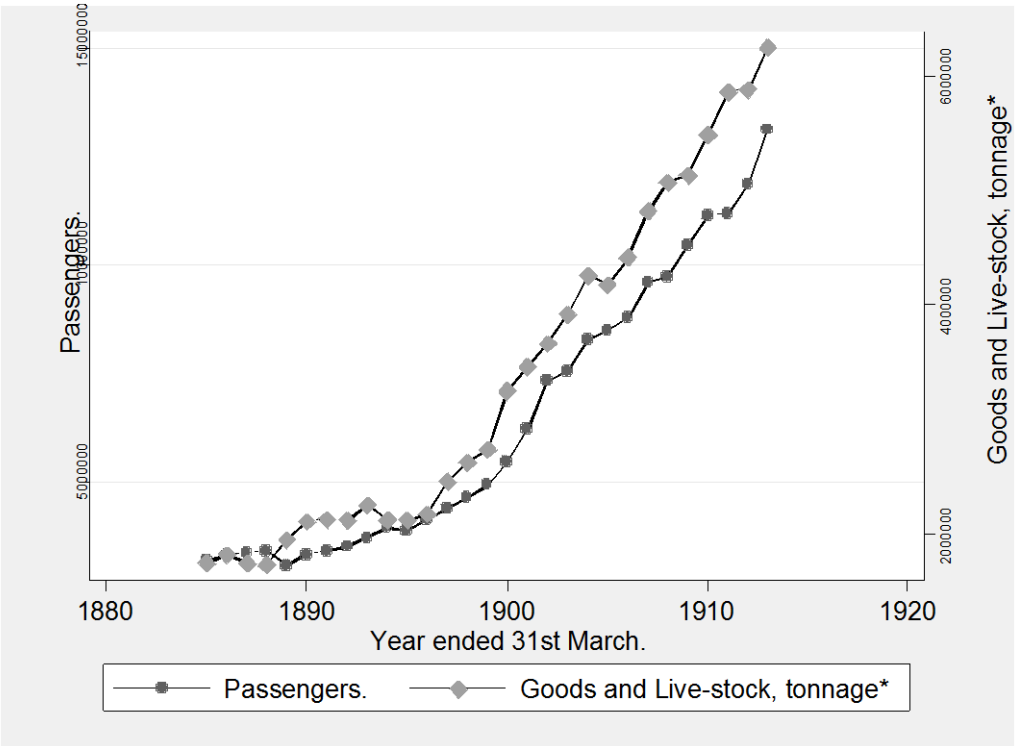
As I am only considering prices within New Zealand, one obvious factor that could prohibit effective arbitrage across regions is the cost of transportation. Another factor is biased technological growth (refrigeration technology). The historical literature emphasizes the key role refrigeration had on the economic development of New Zealand and there is a strong correlation between refrigeration and railway building. It is evident from Figure 3-2, below, that the number of people and the tonnage of goods and livestock transported increased substantially in the mid-1890s (see Appendix A, Table A-13). This is not surprising given the fact that refrigerated rail facilities became available by 1895, making it possible to transport dairy products easily. For example, Taranaki products were initially shipped to Wellington by coastal vessels for trans-shipment to ocean liners due to inadequate roads in Taranaki (G. R. Hawke, 1985). With greater accessibility to transport facilities, it is likely that the price disparities in traded goods would disappear. It is reasonable to

assume that refrigeration prompted building and construction of the new railway lines and it is quite symbolic that 1895 was also the year of some structural changes in the Provincial Dairy price series, established statistically in Section 3.3.1. Notably lower prices of meat, dairy and wheat in Canterbury prior to 1898 (Table 3-1 and Chapter 2: Figures 2-2, 2-3 and 2-4) [23] converged to the average Provincial level in 1900. The wholesale prices of frozen mutton for export were also the lowest at the ports of Lyttleton (Canterbury) and Dunedin (Otago) in 1893 (New Zealand. Dept. of & New Zealand. Registrar General's, 1894).

The South Island was better connected than the North Island prior to 1900 (New Zealand Official Yearbook). Railway and road construction was slow to progress in the North as large areas of the North Island were covered in bush. Thus, transport costs imposed restrictions on the exportation of meat from the more remote areas in the North Island (G. R. Hawke, 1985). Auckland was particularly isolated from the rest of the North Island until the main trunk railway was completed in 1908, connecting Auckland with Wellington and other localities (New Zealand. Dept. of & New Zealand, 1911). Again it might be expected that regional price gaps would drop sharply within a few years of the railway completion. In Section 3.2 (Table 3-2), it was demonstrated that the degree of market integration post-1900 between Auckland and other provinces improved significantly, particularly between Auckland and Wellington.

[23] See Appendix for individual items data, Appendix A, Tables A-5, A-6 and A-7.

Figure 3-2. Number of passengers and the tonnage of goods and livestock transported



Source: New Zealand Official Yearbook, various years

From the discussion above, the observed convergence in price index series could partly be attributed to the greater availability of rail facilities and increased amount of goods and livestock transported across the country (see Appendix A, Table A-13).

The impact of the introduction of refrigerated technology on prices could occur through the 'biased' implementation channel based on the resources in place at the time. The refrigeration boom initially benefitted the South more than the North, based upon the initial advantage of easily accessible and readily cultivable land (New Zealand. Ministry for Culture & Heritage, 2003). Furthermore, soil and climatic conditions in the North did not suit the pasturing of sheep and there were only local markets for the production of butter and cheese. For similar reasons, the use of refrigerated technology required for mass milk and cream separation, storage and cheese-making, was first implemented in the far south (Otago/Southland), and only joined by Wanganui, South Auckland and Taranaki by 1900 (G. R. Hawke, 1985). In terms of the price fluctuations, this could mean that the shocks to the price series in meat and dairy would occur in the South Island Provinces first.

In the next section, I use the Provincial Dairy and Meat price series to statistically demonstrate whether, in fact, there existed South-North causality in the meat and dairy price markets.

3.5 Testing for Causality: Leading Provinces

To address whether Canterbury and Otago were, in fact, leading the fluctuations in the dairy and meat price series, it is appropriate to use a Granger causality test. However, in the context of a non-stationary data series, the standard Wald test statistic does not follow its usual asymptotic Chi-square distribution. Therefore, I followed the Toda-Yamamoto (T-Y) procedure to test for Granger (non-) causality (Toda & Yamamoto, 1995). Table 3-8 represents the pairs of provincial dairy series, where a rejection of the null hypothesis implies there is Granger Causality. It should be pointed out that if the variables are cointegrated then there must be a causal relationship in at least one direction, however, the converse is not true (Johansen, 1988). Table 3-8 shows that Canterbury is the leading Province in all variable pairs for the Dairy index.

Table 3-8. VAR Granger/Block Causality Exogeneity Wald Tests: Dairy

Dairy Price Series Variable Pairs	Granger Causality Block Wald χ^2tests (first variable: leader)	Granger Causality Block Wald χ^2 tests (second variable: leader)	Leading Province in the Granger Causality Sense
Auckland-Canterbury VAR=3	$\chi^2(3)=5.54$	$\chi^2(3)=7.68$**	Canterbury
Canterbury-Otago VAR=1	$\chi^2(1)=4.103$**	$\chi^2(1)=1.36$	Canterbury
Canterbury-Wellington VAR=1	$\chi^2(1)=18.82$**	$\chi^2(1)=0.242$	Canterbury
Auckland-Otago VAR=1	$\chi^2(1)=0.0016$	$\chi^2(1)=5.83$**	Otago
Otago-Wellington VAR=1	$\chi^2(1)=2.89$*	$\chi^2(1)=6.6$**	Bi-directional
Auckland-Wellington VAR=1	$\chi^2(1)=3.75$**	$\chi^2(1)=0.054$	Auckland

*, ** significant at 10 and 5 %, respectively

In the case of the meat series, Otago is revealed as the leading Province (Table 3-9). The first shipment of frozen meat was from Dunedin in 1882 with the number of carcasses of frozen mutton exported from Otago being the highest until at least the late 1890s. Some of the earlier freezing works were also built in Otago. Many freezing works were located at ports as it was cheaper to transport live animals than frozen meat (Hawke, 1985) and, as discussed in Section 3.4 above, railway and road construction was slow to progress in the North with large areas of the North Island covered in bush. Thus, it is reasonable to assume that the changes in fluctuations in Otago meat prices preceded those in other Provinces.

Table 3-9. VAR Granger/Block Causality Exogeneity Wald Tests: Meat

Meat Price Series Variable Pairs	Granger Causality Block Wald χ^2 tests (first variable: leader)	Granger Causality Block Wald χ^2 tests (second variable: leader)	Leading Province in a Granger Causality Sense
Auckland-Canterbury VAR=3	χ^2 (3)=1.556	χ^2 (3)=13.29**	Canterbury
Canterbury-Otago VAR=3	χ^2 (3)=0.86	χ^2 (3)=10.6**	Otago
Canterbury-Wellington VAR=1	χ^2 (1)=0.231	χ^2 (1)=3.64*	Wellington (Weakly)
Auckland-Otago VAR=2	χ^2(2)=0.27	χ^2 (2)=8.93**	Otago
Otago-Wellington VAR=3	χ^2 (3)=5.955	χ^2 (3)=7.44**	Otago
Auckland-Wellington VAR=3	χ^2 (3)=0.63	χ^2 (3)=18.37**	Wellington

*, ** significant at 10 and 5 % levels, respectively

The South Island Provinces were undeniably more economically and resource advantaged during the 19th century. When profits from refrigerated shipping were realized, it was much easier to convert the readily available farmland from agricultural to pastoral. Statistically, I found evidence of Canterbury dairy prices leading the dairy sector prices and Otago leading the meat sector prices. This evidence is consistent with the historiography on economic development in New Zealand.

3.6 Some concluding remarks

From the early 1900s New Zealand regions became better integrated perhaps due to the greater availability of railways, connecting various parts of the country, and a refrigeration related boom creating incentives for pastoral use of land in the North. Not only were there differences between the North and the South, but also within the two islands. Lack of reliable land transportation was one of the reasons Auckland was relatively more isolated within the North Island, with the importance of railways rising around the time of the advancement of freezing works. The introduction of refrigeration from the 1880s led to substantial changes in the pattern of regional fluctuations and by 1900 New Zealand provincial markets became more integrated, especially the North Island with the South Island Provinces. The convergence of housing prices between Canterbury and Wellington was also consistent with inter-provincial migration patterns. Negative rates of net interprovincial migration in the South and positive in the North, indicate that during 1886-1911 the population was moving North with the shift of economic activity (Appendix A, Table A-4).

The main focus of this chapter was to establish the degree of market integration within the New Zealand dairy and meat sectors using the price index series constructed in Chapter 2, and to determine whether the theoretical assumptions on the South-North convergence were supported statistically.

Statistically, I found that both Meat and Dairy price series (traded goods) either exhibited convergent behaviour in the long run (Meat series) or ‘catching up’ (Dairy series). This was only established for the Auckland-Canterbury pair. Nevertheless, the coefficient of variation analysis confirmed considerable declines in Provincial dispersion post-1900 across all sub-index series. In addition, it was established that Canterbury dairy prices led the dairy sector prices, and Otago the meat sector prices. These findings are suggestive of a South-North convergence, demonstrating that the refrigeration boom initially benefitted the South and gradually involved the North. The dominant position of the South began to diminish post 1898, with greater accessibility of the railways and more land becoming suitable for farming in the North. Dairying, beef and sheep farming became the predominant industries in the

North Island (dairying expanded on the better lowlands, while sheep and beef moved into the hill country).

The Provincial analysis undertaken here is important in its own right, but also allows for comparison with other countries. McLean (1999) concluded that for the four capital cities in Australia there was no clear trend, during the 1870-1914 period, towards greater integration of commodity markets with the exception of selected food items (bacon and potatoes). Similarly in Canada, despite the fact that that price dispersion across the country was much higher in the early 1880s than in 1900, the price levels only seemed to converge by the early 1920s (Minns & MacKinnon, 2007). It seems that the timing of the emergence of a national market for goods in New Zealand was quite different from that in Australia or Canada, where, in both cases, the regional divergence persisted well into the 1900s.

Chapter 4

4 Disparities in real wages in New Zealand, 1873-1913

> "Study of New Zealand's social history begins with an early 20th century situation in which every dairy farm, every sheep station… every trade union, every lodge and friendly society, was in the process of being drawn into an intricate socio-administrative system which ends up by being just another way, of saying 'New Zealand'…As a result of this process New Zealand becomes a single society where the centre did not abolish the regions, but rather integrated them…"
>
> Oliver, W.H (1969)

4.1 Introduction

By the beginning of the 20th century, New Zealand's Provincial commodity markets were becoming better integrated. As was observed in the previous chapter, such outcomes were related to reduced transportation costs, migration, expansion of pastoral land and a shift of economic activity northwards. A high degree of integration among commodity markets, however, does not necessarily imply labour force market integration, which is subject to many other factors such as unemployment, wage hours, working conditions, non-wage aspects (e.g. many occupations included board and lodging) and government policies, including wage regulation and wage setting. The standard approach to an examination of living standards across regions is to use occupations that are representative of the economy and can be directly compared across regions (i.e. unskilled labourers, carpenters).

Historically, the question of labour market integration is closely linked to migration and labour force movements. Migration movements, however, may not always be the best indicator of labour market integration. Boyer and Hatton (1994), for instance, argue that 'an analysis of the pattern and extent of migration movements shed little light on the issue of integration, and wage rates appear to be a better measure of labour market integration.' In this Chapter, I examine labour force movements and real wages of the two representative (based on the Census) urban and rural sector occupation categories i.e. farming and building, with a view to

ascertaining whether there were any persistent disparities across provinces within urban and rural environments between 1873 and 1913.

While some historical literature on fluctuations in aggregate wages (Arnold, 1982a; Clinkard, 1919) and labour market conditions (Crowley & Salmond, 1950; Dowie, 1966; Fairburn, 1975; Martin, 1995) is available, historians have not examined regional disparities in real wages over time, or regional variations within occupations in New Zealand. In the previous Chapter on price market integration, it was demonstrated that both population movements and price changes acquired a South-North gradient with the greater integration of price markets post 1900. In Section 4.2 I explore the direction of labour force movements within urban and rural sectors of the economy. In Section 4.3 I use occupation-specific real wages[24] by region to examine the issue of integration by establishing whether there were any differences within urban and rural sectors or across regions. In section 4.4 I present different measures of inequality across regions, building on the analysis of real wage patterns presented in Section 4.3.

4.2 Labour force movements

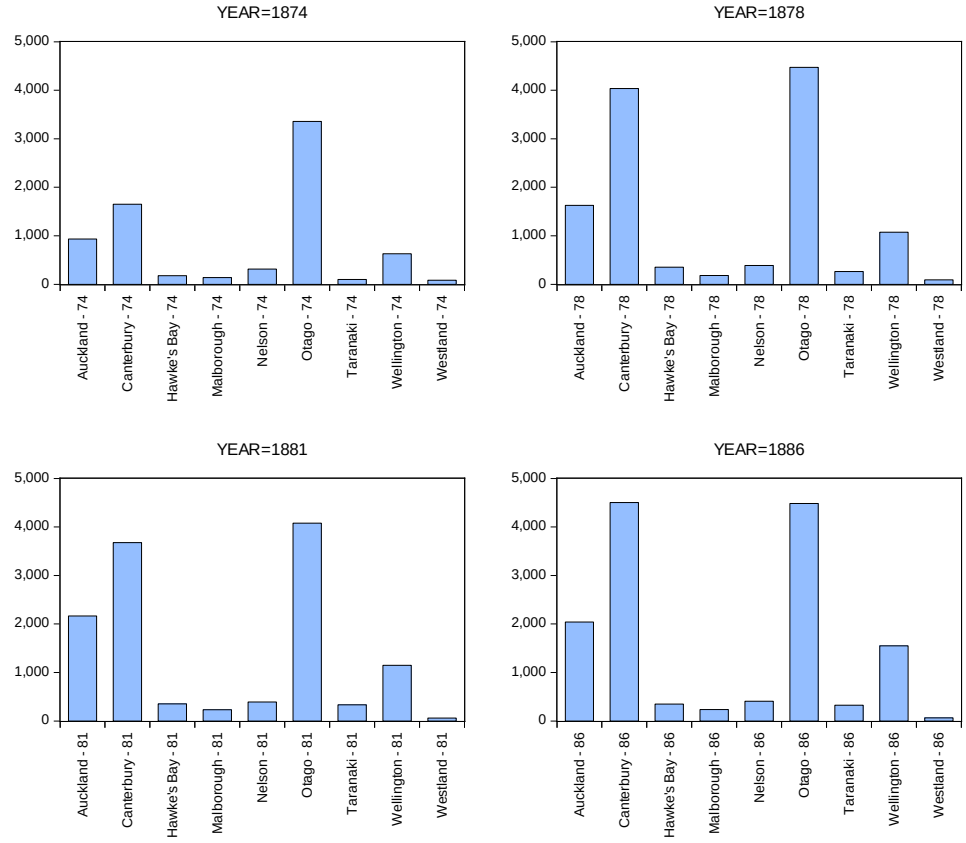
Negative rates of net interprovincial migration in the South and positive rates in the North showed that, during the period 1886-1911, the population was moving North with the shift of economic activity (Brosnan, 1986). From the mid-1890s, with the greater availability of rail facilities, not only the tonnage of goods and livestock transported increased but the number of people travelling also increased exponentially (Chapter 3). The objective of this section is to explore the direction of labour force movements within the urban and rural sectors of the economy and to find if both exhibited the South-North gradient during the 1874-1911 period.

[24] Appendix B (B1 and Tables B-1 to B-6) contains information on how the composite real wage index by Province was constructed. The composite real wage data in Appendix B, Table B-& was also extended to 1940 (for the use in the infant mortality chapter).

4.2.1 Rural sector wages:

From its earliest origins, the New Zealand economy has been characterized as predominantly rural, producing large volumes of agricultural and pastoral exports. In 1881, the rural population of New Zealand was almost 60 % of the total population, which gradually equalized with the urban population by 1911 (Thorns & Sedgwick, 1997). Some argue that the rural working class did not seem to exist in New Zealand, as the land was comparatively freely available and accessible to those who wanted it (C. Campbell, 1975). During the last quarter of the 19th century, there were some significant transformations in the rural sector, for example breaking-up of large farm estates and increased financial viability of family farms mainly due to profits from refrigeration. However, the relative importance of rural workers without land should not be underestimated. New Zealand's rural economy was heavily reliant upon wage-labour. During the period 1874-1911, farm or rural labourers (farm labourers with and without board) consistently contributed 8-10 % to the total labour force and 29-34% to the rural labour force (Martin, 1983). Persons engaged in agricultural pursuits continued to comprise 60 to 70% of the rural labour force in Canterbury and Otago throughout 1874-1911 (*Occupations of the People, New Zealand Census*). Arable cultivation was highly labour intensive, where seasonal workers played an important role prior to labour efficiency savings from mechanization and technological advances. Particularly, higher concentrations of rural labourers in Canterbury and Otago were largely explained by extensive development of arable farms (See Figure 4-1). By 1860, approximately 80 % of the total acreage was under crops and a similar percentage of the overall number of sheep were located in the South Island, overwhelmingly in Canterbury and Otago (Martin, 1983). During the second half of the 19th century the South Island grew rapidly to dominate New Zealand's rural economy, especially in arable cultivation.

Figure 4-1. Agricultural labourers distribution across provinces, 1874-1886



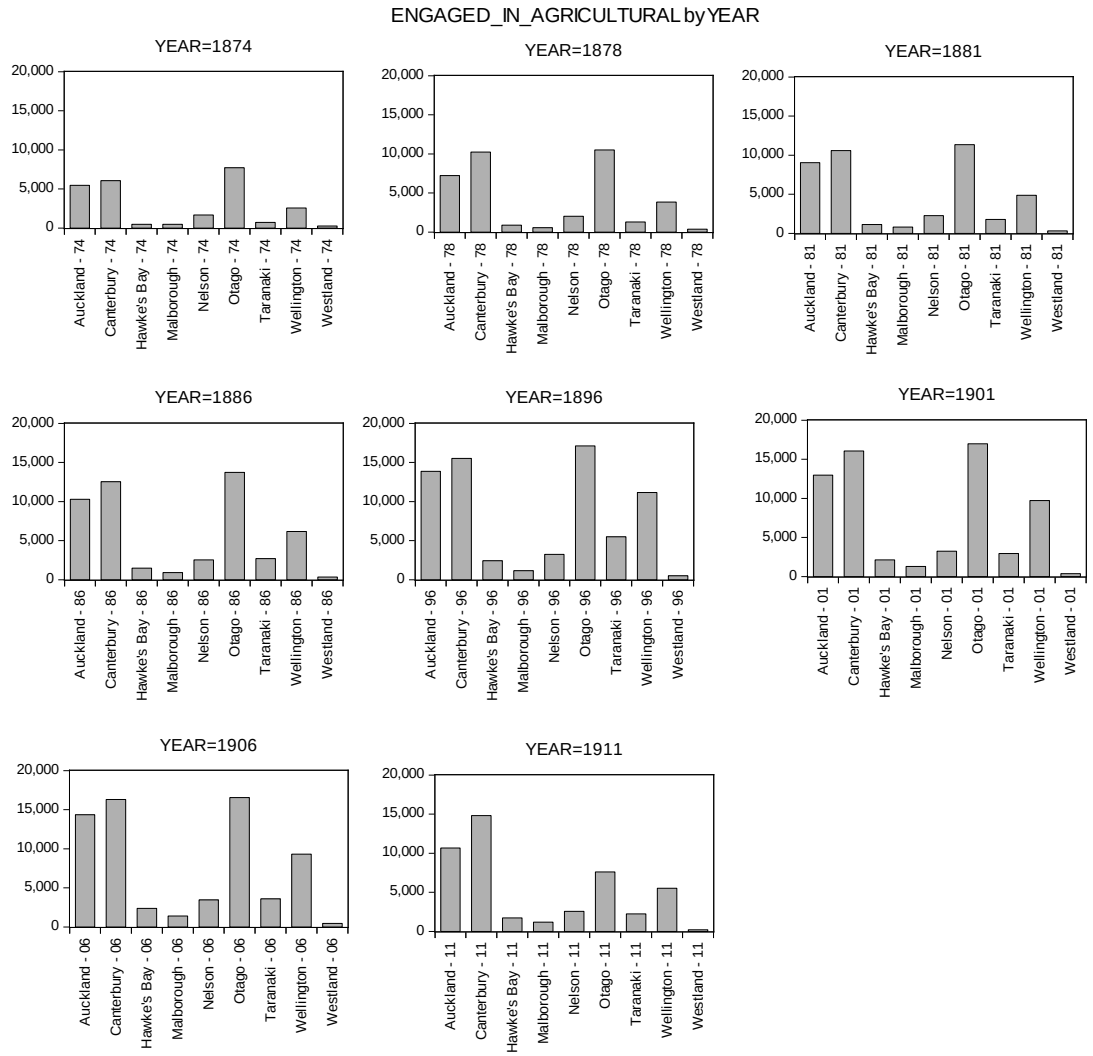
Source: New Zealand Census Statistics, 1874-1886

Agricultural labourers maintained their high proportion in the rural sector labour force, while the role of pastoral and dairying labourers gradually declined. According to the New Zealand Census (1891-1911), dairying first became significant in terms of labour in 1901. At the same time pastoral sector labour requirements significantly declined with the percentage of labourers falling from 73% in 1891 to 44.4 % in 1911. Martin (1983) argued that these two trends reflected the shift in landholding structure towards smaller, family-farm oriented units of production. Further evidence on employment status (1891-1911) of the pastoral labour force is also indicative of a steady decline in the importance of wage-earners (from 75% to 50%), and thus a trend towards smaller farms (*Census New Zealand, Occupations of the People*).

Figures 4-2 and 4-3 show the distribution of agricultural and pastoral labour during the 1874-1911 Census years, where it appears that Canterbury and Otago had the highest number of people engaged in agricultural produce throughout that period.

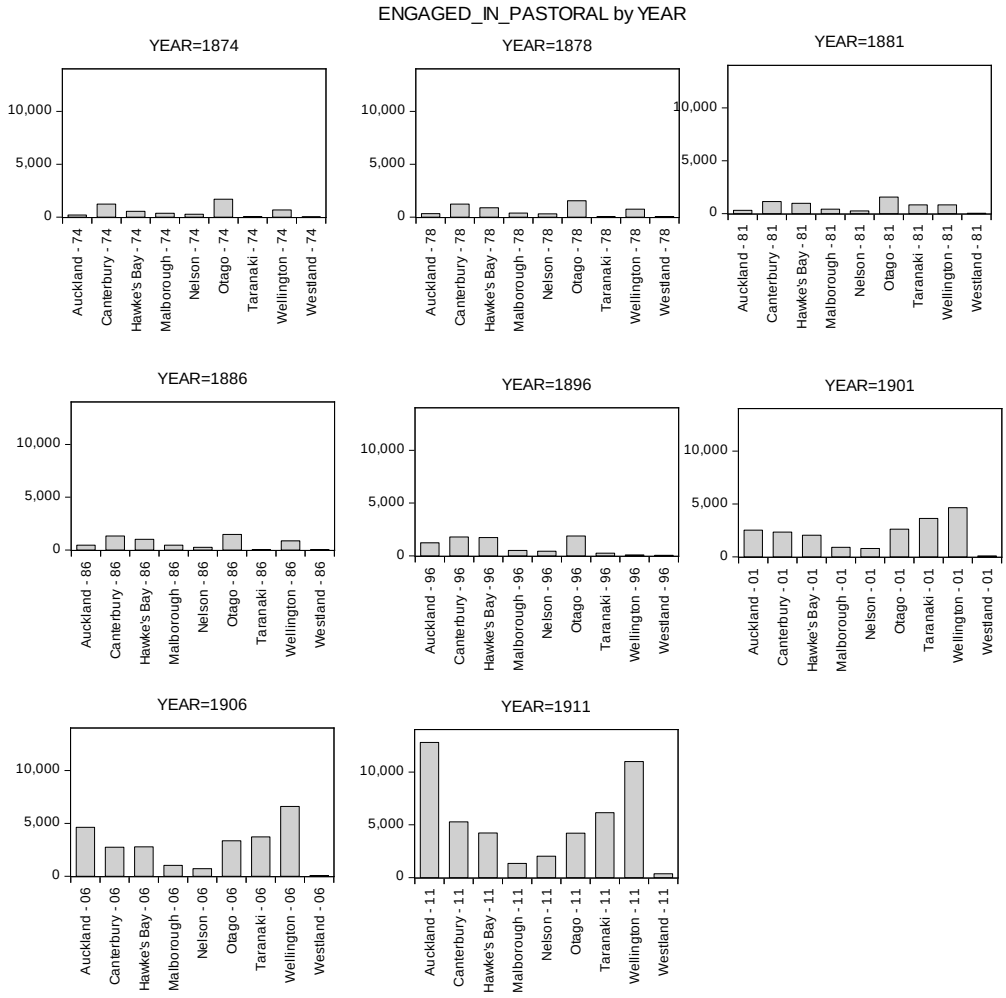
The number of people engaged in agricultural pursuits declined significantly everywhere in 1911, but especially in Otago (from 16549 to 7607). This should be contrasted with the trend in the pastoral sector, where the increase in pastoral labour in the North (Auckland and Wellington) was much higher than in the South (Canterbury and Otago) in 1911. Even in 1911, Canterbury continued to dominate the agricultural sector in terms of labour where, as can be seen in Figures 4-2 and 4-3, there was a clear gradient from the primarily agricultural farming in the South towards more pastoral farming in the North.

Figure 4-2. Labour force movements in Rural Sector (engaged in agricultural sector), 1874-1911



Source: New Zealand Census Statistics, 1874-1911

Figure 4-3. Labour force movements in Rural Sector (engaged in pastoral sector), 1874-1911



Source: New Zealand Census Statistics, 1874-1911

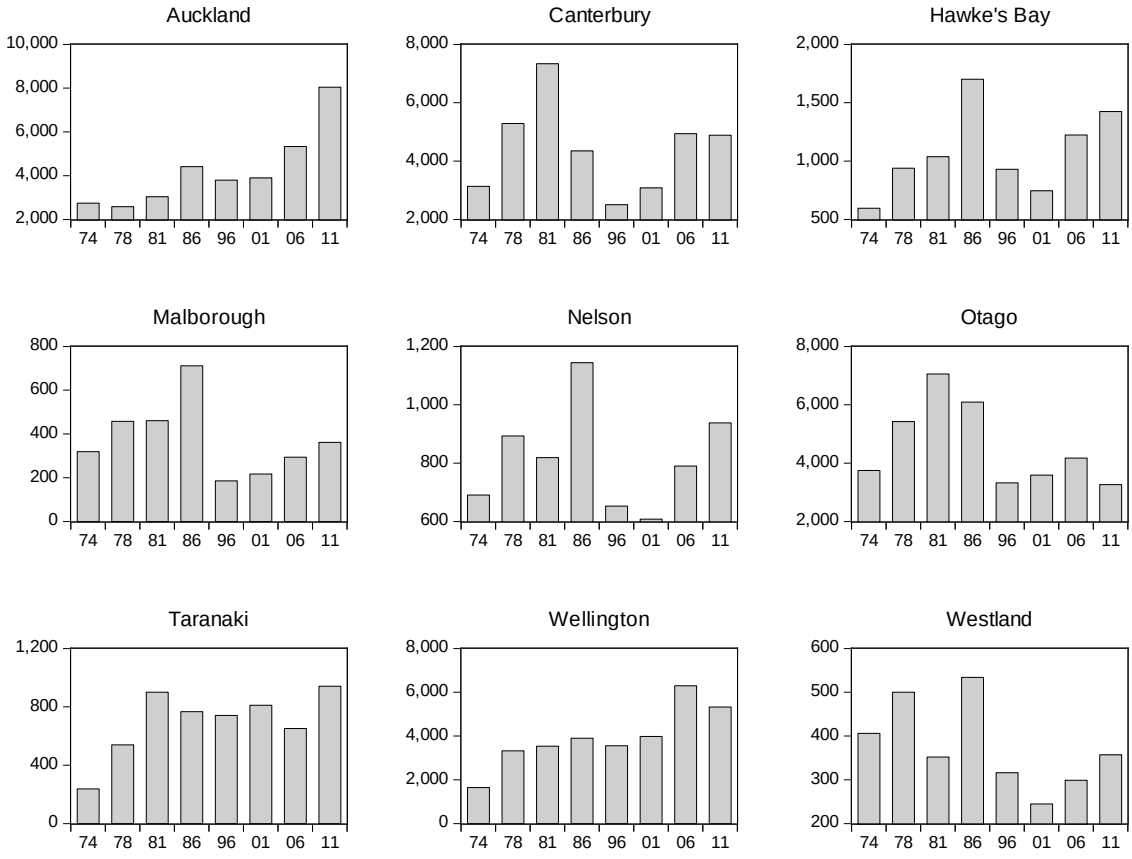
4.2.2 Building trades

By the end of the 19th century, New Zealand's population distribution shifted markedly in favour of towns. Between 1871 and 1911 New Zealand's rural population fell from 60-70 % to approximately 46% of the total population (Thorns & Sedgwick, 1997). Building trades or artisan occupations included carpenters and general labourers, which were listed under skilled and unskilled worker categories respectively.

Labour force movements of the building trades (Figure 4-4) appeared to have a different dynamic from that of farming (Figure 4-2 and 4-3). The peak for Canterbury and Otago occurred in 1881 and seemed to fall significantly thereafter, reaching a low point in 1896 (according to the 1896 Census). The peak for the

peripheral Provinces: Hawke's Bay, Marlborough, Nelson and Westland occurred later in 1886, and the low point was in 1901. It seems that labour force movements in the peripheral Provinces (Nelson, Westland, Marlborough, and Hawke's Bay) lagged behind the labour force movements in Canterbury and Otago. Although the 1896 decline in the number of employed was common across all provinces, the number of employed in building trades in Auckland and Wellington gradually increased compared to Canterbury and Otago. The breakdown of occupations (from *the Department of Labour Reports*) indicated that nearly one-third of general labourers were out of work by April 1896, at a time when the economy began to improve (New Zealand & Statistics, 1891-1924).

Figure 4-4. Labour force movements in the Building Sector, 1874-1911



Source: New Zealand Census Statistics, 1874-1911

Similar to farming, the shift towards the North existed in the building sector as well. This is consistent with the urban population growth which also acquired the South-North gradient (Gibson, 1973). House construction was the most significant form of

private investment during the 19th –beginning of the 20th century (Dowie, 1966) and, not surprisingly, caused considerable increases in population growth in the North Island (mainly due to an increase in net migration in Auckland and Wellington), which was also associated with an increase in the number of carpenters and other construction workers in those Provinces.

4.3 Provincial wages: explanation of the patterns

In general, people move from one region to another for higher wages. There could be other reasons such as: to escape unemployment; future prospects and employment opportunities with new land available for farming; or a growing demand for infrastructure building, however, higher earnings remain the main driving force. In this section, I use occupation-specific real wages by region[25] to examine the issue of integration by establishing whether there were any differences within urban and rural sectors or across regions.

4.3.1 Farming

From the discussion in Section 4.2.1, farm labouring was the dominant occupation in the rural sector, with farm labourers mainly concentrated in the South Island. Frequent fluctuations in the wage rates of farm labourers with and without board (Figure 4-5) could be attributed to the highly seasonal nature of this occupation (especially those without board, who earned daily wages). A decline in real wages was observed across all Provinces during 1873-1880 and it is evident from Figure 4-5 that farm labourers' real wages (both with board and without) increased slightly in the 1880s and on average fluctuated around the constant mean till 1895. Real wages in Auckland were persistently lower than in other Provinces during 1873-1881 and 1886-1897, but by 1900 the fluctuations of real wages became less volatile across the Provinces. Only Wellington showed a significant increase in farm-labourers' earnings between 1898 and 1904, which seemed to be the result of the increased cost of board (the increase was apparent for farm-labourers with board but not without).

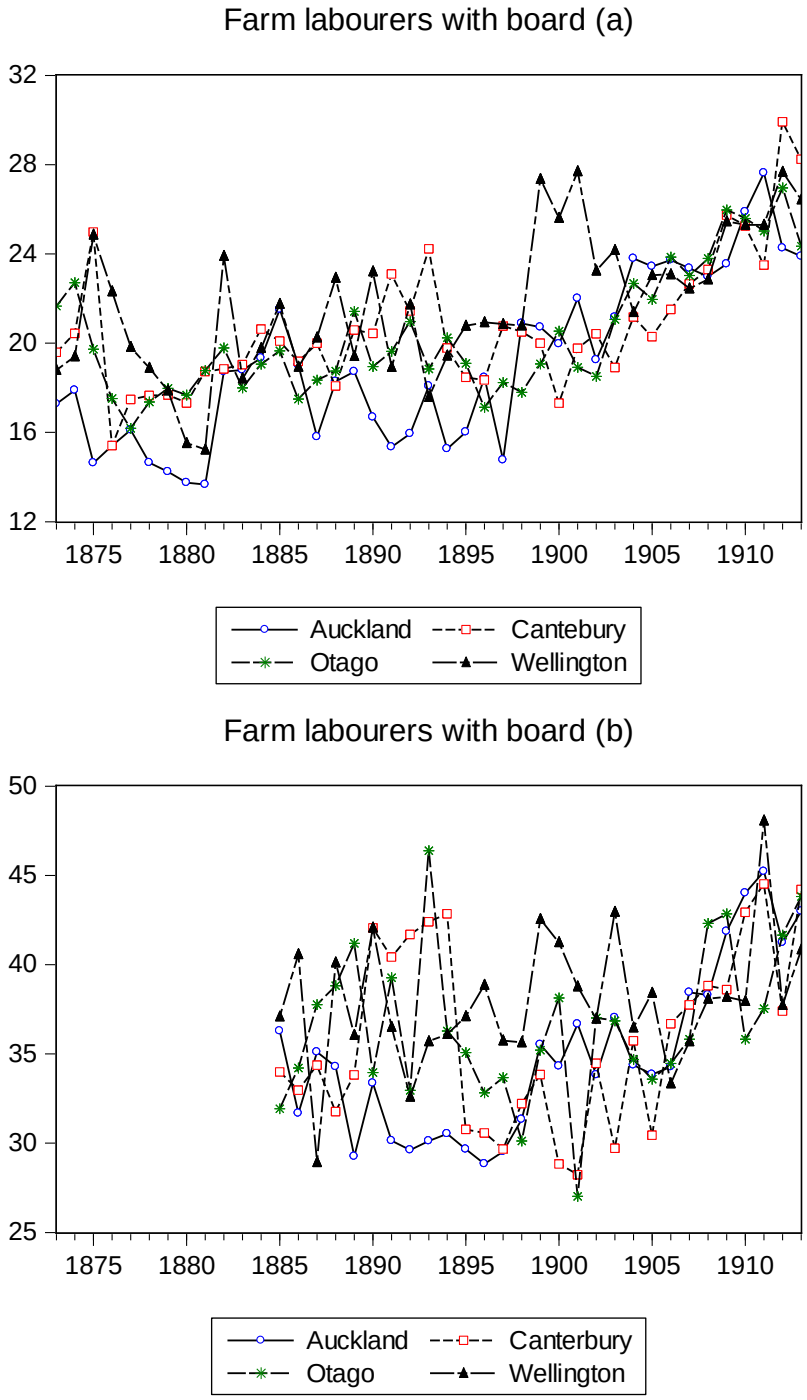
[25] Construction of occupation specific real wages by provinces is presented in Appendix B.

On average, the cost of board during 1885-99 was the highest in Otago and the lowest in Auckland, while during 1900-13 the cost of board became the highest in Auckland and the lowest in Canterbury (Table 4-1).

Table 4-1. Cost of board across provinces (shillings per week)

1885-1899					
PROVINCE	Mean	Max	Min.	Std. Dev	Obs.
Auckland	13.98	19.31	10.38	2.49	15
Canterbury	15.23	23.07	8.90	4.00	15
Otago	16.94	27.54	11.98	3.97	15
Wellington	16.05	21.64	8.68	3.12	15
Total	15.55	27.54	8.68	3.54	60
1900-1913					
Auckland	15.11	19.11	10.42	2.91	14
Canterbury	13.60	21.02	7.48	3.67	14
Otago	14.24	19.48	8.11	3.60	14
Wellington	14.36	22.77	10.06	3.37	14
Total	14.33	22.77	7.48	3.35	56

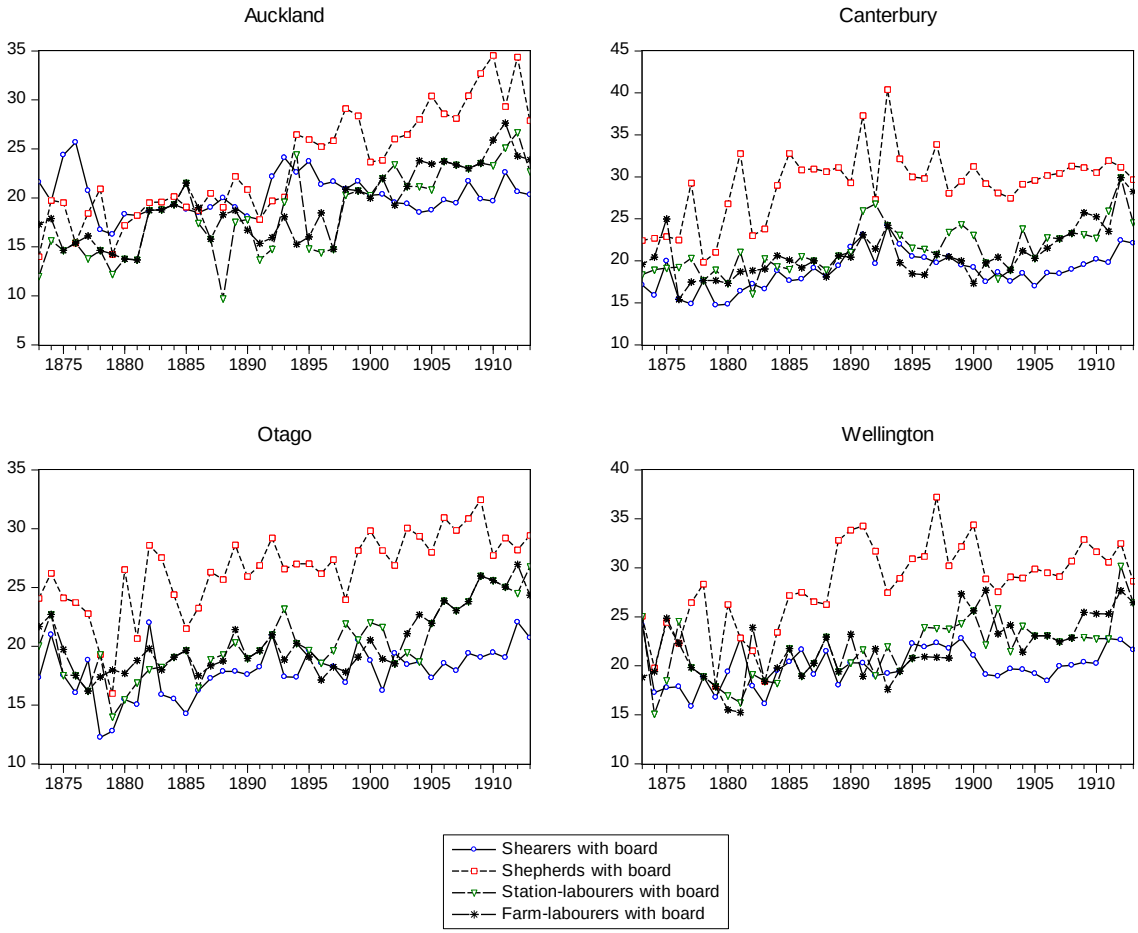
Figure 4-5. Real wages of farm labourers with and without board (shillings per week)



In addition to farm labourers, other rural wage earners included: shearers, shepherds, and station labourers (all included board). These occupations were considered as permanent, supplemented by semi-permanent mustering work (New Zealand. Ministry for Culture & Heritage, 2003). Real wages (expressed in weekly terms) of shepherds were consistently higher than those of other rural wage-earners. While

farm labourers, shearers and station labourers were unskilled rural occupations, shepherds earned more respect and money and were considered as skilled. It is evident from Figure 4-6 that shepherds had higher wages compared to other rural occupations across all Provinces, except Auckland, where real wages of shepherds were low and matched those of other rural wage earners. Wages of shepherds in Auckland only began to rise to the average provincial level post 1895.

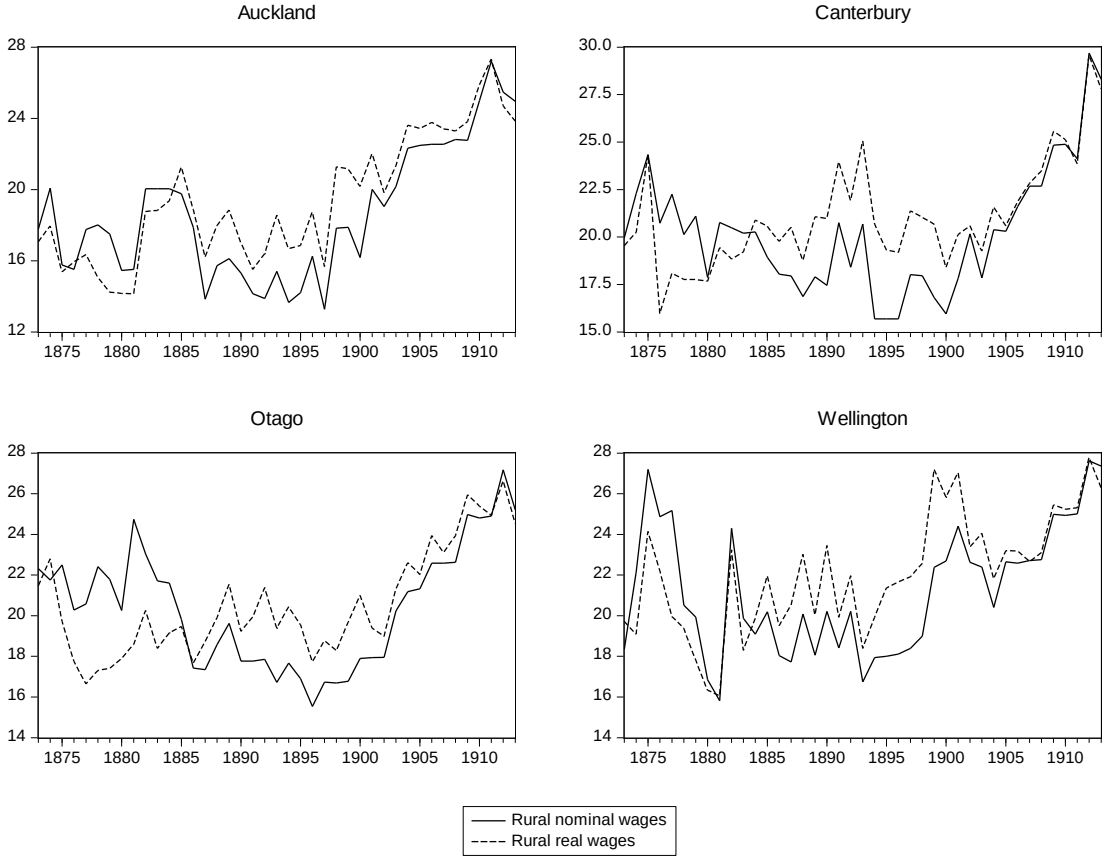
Figure 4-6. Real wages of rural workers by Province (in shillings per week)



In Figure 4.7 I present both nominal and real composite wages in the rural sector (rural wages included both board and non-board rural workers). The fall in the nominal wages occurred in response to a fall in prices driven by external shocks (fall in the world prices of wool and wheat in the late 1870s-1880s). When average farm wages were falling in the 1880s, prices were declining even faster, which resulted in a real wage growth. This was particularly apparent in Canterbury and Otago, the centres of agricultural and pastoral production. Post 1895, the increasing trend

became apparent for all Provinces. Rural wages in Auckland were, on average, the lowest during 1873-1898 (apart from an increase in 1882-1885). This changed dramatically during 1899-1913, when rural wages in Auckland grew rapidly and achieved the average provincial level.

Figure 4-7. Composite real wages, engaged in agricultural and pastoral pursuits (shillings per week)



An equality of means and variance test showed that there were marked differences across Provinces prior to 1900, which dissipated during the period 1900-13 (Table 4-2). On average, real wages in Auckland grew the most of the provinces (mean real wages there increased by 34% in the 1900-13 period compared to 1873-99). Alternatively, an increase in other provinces varied between 13 and 20%.

Table 4-2. Composite real wages (weekly in shillings)

1873-99					
PROVINCE	Mean	Max	Min.	Std. Dev	Obs.
Auckland	17.34	21.28	14.13	2.09	27
Canterbury	20.17	25.05	15.96	2.06	27
Otago	19.23	22.80	16.65	1.48	27
Wellington	20.72	27.21	16.06	2.44	27
Total	19.37	27.21	14.13	2.40	108
1900-13					
Auckland	23.32	27.33	19.82	2.02	14
Canterbury	22.91	29.60	18.40	3.24	14
Otago	23.12	26.64	18.98	2.36	14
Wellington	24.60	27.79	21.82	1.79	14
Total	23.49	29.60	18.40	2.44	56

The rural sector in New Zealand was dominated by unskilled labour (agricultural and pastoral labourers). Most of the reported rural labourers were provided with board, which varied between 14 and 16 shillings per week (according to the difference in earnings between farm labourers with and without board). Rural wage earners in Auckland had the lowest wages until 1900 where the wages of skilled rural workers, i.e. shepherds, were also the lowest, until they began to earn a premium post-1895. Auckland's economy, dominated by kauri and kauri gum exports until 1910, was not reliant upon pastoral or agricultural farming with the low demand for agricultural or pastoral services until later in the 1890s being reflected in the absence of the skill premium among shepherds.

Composite rural wages declined during 1873-1880 and increased in the 1880s, particularly in Canterbury and Otago. Canterbury experienced an increase in real wages during 1880-1894 and then a fall during 1895-1900. An increase in real wages in Otago during 1885-1890 was more moderate, and real wages fluctuated around a constant mean during 1880-95. Real wages in Auckland had an increase in the beginning of the 1880s, but then stabilized until a further increase in 1898. Real wages in Wellington reached a period high in 1876, and then dropped in 1881 with no particular trend between 1882 and 1893. Post-1900, rural sector wages were increasing across all provinces and occupation groups.

4.3.2 Building

In the building sector, there were no significant differences in real wages of carpenters, masons, plasters etc. within the skilled occupation category until 1905. Post 1905, the weekly earnings of bricklayers, plasterers and masons were increasing, while those of carpenters, painters and plumbers were decreasing. This was observed in all Provinces. There were also some marked differences across Provinces and between skilled and unskilled categories. Similar to the rural sector, building sector real wages were particularly volatile in the 1870s. Figure 4-8 shows that real wages in building sector were generally higher in Otago (fluctuated between 49 and 68 shillings per week) and lower in Auckland (fluctuated between 40 and 60 shillings). In Chapter 2, it was also observed that housing prices were consistently higher in Dunedin and lower in Auckland compared to other Provinces during 1885-1898.

Most apparent was the difference between skilled and unskilled building occupations. It is clear from Figure 4-8 that the real wages of general labourers remained consistently lower than those of carpenters or other skilled workers. This pay differential seemed relatively low in Wellington compared to the other Provinces.

Figure 4-8. Occupation specific real wages in the building sector (shillings per week)

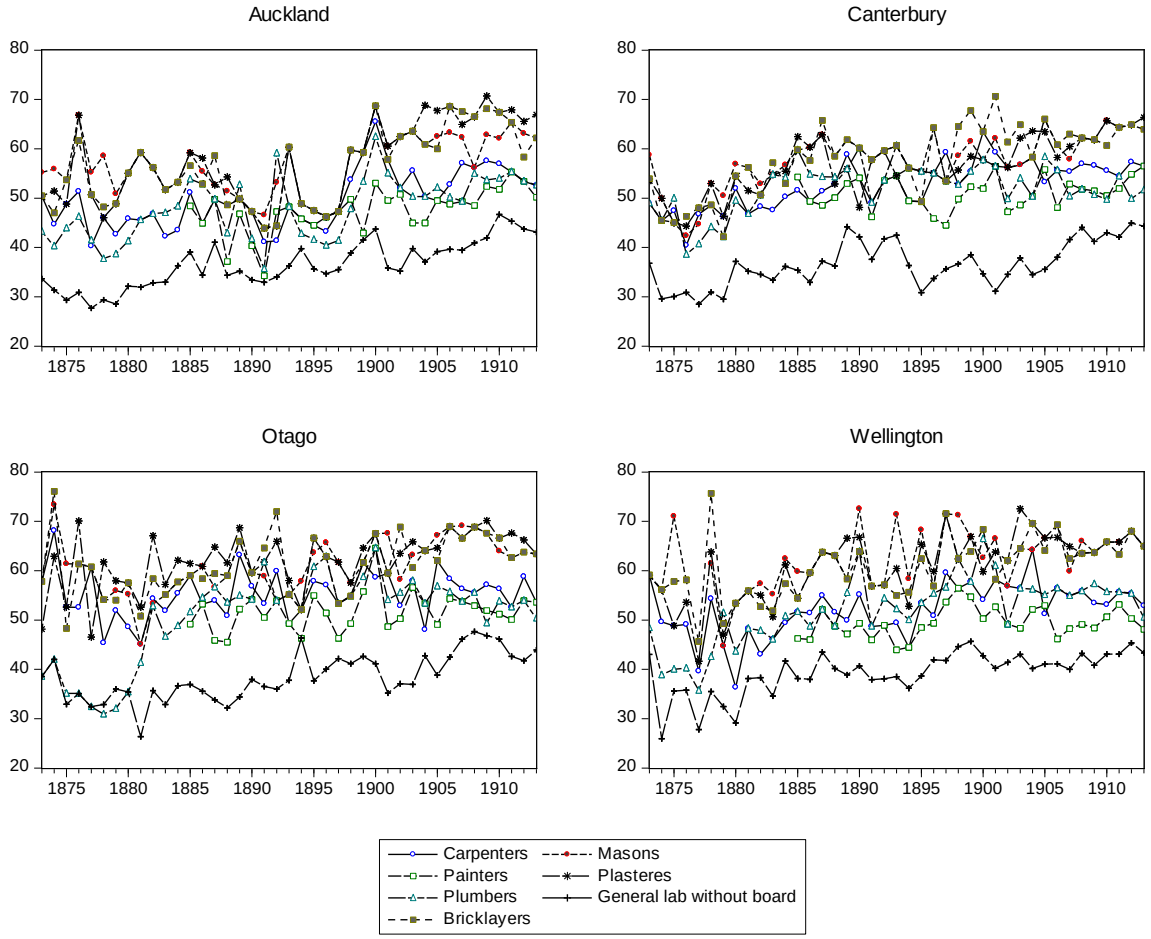


Figure 4-9 shows composite[26] nominal and real wages in the building sector. Both real and nominal wages trended in the same direction in Auckland and Wellington. 'A slump in construction employment in the 1880s' (G. R. Hawke, 1985), could only be observed in the real wage decline in Auckland, but not other provinces. Between 1880 and 1890 real wages in Canterbury and Otago were increasing, while nominal wages were falling. From approximately 1895, both nominal and real wages were growing simultaneously, when union activity grew and no doubt played a role in the increases (Clinkard, 1919). For example, in 1898 an industrial agreement regarding minimum wages and working hours (limited to 46 per week) of industry workers was made in Wellington. The hours of labour declined on average by

[26] Wages of carpenters, general labourers, painters/plumbers, masons, plasterers, and bricklayers are included in the composite building wages. Many artisans were paid on a daily and not weekly basis. For consistency purposes (when constructing aggregate wages), artisan wages were normalized to a five-day week.

approximately 5 % from 1899 (Clinkard, 1919). An increase in the building sector real wages between 1880 and 1890 (in Canterbury, Otago and Wellington) was somewhat of an aberration as prices were falling faster than the average wages, resulting in the higher real wages (Figure 4-9).

Figure 4-9. Composite real and nominal wages, engaged in building and construction (shillings per week)

Building occupations were the most volatile among urban occupations in New Zealand, where employment was largely dependent on the country's financial performance and government's provision of public relief work. The Building sector real wages, presented in this chapter, however, do not account for unemployment as there were no reliable Provincial estimates available for that time period[27]. In

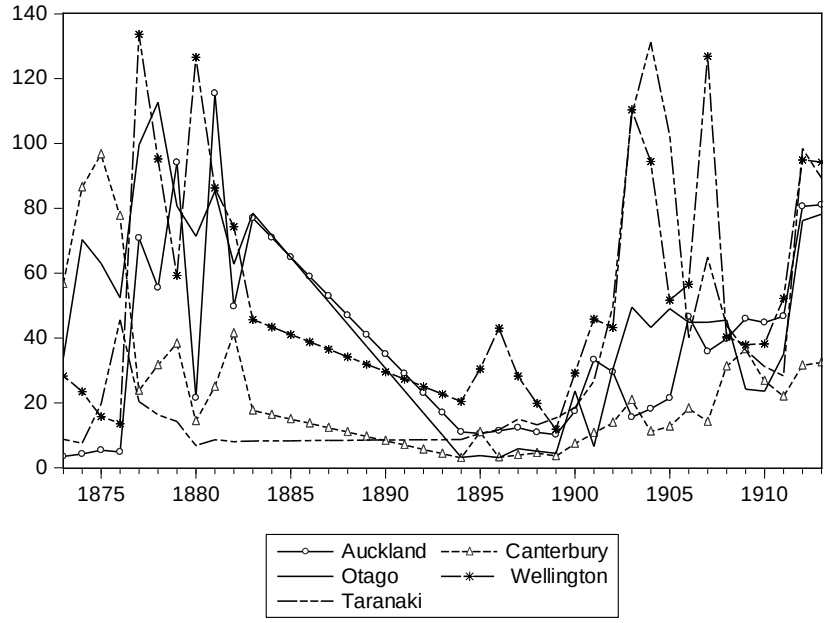
[27] The number of persons assisted by the Bureau of Industries is available from 1893. The Bureau of Industries did not provide unemployment benefit, per se, but rather redistributed the unemployed from areas with surplus labour in a particular occupation, to those in deficit. Please see Appendix B, B2 and Table B-10.

addition, it has been stressed in the past that Canterbury and Otago were the centres of unemployment in the 1880s (R. J. Campbell, 1976; Hight, Straubel, Gardner, & Scotter, 1957), and therefore an improvement in living standards only applied to those with stable employment.

Any influx of building sector unskilled jobs was dependent on the government's expenditure on public works i.e. development of public infrastructure, roads and railways (New Zealand. Parliament. House of, 1893). Public works expenditure per person in each respective Borough was on the rise in the 1870s and then later in the 1900s (Figure 4-10). A gap in the series between 1883 and 1894 (no Provincial data available) was linearly interpolated. When public works data resumed in 1894, it was clear that a large decline in the funds available for the financing of public works occurred between 1883 and 1894. From the late 1870s there was a substantial decline in the local body capital expenditure, which was followed by a fall in the import of building materials relating to a decline in the house construction in the 1880s (Dowie, 1966). The 1880s were the time of general depression for New Zealand's economy when unemployment, in particular, worsened. Figure 4-11 shows the percentage of unemployed among carpenters and joiners, which increased in 1879, 1886-88, and 1893-94[28]. Expenditure on public works, the number of employed, and real wages were all falling in response to external influences and the overall depressed state of the economy.

[28] This unemployment index is of limited validity as it only includes carpenters and joiners, although building sector occupations did dominate the number of the applications for assistance. The number of men assisted to find work by the labour department is reported from 1892 for different provinces, however, its use as an unemployment index is also limited (see Appendix B, B2)

Figure 4-10. Public works expenditure per capita (in shillings)

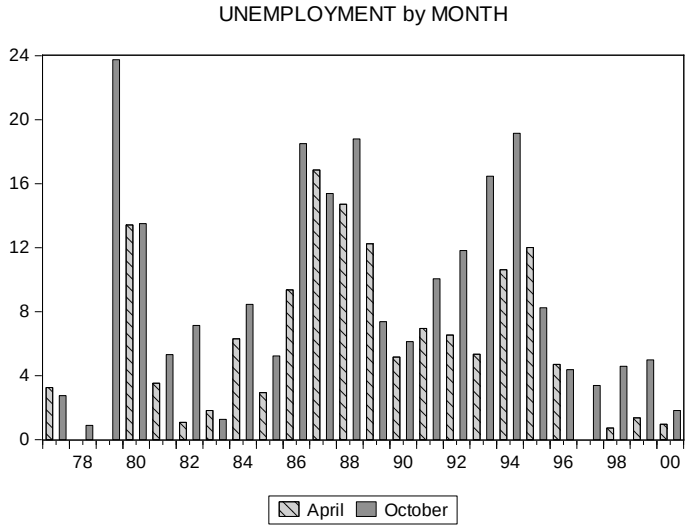


According to Table 4-3, Auckland's building sector real wages grew the most (18%) during 1873-1913, while the average growth rate in real wages for other Provinces was only 10% (the period average between 1873-99 and 1909-13). A difference of means test was used to confirm that disparities in real wages (deviations from the mean) across Provinces diminished during 1900-13 relative to the earlier period. By 1900 the growth of building societies, improvements in city transport, accelerated suburban growth and cheaper land at the city fringes all contributed to the return to prosperity (Fairburn, 1975). This was also reflected in a decrease in the level of unemployment by 1900 (Figure 4-11).

Table 4-3. Composite real wages, building sector

1885-1899					
PROVINCE	Mean	Max	Min.	Std. Dev	Obs.
Auckland	47.22	53.92	39.72	3.61	27
Canterbury	50.20	55.88	40.44	4.36	27
Otago	52.59	60.71	43.50	4.09	27
Wellington	51.68	60.84	31.72	5.83	27
Total	50.43	60.84	31.72	4.93	108
1899-1913					
Auckland	56.03	61.49	53.26	2.27	14
Canterbury	55.27	57.53	51.60	1.65	14
Otago	57.50	61.61	54.82	1.99	14
Wellington	56.93	59.40	53.88	1.46	14
Total	56.43	61.61	51.60	2.01	56

Figure 4-11. Unemployment of New Zealand ASCJ[29] (% unemployed)



Source: Monthly Reports of the ASCJ, data extracted from Roth (1978)

4.4 Inequality

In the previous section, I established that, prior to 1900, there were some real wage inequalities both across regions and occupations. The patterns of regional wage dynamics, described in Section 4.3, are analysed in this section via coefficient of variation analysis. I consider both regional and other types of inequalities i.e. skilled-unskilled, urban-rural and inequality of earnings[30] (ratio between high and low earnings).

In Section 4.3.1 it was emphasised that most rural occupations included a board component. It would be interesting to see if the variation of regional average wages for the workers with board is any different from those without board[31]. It was demonstrated in Section 4.3.1 that a significant increase in the farm-labourers' earnings in Wellington between 1898 and 1904 was the result of the increased cost of board (the increase was apparent for farm-labourers with board but not without).

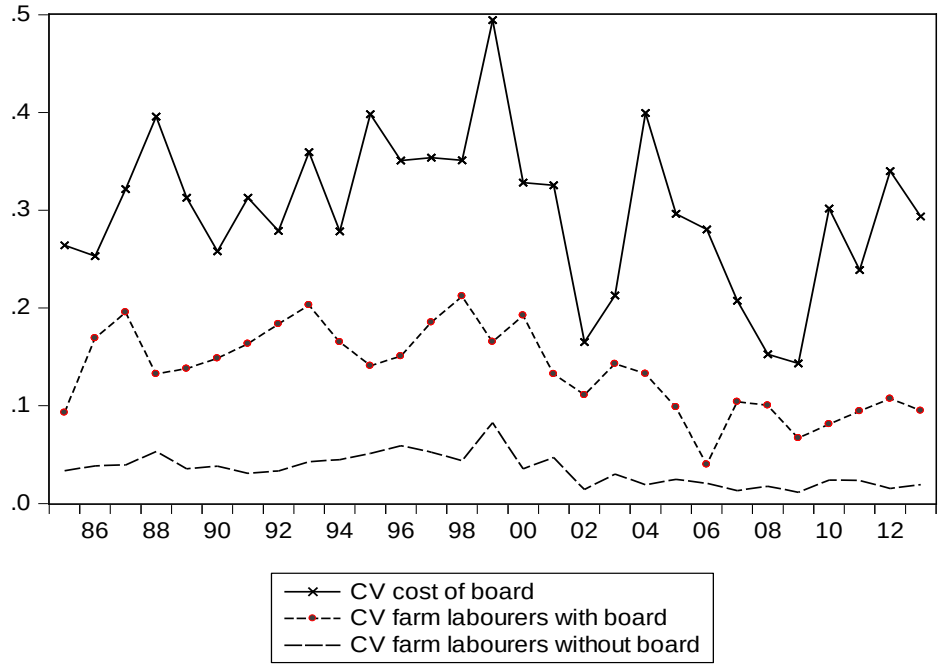
[29] Amalgamated Society of Carpenters and Joiners

[30] Included only building and rural occupations without board

[31] I use nominal wages only for this case to demonstrate the effect of variation of the cost of board on farm workers' wages.

It also appears that, on average, the cost of board was the highest in Otago during 1885-99, and in Auckland during 1900-13. It is evident from Figure 4-12 that the coefficient of variation for non-board[32] farm workers remained in the 5% range, while the degree of regional dispersion for board workers fluctuated between 15% and 20% during 1885-1900. It can be noted that the variation in the cost of board did not decline over time (on average it remained around 29%). This demonstrates that differences in the cost of board across Provinces greatly contributed to a higher Provincial variation in the average wages of farm workers with board.

Figure 4-12. Coefficient of Variation (all provinces): Average Provincial Wages of Farm Labourers without board

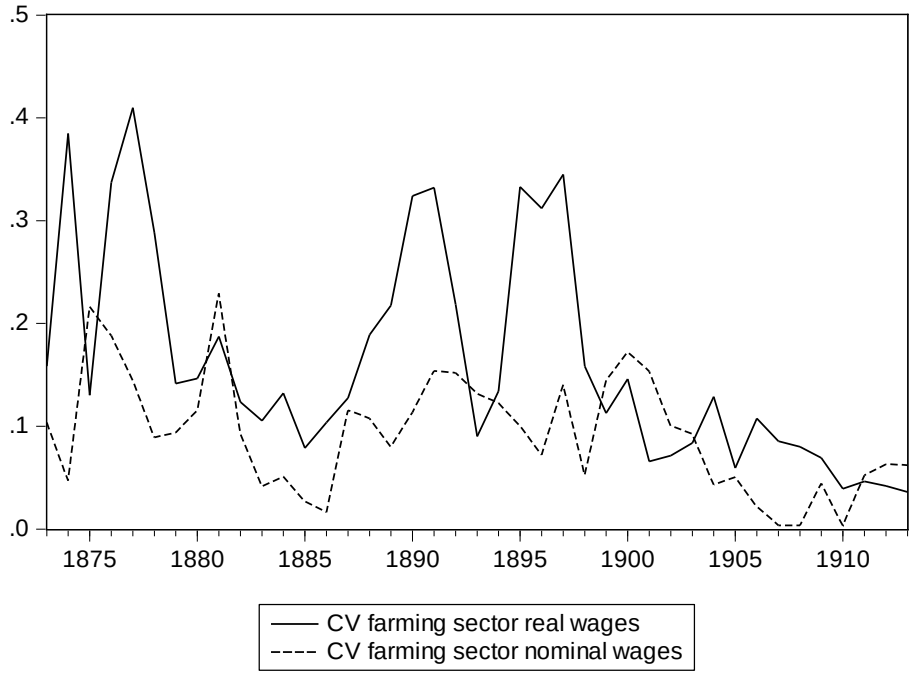


The coefficient of variation for the composite rural wages showed that the level of dispersion was significantly higher in real wages than in the nominal (Figure 4-13). Real wages were particularly volatile during 1873-78. In 1875 farm-labourers' real wages across Provinces ranged from 14 shillings to 25 shillings per week. In 1886-99 farm labourers' real wages remained the lowest in Auckland, creating a gap between Auckland and the other Provinces. Provincial wage disparities declined to a

[32] Daily wage rates of farm labourers without board were normalized to the equivalent of weekly rates.

minimum in 1885, followed by an increase in the second half of the 1880s and beginning of the 1890s where there was a significant decrease in the degree of regional variation post 1900.

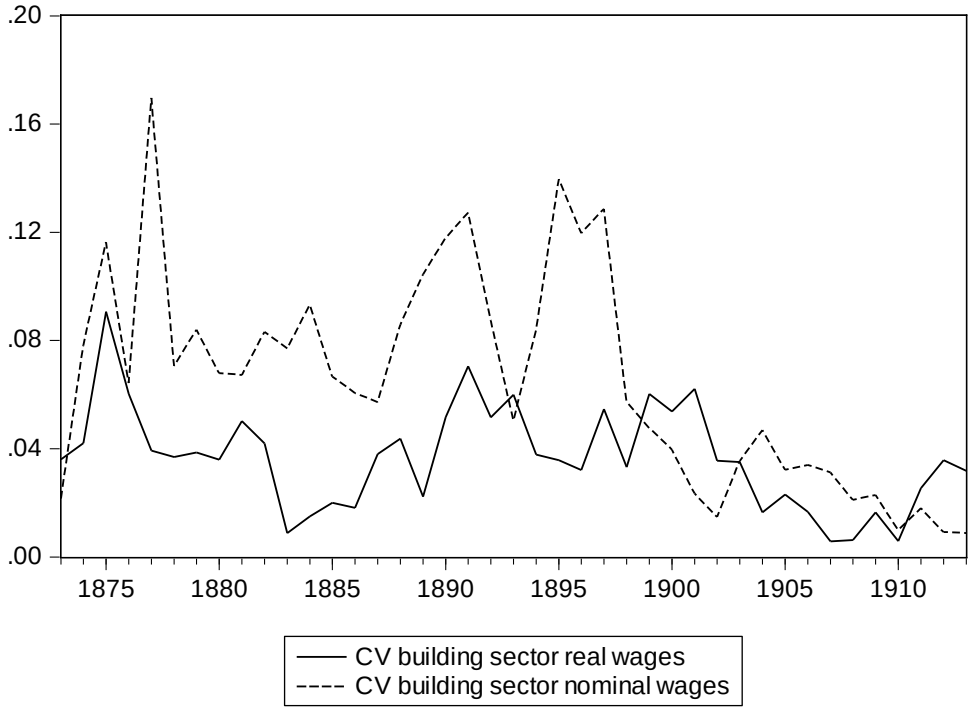
Figure 4-13. Coefficient of Variation (main provinces only): Composite Rural Wages (real and nominal)



In the building sector, Provincial disparities in real terms were much lower than in the rural sector (on average 3% in building vs. 16% in rural). Apparently, Provincial disparities in the building sector were higher in nominal terms as some of the Provincial variation in nominal wages was negated once the changes in the general level of prices across Provinces were taken into account.

Tests for equality of means (F-tests) and variances among Provinces in the rural sector were used to identify whether, prior to 1900 (1873-1899), real wages varied significantly across Provinces (the null hypothesis of equality was rejected) and the opposite was true for the period post 1899 (1900-1913). Correspondingly, in the building sector the null hypothesis of equality of means was rejected for 1873-99, but the null hypothesis of equality of variances across Provinces was not rejected for either period, implying that there was a greater degree of volatility in the building sector than in the rural sector wages.

Figure 4-14. Coefficient of Variation: building occupations



In Section 4.3, it has been demonstrated that the skill premium in both rural and urban sectors varied across Provinces. The rural sector skill premium increased during 1873-1895 and fell thereafter (Figure 4-15). The fall in the rural skill premium could be ascribed to the decreasing role of pastoral labourers (Section 4.2.1) and sheep farming in general, in favour of increased dairy production and cattle farming (from 1896 to 1914, butter production increased nearly five-fold, and cheese increased more than ten-fold (Sanderson, 2008)).

It is clear from Figure 4-16 that the shepherds' skill premium was the highest in Canterbury and the lowest in Auckland, which is not surprising given that soils and climatic conditions in the North did not suit the pasturing of sheep (New Zealand. Ministry for Culture & Heritage, 2003). Alternatively, Canterbury and Otago had more suitable land for agricultural production and the pasturing of sheep in the 19th century.

Figure 4-15. Skill premium (ratio of shepherds to farm labourers' real wages), 1873-1913

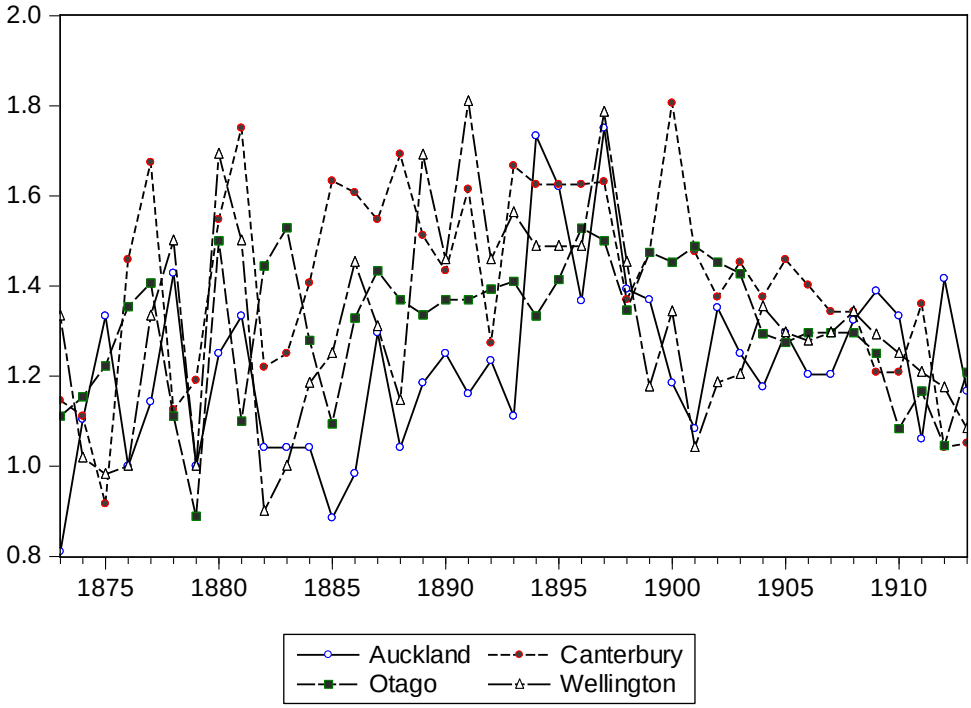
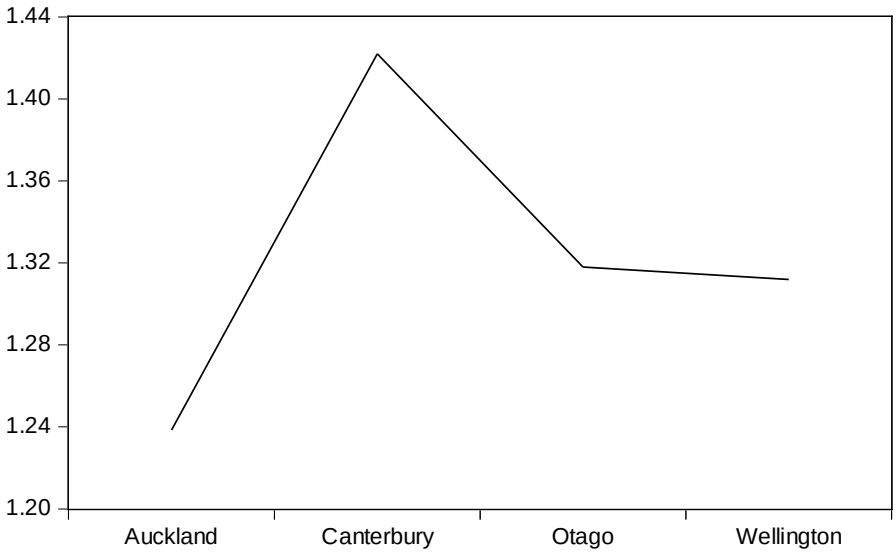


Figure 4-16. Rural skill premium (period mean 1873-1913)

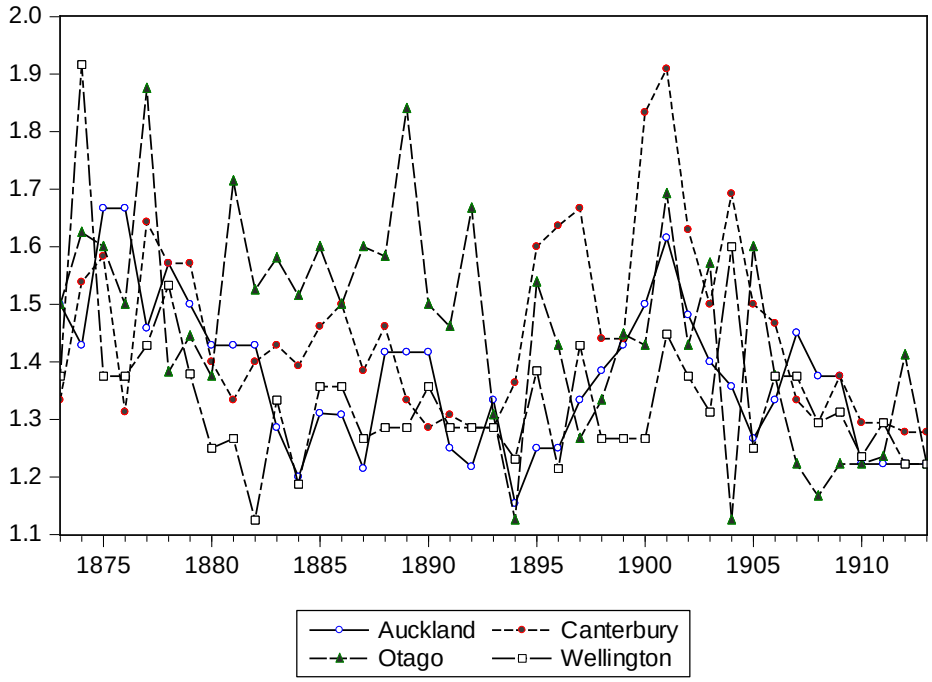


There was an increase in the building sector skill premium between 1895 and 1900, which could be related to the relatively more advantageous position of skilled wage earners (i.e. carpenters) in this sector as many of them were unionised workers

covered by the arbitration system introduced in New Zealand in 1894 *(Industrial Conciliation and Arbitration Act)* [33].

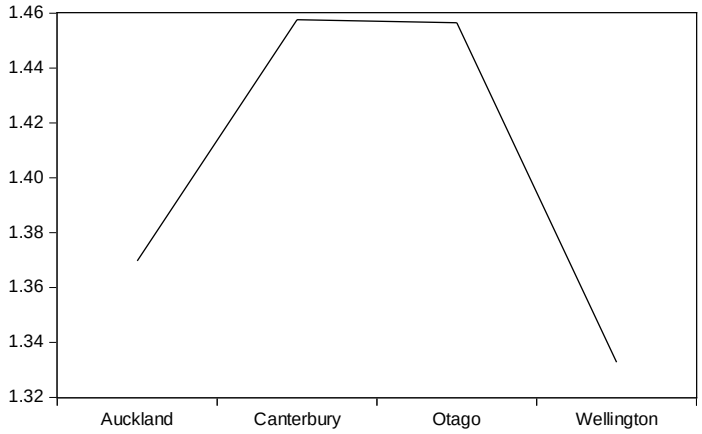
Carpenters' skill premiums were the highest in Otago between 1875 and 1894 and in Canterbury between 1895 and 1905, with the lowest skill premiums in Wellington (Figure 4-17 and 4-18).

Figure 4-17. Skill premium (ratio carpenters to general labourers real wages), 1873-1913



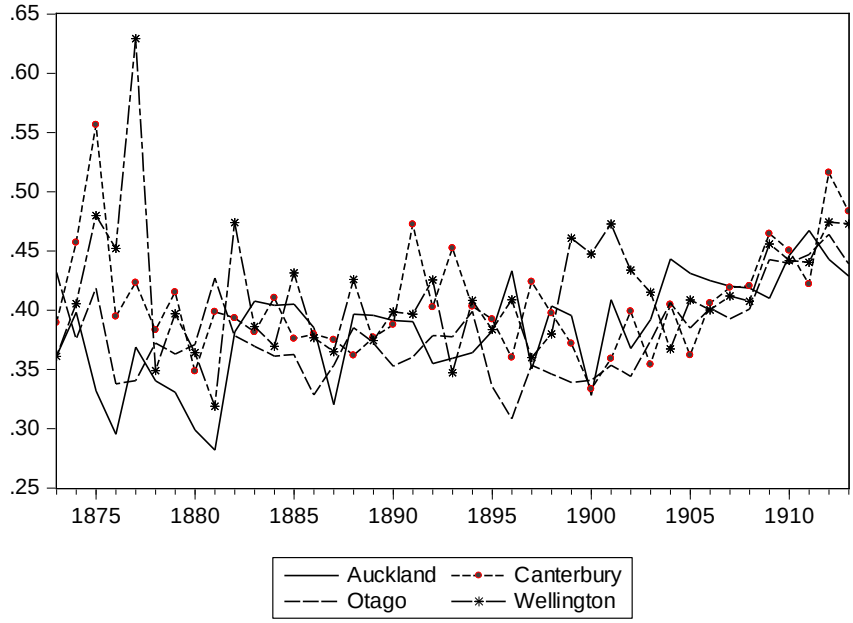
[33] The *Act* imposed compulsory arbitration of industrial disputes and created the Court of Arbitration as the final authority. Its jurisdiction applied only to unions of employers and employees who were registered under the Act, but the Court had the power to set wages, which was later transformed into a nationwide system of "awards[33]", including minimum wage setting and working conditions supervision (*New Zealand. Ministry for Culture & Heritage, 2003)*. One of the positive outcomes of such development was that unions now had an opportunity to achieve an award (preferences to wages, working hours and general work environment). The duration of each award was three years. The majority of the awards were made during the first ten or twelve years of the operation of the 1894 Act, which led to an increase in wages for the unionised workers.

Figure 4-18. Building skill premium (period mean 1873-1913)



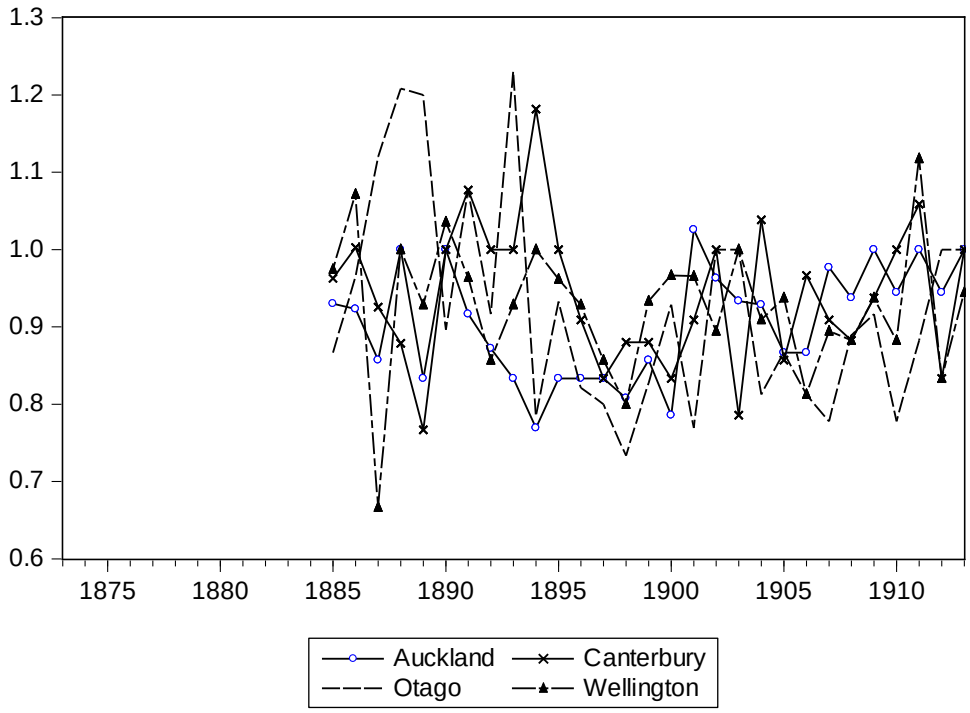
Real wages of the rural workers, on average, were only 40% of the building and construction workers. The presence of the board component and unavailability of farm owner's income statistics understated rural wages in rural sector. Building and construction sector wages included skilled occupations such as carpenters, while rural wages mainly included agricultural and pastoral labourers (apart from shepherds), most of them unskilled.

Figure 4-19. Composite rural to urban real wage ratios, 1873-1913



A direct comparison between unskilled labourers in rural[34] and urban sectors shows that there was no significant premium in the rural sector (Figure 4-20). The pay premium of rural wage earners rose slightly in Otago in 1887-88 and it appears that the earnings of rural labourers relative to general labourers without board were improving only in Auckland (Table 4-4). The rural pay premium in 1900-13 was lower in Canterbury and Otago, and remained the same in Wellington compared to the 1873-99 period. Provincial disparities in the unskilled rural-urban ratio were persistent during 1885-1895, which diminished post 1900 (equality of means and variances across provinces was rejected for the 1885-1899 period, while accepted for the 1900-13 period).

Figure 4-20. Unskilled rural urban real wage ratio (farm labourers to general labourers)



[34] Wages of farm-labourers without board only became available in 1885.

Table 4-4. Descriptive statistics: Unskilled rural urban real wage ratio

province	mean	min	max	std. dev	N of obs
1873-99					
Auckland	0.87	1.00	0.77	0.07	15
Canterbury	0.95	1.18	0.77	0.10	15
Otago	0.96	1.23	0.73	0.17	15
Wellington	0.93	1.07	0.67	0.10	15
1900-13					
Auckland	0.94	1.03	0.79	0.06	14
Canterbury	0.93	1.06	0.79	0.08	14
Otago	0.89	1.00	0.77	0.09	14
Wellington	0.93	1.12	0.81	0.08	14

The wage gap (ratio of the 90th percentile wage to the 10th percentile) between the rich and the poor shrank by only a small margin by the beginning of the 20th century (Table 4-5). The percentage decrease was higher in Auckland and Wellington than in Canterbury and Otago, with the earnings inequality on the rise in the late 1870s-early 1880s and 1890s (Figure 4-21). As has been mentioned earlier, composite real wages were exclusive of farmers' income and female employees' earnings (some of the strictly female occupations i.e. nursemaids, housemaids or needlewomen were not included as all of them included board component), therefore the earnings inequality might be further understated than shown in Figure 4-21.

Figure 4-21. Ratio of 90th percentile wage to 10th percentile wage (composite real wages) for full-time male employees

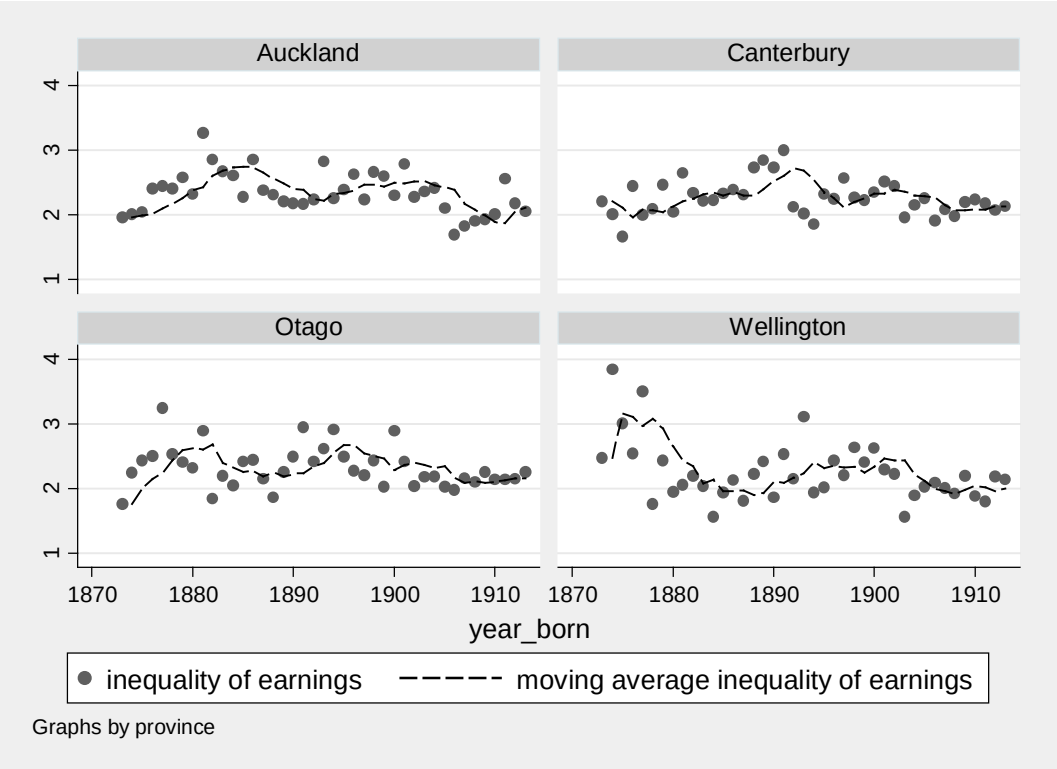


Table 4-5. Descriptive statistics: inequality of full-time earnings

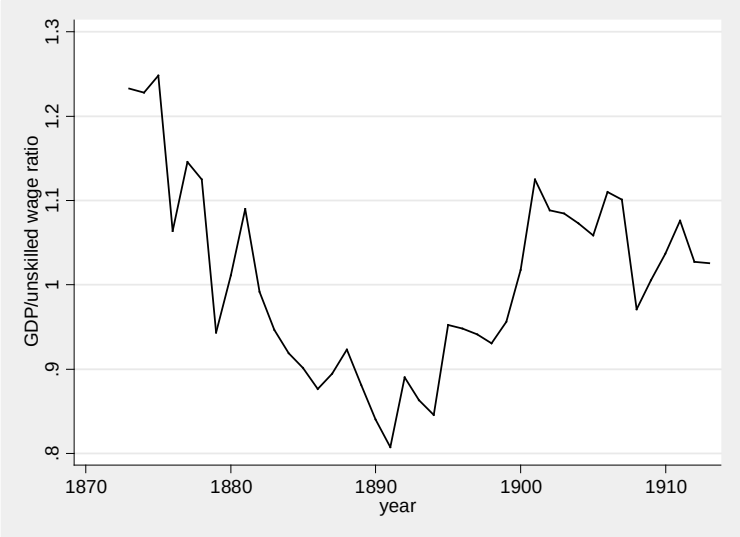
province	mean	Std. dev	min	max	cv
1873-99					
Auckland	2.44	0.30	1.96	3.27	0.12
Canterbury	2.31	0.31	1.66	3.00	0.13
Otago	2.38	0.34	1.76	3.25	0.14
Wellington	2.34	0.53	1.56	3.84	0.22
1900-13					
Auckland	2.16	0.31	1.70	2.78	0.14
Canterbury	2.16	0.18	1.91	2.51	0.08
Otago	2.16	0.11	1.98	2.41	0.05
Wellington	2.02	0.20	1.56	2.29	0.10

There exist other national measures of inequality in New Zealand that capture rents from farming/production; these include rental wage ratios and GDP per capita to unskilled workers[35]. Greasley and Oxley (2005) identified that inequality was rising

[35] Lindert and Williamson (2003) used these indicators to measure inequality across countries.

between 1890 and 1920 (increase in the rental wage ratio) and that these distributional shifts meant that 'landowners reaped virtually all of the gains from higher productivity.' The ratio of GDP per capita to unskilled workers' (general labourers) wage (Figure 4-22), a rather crude inequality measure, was also decreasing during 1873-1891 and increasing thereafter, which basically implies that the benefits of growth mostly went to capital and not labour.

Figure 4-22. Trend in crude inequality indicator (GDP per capita/unskilled wage ratio)



In this section, it has been shown that the degree of dispersion across Provincial real wages was higher in the rural than in the building sector (on average, 16% in rural vs. 3% in building) with real wages in the rural sector being particularly volatile during 1875-78 and 1886-99. The higher degree of dispersion in the rural sector can be partly attributed to the presence of a board component in the series, which appeared to vary considerably across Provinces. Since the introduction of the 1894 *Industrial Conciliation and Arbitration Act*, wage adjustments were mostly regulated based on increases in the cost of living (Hammond, 1917). Such a case could not be made for the farming occupations, since a large proportion (around 90% - *Occupations of the People, the New Zealand Census 1874-1886*) of farm-labourers lived with their employers and were furnished with board and lodging. Despite the observed dispersion in the 1870s and the mid-1880s-1890s, Provincial real wages began converging by the beginning of the 20th century.

Under the 1894 *Act*, compulsory arbitration only covered most industry occupations and some rural occupations such as shearers, while freezing workers and farm labourers were excluded. Generally, skilled workers such as carpenters, formed unions where, to become a member, one had to satisfy certain requirements[36]. Thus, it is not surprising that the skill premium in the building sector was, on average, higher than in the rural sector. For the same reason, the skill premium in the building sector increased between 1895 and 1904. The majority of awards (preferences to wages, working hours and general work environment) were made during the first ten or twelve years of the operation of the 1894 Act (New Zealand. Ministry for Culture & Heritage, 2003). Compulsory arbitration was temporarily amended in 1908, which may have partially contributed to the decrease in the building skill premium post 1905. Alternatively, the fall in the rural skill premium post 1895 could be ascribed to the decreasing role of pastoral labourers and sheep farming in general, in favour of increased dairy production and cattle farming.

The skill premium variation across Provinces in both urban and rural sectors appeared to be relatively high (ranging from 20% to 60% across Provinces) during 1880-99, but this significantly diminished post 1900. On average, during 1873-1913, Canterbury and Otago had higher skill premiums in both the urban and rural sectors compared to Auckland and Wellington.

4.5 Some conclusions

It was previously recognized that the South Island was better connected than the North prior to 1900 (New Zealand Official Yearbook). Railway and road construction was slow to progress in the North, with large areas being covered in bush. Auckland was particularly isolated from the rest of the North Island until the main trunk railway was completed in 1909, connecting, by land, Auckland with Wellington and other localities (New Zealand. Dept. of & New Zealand, 1911). Negative rates of net interprovincial migration in the South and positive in the North showed that, during the period 1886-1911, the population was moving North with

[36] Such as good health and trade experience for at least 5 years (Roth, 1978)

the shift of economic activity (Brosnan, 1986). The analysis presented in section 4.2 also showed that the labour force movements in New Zealand were characterized by the South-North gradient, which existed in both rural and building sectors.

Overall, although real wages in both sectors were falling in the mid-1870s and increasing in the beginning of the 1880s, they fluctuated around a constant mean during 1885-1895. Regional experiences, however, varied considerably prior to 1900. The degree of dispersion in Provincial real wages was higher in the rural sector than in the building sector (on average, 16% in rural vs. 3% in building). Real wages in the rural sector were particularly volatile during 1875-78 and 1886-99. Specifically, an increase in real wages in the 1880s was more apparent in Canterbury and Otago compared to other Provinces. Average wages were falling in response to the fall in prices driven by external shocks (fall in the world prices of wool and wheat in the late 1870s-1880s), resulting in growth in real terms. The fall in prices was more dramatic in Canterbury and Otago as these Provinces dominated the agricultural and pastoral sectors. Despite an increase in wages in real terms, the 1880s have been identified as the time of general depression for New Zealand's economy, when unemployment in particular, worsened (Martin, 1995). Furthermore, earnings inequality was also increasing in the late 1870s-early 1880s and 1890s, potentially understating the overall increase in real wages during that period. The higher skill premium (in both sectors) in Canterbury and Otago during 1873-1913 was also an indication of a more unequal earnings distribution compared to Auckland or Wellington.

Occupation-specific and composite real wages exhibited convergent behaviour towards the beginning of the 20th century: real wages in both urban and rural sectors were converging to the provincial average and skill premiums significantly diminished by 1913. Towards the mid-1890s regional economies prospered, with most sectors of the economy showing progress and high levels of employment (*Department of Labour Annual Reports*). The effect of legislation changes (*Industrial Conciliation and Arbitration Act* of 1894) was reflected in the increase in wages of unionised workers. The skill premium in the building sector was, on average, higher than in the rural sector (rural occupations were not covered by the

act). As Pool and Sceats (2003) expressed (p.342): “NZ was to become a pioneer welfare state through its industrial *Conciliation and Arbitration Act*, of 1894, and the underlying ideology of “social wage” sufficient to sustain a working man and his family”.

Chapter 5

5 Infant Mortality decline and its socioeconomic correlates in New Zealand, 1873-1940

So far, I have constructed and discussed a new Provincial CPI series and a new Provincial real wage series (both composite and for building and farming separately). I also found some persistent disparities in commodity price markets and Provincial real wages prior to 1900.

In this chapter, I analyse sub-national trends in Non-Maori infant mortality (Maori were excluded due to data unavailability) to examine if there were any disparities in health outcomes across regions. To satisfy the second objective of this thesis, I use the new monetary measures discussed earlier plus additional socio-economic variables (derived in this Chapter) to examine the effects of socio-economic factors on infant mortality in New Zealand. The interest in infant mortality arises from the fact that both average stature and infant mortality can be used as measures of health of a given population, and as international studies show they appear to be highly negatively correlated (Akachi & Canning, 2007, 2010; Arcaleni & Peracchi, 2011; Haines, Craig, & Weiss, 2003; Hatton, 2011a; Peracchi, 2011).

5.1 Introduction

Historically, the popular view of New Zealand is one of a healthy country that was famous for an outstandingly low infant mortality rates (IMR) during the first half of the 20th century and even earlier. This notion has been challenged by Ian Pool[37], who argued that "this mortality advantage was enjoyed by younger people belonging to one ethnic group" (Pool, 1982). Essentially, mortality data published before 1920 did not include the indigenous people of New Zealand (Maori), who were later estimated to experience much higher mortality at all ages (ultimately, demographic

[37] Starting in 1964, much of the work on the Maori demographic history comes from the efforts of Ian Pool

transition of the Maori population occurred later and had different characteristics than that of Pakeha/NZ Europeans)[38]. Furthermore, other work showed that the advantage in cohort life expectancy at birth that New Zealand had over other countries, did not extend to adult ages (New Zealand. Statistics New, 2006; Pool & Cheung, 2003, 2005). Nevertheless, the secular decline in infant mortality appeared to have occurred earlier in New Zealand than in other countries with comparable labour markets (such as England, Australia, and the US), where the mortality of the indigenous population was also not accounted for (Australia and the US) (Mein Smith, 1997; New Zealand. Statistics New, 2006). Demographers and social scientists suggest that the unique set of circumstances of the New Zealand environment is responsible for such low infant and child deaths (less so for the adults as those were born and raised overseas)[39]. Specific New Zealand characteristics are generally attributed to a favourable climate and disease free environment (i.e. relative isolation of New Zealand and its regions), a large proportion of rural and farming population, the abundance of "wholesome food", and favourable economic conditions (Neale, 1925; Newman, 1882; Pool & Cheung, 2005). However, such explanations are speculative (although not necessarily untrue) and based almost entirely on early observations of contemporaries.

Concerns about the health status of the colony's European residents first found an expression in the analysis of mortality by doctors (Newman, 1882) and mathematicians (Adams, 1896; Segar, 1901), who intended to show New Zealand's climatic and other advantages over Britain or Australia (Dow, 1996). Population-wide diseases (e.g. tuberculosis) and pandemics (e.g. influenza) also initiated a number of publications by medical scientists in the 19th century (Colqhoun, 1889; Segar, 1901). The rapid decline in infant mortality during 1870-1920 created an increased interest in studying its determinants (Fraser, 1928; Neale, 1925; Newman,

[38] Pool (1994) referred to the epidemiological transition of NZ Europeans as "Classic/Western", and of Maori as "Transitional," which had different characteristics.

[39] Neale (1925) noted that in the earlier years (1870s-1880s) the higher proportion of infantile to total deaths was in part attributed to "an abnormally high proportion of children in the total population."

1882; Watt, 1921). Often, the considerable decline in post-neonatal deaths in the 1900s was attributed to the Plunket Nurses' efforts, however, other researchers recognized the role of the *Department of Health* in creating initiatives which also contributed to this decline (Watt, 1921).

Overall, the analysis of non-Maori mortality originated in purely demographic-based studies, often with little social or economic perspective (Bryder, 1991; Dow, 1996; J. Gibson, 1971; Gilson, 1969, 1970; Gilson(Vosburgh), 1971). Ian Pool (see for example, (Pool, 1982, 1985, 1991b, 1993, 1994; Pool et al., 2009; Pool & Cheung, 2003, 2005; Pool, Dharmalingam, & Sceats, 2007) is perhaps one of the few who tried to put the New Zealand demographic transition and health patterns into a broader perspective by considering social and economic outcomes. However, his work is generally limited in its consideration of Provincial disparities in health outcomes[40]. Due to the lack of readily available data, the hypothesized relationships between infant mortality, fertility and other socio-economic determinants were 'tested' by "pointing to associations with trends in various factors co-varying over time with mortality changes" (Pool & Cheung, 2005).

In this Chapter, the first objective is to review the non-Maori "health transition"[41] and its determinants from a socio-economic perspective and draw some comparisons with Australia[42]. The second and main objective is to analyse regional health inequalities in terms of infant mortality. Measuring the effects of economic and social factors on regional infant mortality rates is not a common exercise as historical data are often limited and contain little information on regional incomes. In the absence of regional income estimates, some studies for other countries used

[40] An exception is the work of Pool and Tiong (1991), where they consider sub-national differences in the decline of Pakeha fertility during the period 1876-1901

[41] Caldwell and Australian National University. Health Transition (1989) employs the term "health transition" which combines both epidemiological transition (changes in levels of sickness as well as mortality) and related social changes.

[42] The data on Maori mortality is not available till later in the 20th century, thus for the purposes of this study I concentrate on non-Maori mortality.

employment structure or occupation data. In Britain C. Lee (1991); Williamson (1981), for instance, expressed infant mortality as a function of population density, population size, number of families/population per inhabited house, housing provision and employment mix variables. Kalipeni (1993) estimated infant mortality as a function of demographic (age at first marriage, total fertility rate) and socio-economic determinants (female literacy rate, home-craft centres, percentage of females in agriculture, and maternity beds per 10,000 of females) in Malawi for two Census years (1977 and 1987). Fortunately, in New Zealand, the Department of Statistics has been relatively consistent in collecting and publishing key economic performance and vital statistics data. The vital statistics, in particular, are considered the most complete, systematic and long running series in the world, dating back to the mid-1800s (Kannisto, 1994; Neal, 1923[43]; Sceats and Pool, 1985a[44]). Most of this data primarily come from the New Zealand Department of Statistics (1873-1935), Annual reports (Various years), Appendices to the Journals of the House of Representatives, and the New Zealand Census Publications.

By way of contrast to the existing New Zealand demographic literature, I use data for the four most populous Provinces with economically important centres: Auckland, Canterbury, Otago and Wellington[45]. Similar to other studies, I include measures of population density (persons per dwelling) and income (real wages), as well as other measures that capture the effects of social policies and provisions (i.e. education, public works expenditure). The questions I attempt to address include: whether the secular decline in infant mortality commenced at the same time across all regions; whether the patterns of decline were different and if they were, which Provincial characteristics were likely to play a role and what were the common socio-economic factors that influenced the decline and fluctuations in infant mortality rates?

[43] Neale (1923) further noted that the low rate of infant mortality can in no way be attributed to a coexistence of complete birth-registrations in the face of defective deaths-registrations.

[44] Sceats and Pool (1985a) did not identify under registration of deaths at post-neonatal ages.

[45] The data sources, unit of measurement and coverage are presented in the Appendix C, Table C-1.

The chapter is organized as follows. In Section 5.2 I review the nature and causes of the non-Maori infant mortality decline in relation to Australia. In particular, I evaluate the New Zealand and Australian secular decline in infant mortality in terms of the disease environment, socio-economic circumstances, and medical care interventions and policies. In Section 5.3 I use regional infant mortality to examine convergence among Provinces and in Section 5.4 I present the within-country analysis of the potential demographic and socio-economic determinants of infant mortality in New Zealand. In Section 5.5 I use a panel fixed effects model to test the hypothesized relationships between infant mortality and its determinants for the period 1874-1919 and in Section 5.6 I review the results and draw some conclusions.

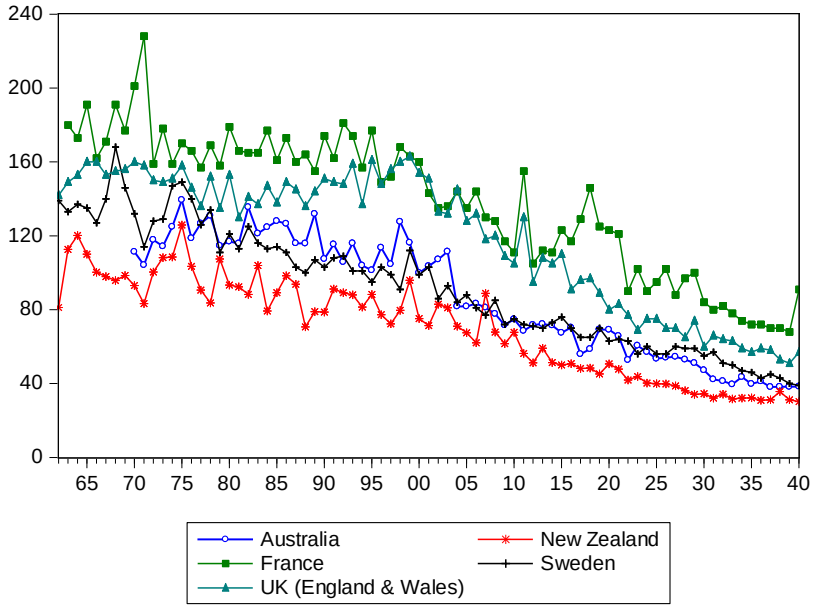
5.2 New Zealand health transition in retrospective, some comparisons with Australia

In most developed countries, the essentially universal decline in infant mortality had its origins in the last quarter of the 19th century. The exact timing of the decline varied due to country-specific economic, social and disease environments. Woods, Watterson, and Woodward (1989), for instance, identified three distinct patterns of the decline in infant mortality across Europe: Swedish, French and British. Sweden was probably the first country to display a pattern of early and fairly steady decline throughout the 19th century. The French pattern, characterized by much higher infant mortality rates, exhibited a delayed decline dating to the late 1890s. The British pattern showed infant mortality initially increasing between the 1880s and 1890s, with the decline only gaining momentum from 1899, which is often identified as the turning point. Both New Zealand and Australia seem to closely approximate to the Swedish infant mortality pattern (see Figure 5-1).

Assumed similarities in living standards, culture, urbanization patterns, and reliance on agricultural and pastoral exports are often raised when comparing Australia and New Zealand. Based on previous studies, it is possible to evaluate New Zealand and Australian secular decline in infant mortality in terms of disease environment, socio-economic circumstances, and medical care interventions and policies. Similar to

Northern and Western Europe, infant mortality rates in Australasia fell between 1870 and 1950 (Mein Smith, 1997). The decline of infant deaths in the 1890s was universal or, as pointed out by van de Walle (1979), "fast, massive, and irreversible". Compared to the world epidemic rates of infant mortality in the 19th century (other than Sweden), the number of infant deaths in Australia and New Zealand was not nearly as high (Figure 5-1). The favourable position of babies born in Australasia compared to the infant death rates obtained from the "Old World" countries of Europe was recognized as early as the beginning of the 20th century (Mein Smith, 1997).

Figure 5-1.International trends in infant mortality rates per 1,000 live births



Source: Extracted fromMitchell (1998a, 1998b)

NZ series - Annual reports (Various years)

In both Australia and New Zealand the fall in post-neonatal mortality (infant deaths between 1 month and the first birthday) was responsible for a great proportion of the decline in infant mortality between 1870 and at least 1920. In Australia (1900-1945) approximately a third of neonatal deaths were from congenital defects and prematurity (or low birth weight), while the other two-thirds (post neonatal deaths: between 1-12 months) from gut infections (Mein Smith, 1997). Likewise in New Zealand, the number of infant deaths from malformations and diseases of early infancy increased during 1887-1902 (Appendix C, Figure C-1). The reduction in

neonatal deaths between 1872 and 1926 contributed little to the decline in infant mortality (Fraser, 1928), where most of the improvement in infant mortality rates has been attributed to the reduction in infectious and intestinal diseases, predominantly gastric[46]. Further evidence, from the *New Zealand Medical Journal* (1947), indicated that during the period 1901-1905, 41 % of infant deaths were recorded during the first month of life, and 59 % in the subsequent months of the first year, whereas in the 1940s, 73.2 % were recorded in the former, and 26.8% in the latter period. This suggests that the infant mortality decline (1872-1940) was mostly attributed to the reduction of post-neonatal deaths due to a demise from infectious diseases.

The two countries experienced an early reduction in the magnitude of year-to-year variations, which is also indicative of the common "epidemiologic transition"[47] that began in the 1900s, when many infectious diseases (such as diarrhoeal and respiratory) retreated. In the period when post-neonatal mortality dominated, urban-rural disparities were the greatest (Mein Smith, 1997). The existence of an "urban penalty" (a much higher mortality rate in urban than in rural areas) has been widely acknowledged by American and European literature on mortality transitions[48]. Generally, the excess urban mortality diminished from the late 19th century onwards, with the improvement in public and health infrastructures, as well as overall living standards. In Australia, the major metropolitan centres, Sydney and Melborne, had

[46] Please refer to Appendix C, Figure C-1: Infant mortality per 1,000 live births from Principal Causes of Death, 1872-1926

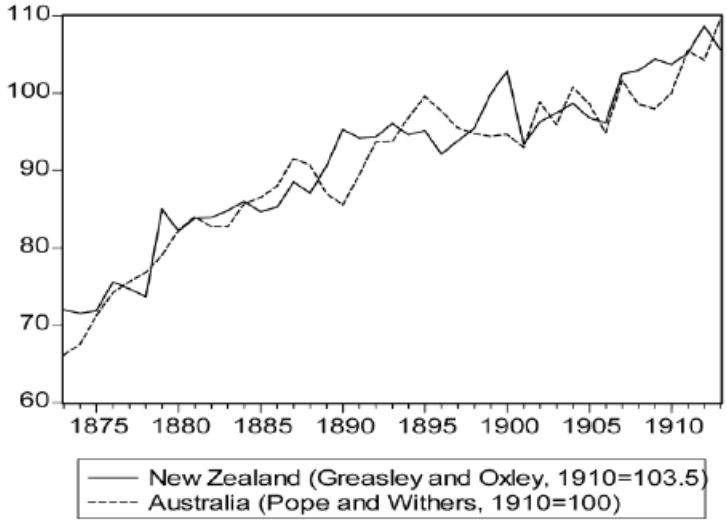
[47] Both Australia and New Zealand (non-Maori and non-aboriginal population) are ascribed to the classical/Western model (Pool, 1994) that describes the gradual, progressive transition from high mortality (above 30 per 1,000 population) and high fertility (above 40 per 1,000) to low mortality (less than 10 per 1,000) and low fertility (less than 20 per 1,000) that accompanied the process of modernization in most western European societies (Omran, 1971). Omran (1971) also pointed out that during the transition, pandemics of infection are gradually displaced by degenerative and man-made diseases as the primary cause of death, and that the earliest changes in patterns of disease and health occur among children and young women.

[48] Mortality transition is often referred to transformations from high to low mortality settings, which is a part of epidemiologic transition.

higher rates of infant mortality compared to other regions between 1880 and 1920, which began to reverse in the 1920s in Sydney and in the 1940s in Melbourne. In New Zealand the urban-rural differential achieved its peak in the 1880s, followed by a subsequent decline. Apparently, the urban infant mortality rate in New Zealand did not completely converge to the rural level during 1878-1921[49].

In terms of socio-economic conditions, the Trans-Tasman labour market was well integrated in the period 1873-1913 (Greasley & Oxley, 2004) where the composite real wage trends move closely as depicted in Figure 5-2. The economic depression and drought in Australia in the 1890s had an impact on real wages and is also associated with the deterioration of infantile health at the time.

Figure 5-2. Composite real wages in New Zealand and Australia, 1873-1913



Source: Extracted from Greasley and Oxley (2004)

In common with the Australian colonies, New Zealand introduced welfare measures at an early stage (e.g. free, compulsory, secular education introduced in 1877) and demographers often point to the importance of these welfare measures (e.g. literacy and education policy) on marital fertility, which has close ties with infant mortality.

[49] I return to this when discussing differences between Australia and New Zealand, please refer to Figure 5-3 and 5-4. Tiong (1988) reported urban-rural infant mortality rates by region for the period 1878-1921 .

Marital fertility also underwent a considerable decline in the 1880s in both New Zealand and Australia, subsequently leading to a further reduction in infant mortality (New Zealand. Statistics New, 2006; Pool & Cheung, 2003). Data for the very early period are somewhat deficient, but marital fertility probably either followed a high level plateau or declined slightly during the period 1860-1880 (Jones, 1971). The shift from mostly rural to urban society, the introduction of compulsory education and various child care practices, the economic depression and the improved survivorship of infants and children are the most commonly identified forces that triggered the fertility decline. Others argue that the empowerment of women is the most compelling argument for the fertility decline in Australia and New Zealand at this time (women in New Zealand gained the right to vote in 1893; in South Australia in 1894 and in the rest of Australia in 1902).

Models for infant welfare schemes in Australia and New Zealand came from England. The infant welfare movement in Australia and New Zealand began in the 1900s and was a part of an international trend. Both in Australia and New Zealand, the key changes in infant mortality took place before the rise of mother craft and nursing institutions (Mein Smith, 1997; Pool et al., 2009; Pool & Cheung, 2005; Pool et al., 2007). For New Zealand, Beaglehole (1988); Pool (1982, 1991b); Skegg (1988) argue that the role of medical technology was relatively small or hardly "played a role of any significance" (Pool & Cheung, 2005) until the 20th century. The activities of Plunket Nurses, founded in 1907 and based in Otago, were particularly directed to more intensive infant care. MacLean (1963) argues that the Plunket Nurses were mainly responsible for the reduction in infant deaths post-1900, by teaching mothers the methods of infant feeding and nurture laid down by Truby King. The *Registration of Births and Deaths Act* of 1908 claimed to have made the Plunket Society services available to practically every mother in the Dominion for babies up to two weeks old (Bryder & Royal New Zealand Plunket, 2003). In Australia, similar nursing societies, visiting nurses and schools for mothers aimed to teach women mother craft and improve conditions into which infants were born (Mein Smith, 1997).

Despite potential similarities between Australia and New Zealand, consistently lower infant mortality rates in New Zealand are indicative of certain New Zealand features that set it apart from other countries including Australia. “The healthy immigrant effect” was an unlikely factor for New Zealand to be healthier than Australia. Newman (1883) explained that while the artificial selection factor could be an issue (e.g. special requirements such as age), assisted migration attracted more capable workers (mostly farm labourers or semi-skilled workers), and its impact was not thought to be strong enough to pass on to future generations. Newman even argued that there could be a selection factor against New Zealand, where people with limited abilities would choose to migrate to New Zealand in search of better health. Alternative arguments against the health immigrant hypothesis are listed as follows. Firstly, the ethnic base of both Australian and NZ immigrants (consisting of English, Welsh, Scots and Irish) was practically identical (Borrie & Australian National University. Demography, 1994; Pool et al., 2007). Secondly, the reciprocal mobility between New Zealand and “Other British Possessions” was dominant during 1861-1900, when 438,000 persons arrived from the UK, Australia and other British colonies, and 377,000 departed to them, leaving a net gain of only 61,000 (Borrie & Australian National University. Demography, 1994; Tremblay & Others, 2005). Thirdly, significantly lower mortality levels in New Zealand during the 19th – mid-20th centuries can not be explained by the fact that New Zealand was a country of the foreign-born, simply because the mortality in the countries of origin was much higher than in New Zealand (New Zealand European life expectancy was one of the highest in the developed world during most of the 19th and 20th centuries). Furthermore, newborns and children benefited the most as they had the chance to enjoy New Zealand’s favourable environmental conditions while growing up. Quite a large imbalance between males and females (the ratio in 1861-70 stood at about 5 males for every female arriving) was similar to the convict period in Eastern Australia (Borrie & Australian National University. Demography, 1994) and if anything, was likely to have a downward bias on the average life expectancy. Thus, selective immigration and late settlement might not to be as important as the relative isolation across New Zealand regions and the isolation of New Zealand itself, which

was associated with long voyages and frequent deaths of migrants even before reaching the coasts of New Zealand.

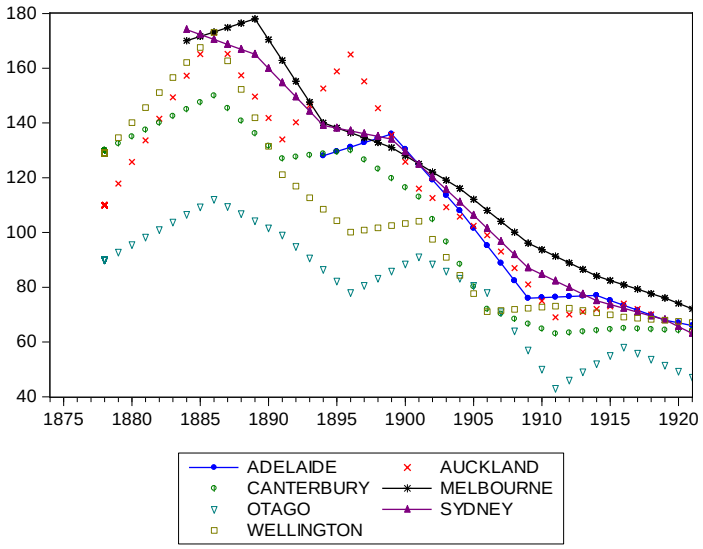
New Zealand has been relatively more rural than Australia (even after the advent of the refrigeration era and increased manufacturing production) and based on the 1891 Census the population in cities over 20,000 was approximately 28.4 % in New Zealand, while in Australia it was 40%. Similar patterns existed for cities over 10,000 (C. Gibson, 1973). In most developed countries, the 19th century urban environment was largely not suited to infants (lack of sanitation, higher population density). Earlier, I discussed the existence of "urban penalty" in both New Zealand and Australia and the spread of disease (especially diarrhoeal and respiratory for infants) was generally more frequent in urban than rural regions. Diarrhoea was probably the deadliest for infants and in Australia, where 75% of the total deaths of infants (in Victoria and New South Wales) during 1882-1901 were attributed to diarrhoeal type diseases (Mein Smith, 1997); in New Zealand the percentage was smaller and comprised approximately 20-22 % (Fraser, 1928). New Zealand's milder climate and the absence of the summer maximum (hot summer weather was largely associated with diarrhoea) could have been favourable for the health of the infants (Neale, 1925). Some historical (R. Lee, 1981; Neale, 1925) and more recent medical literature (Davie, Baker, Hales, & Carlin, 2007)[50] presents related evidence on the effect of summer and winter temperatures on the disease incidence.

Figures 5-3 and 5-4 display New Zealand and Australian metropolitan and non-metropolitan infant mortality rates. Clearly, urban mortality rates in Canterbury, Wellington and Dunedin were lower than those in Sydney, Adelaide and Melbourne. The dynamic of Auckland's urban infant mortality was slightly different (sharp increase in the mid-1890s), and overall moved more closely with Australian urban rates. Non-urban infant mortality rates in New Zealand were universally lower than

[50] Davie et. al. (2007) found that for the period 1980-2000 winter mortality rates, mostly responsible for deaths from circulatory and respiratory diseases, were 18% higher than expected from non-winter rates.

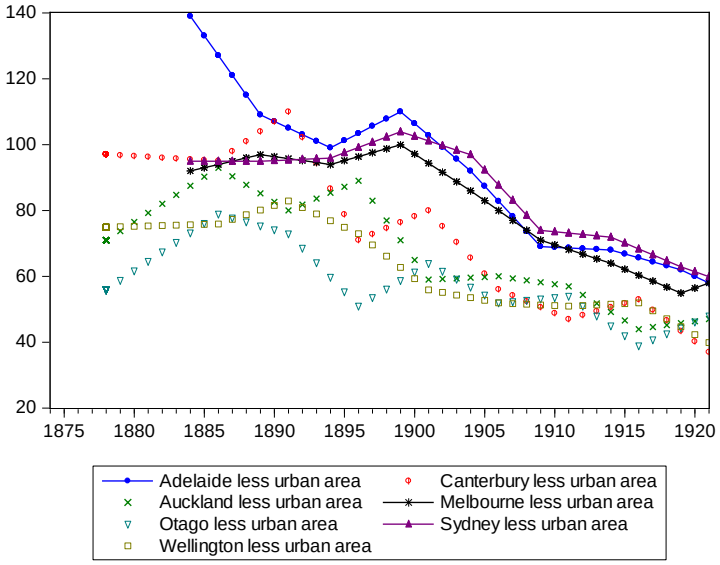
in Australia and it is also notable that infant mortality rates in both rural and urban areas experienced a greater dispersion among the New Zealand cities than the Australian. The differential in urban infant mortality between Australia and New Zealand significantly diminished by 1920, while the gap in non-urban infant rates persisted throughout 1878-1920 (C. Gibson, 1973). Thus, other factors, apart from the disease environment, such as better diet or nutrition might be attributed to better health outcomes in rural New Zealand.

Figure 5-3. Urban infant mortality in Australia and New Zealand



Source: New Zealand data series derived from Tiong (1988)
Australian series extracted from Smith and Frost (1994)

Figure 5-4. Non-metropolitan (rural and small towns) infant mortality in Australia and New Zealand



Source: New Zealand data series derived from Tiong (1988)
Australian series extracted from Smith and Frost (1994)

There is no direct empirical evidence for a greater protein consumption in New Zealand relative to Australia. Speculation by historians and medical scientists with regards to better diets in the colony do exist. For instance, Newman specified the abundance of "wholesome food" as a factor contributing to lower death rates in New Zealand: "the cheapness of breadstuff and potatoes and the low price of meat, combined with general prosperity, give to all abundance of good wholesome food." Moreover, New Zealand was mostly rural, and the type of migrants that were attracted and assisted to come to New Zealand were farm workers and labourers (G. R. Hawke, 1985).

The discussion above highlights the assumption that New Zealand was somewhat "healthier" during most of the 19th century than its close comparators (Australia, for instance). It is therefore possible, as Pool and Cheung (2005) argue, that: "...the mortality history of Pakeha New Zealand in the late 19th and early 20th centuries could be seen simply as documenting another exception to epidemiological transition (Caselli, Mesle, & Vallin, 2002), or it could raise more fundamental theoretical questions." While at the aggregate level, the dynamics of mortality rates is well recognized, disaggregate analysis by major Province is mostly un-researched.

Whereas some of the difference in regional economies of the North and South would be pre-determined by their historical development guided by geographical and climatic differences, health outcomes are expected to be more varied between urban and rural areas, predominantly during periods of intensive industrialization and urban growth. Sub-national analysis of health indicators is rare for New Zealand historical data. The only publication on regional dynamics by Pool and Tiong (1991) considers sub-national differences in the decline of Pakeha fertility during the period 1876-1901. Their work uses the data derived from an unpublished Master thesis by Tiong (1988)[51], who measured the 19th century non-Maori fertility trends and differentials.

5.3 Provincial Infant mortality

In the previous section, I discussed the pattern of infant mortality decline and its possible causes at the aggregate level. In this section I consider sub-national infant mortality and its convergence across Provinces. Historically, there are four economically important and large Provinces in New Zealand: Auckland, Canterbury, Otago and Wellington. My analysis of the regional inequalities of health outcomes concentrates on these four Provinces[52].

5.3.1 Regional patterns and infectious diseases

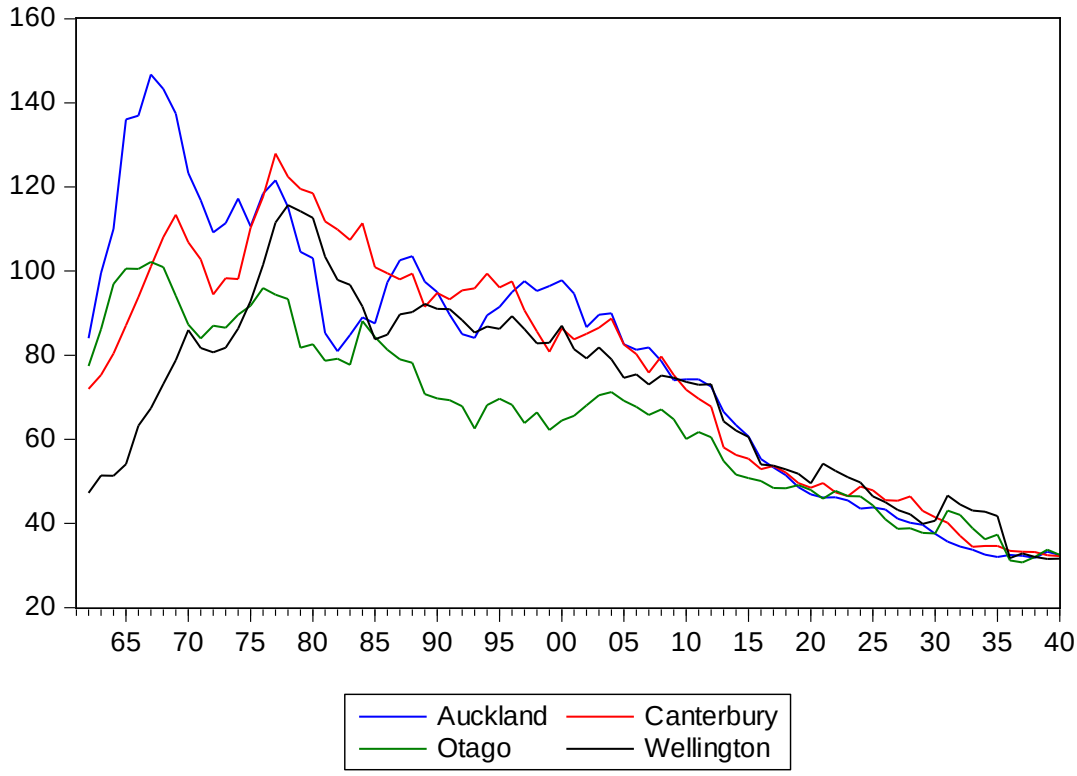
The reduction in infant death and birth rates in New Zealand occurred almost simultaneously. Figure 5-5 depicts smoothed (5 year moving averages (MA)) Provincial trends in infant mortality. Epidemics in the early 1850s and 1870s were the likely outcome of increased rates of immigration that contributed to the faster spread of infectious diseases. During 1861-1865 approximately 85% of the total population increase was due to net migration and only 15 % due to natural increase (Thorns & Sedgwick, 1997). Massive population increases due to migration

[51] Tiong (1988) also briefly presented census statistics data on regional infant and childhood mortality for boroughs and provinces separately.

[52] Please refer to Appendix C, Table C-1 for the more detailed data description.

generally had a negative impact on the disease environment in New Zealand. Epidemics of the 1870s for example, coincided with an increased flow of migrants (initiated by Vogel's scheme) into New Zealand. Certain infectious diseases (such as respiratory and diarrhoeal) particularly targeted infants, while others affected them indirectly. For instance, the 1874-75 measles epidemic was considered likely to affect neonatal mortality as maternal measles was generally associated with an increased risk of premature labour, miscarriage, and low-birth-weight infants. The relatively common increase in infant mortality rates (IMR) could be a composite result from the 1872 smallpox outbreaks in Auckland and Wellington, whooping cough in 1873 and a typhoid epidemic in 1874. I discussed in section 5-2 that the most common causes of infant death were the diseases of early infancy and gastric and intestinal diseases (diarrhoeal diseases) that together contributed to about 50% of all infant deaths (see Appendix C, Figure C-1).

Figure 5-5. Provincial Infant mortality (infant deaths per 1,000 live births), 1862-1940



5.3.2 Convergence across provinces

Infant mortality across Provinces was particularly volatile throughout 1862-75. On average, during 1872-99, Auckland had the highest incidence of both epidemic and

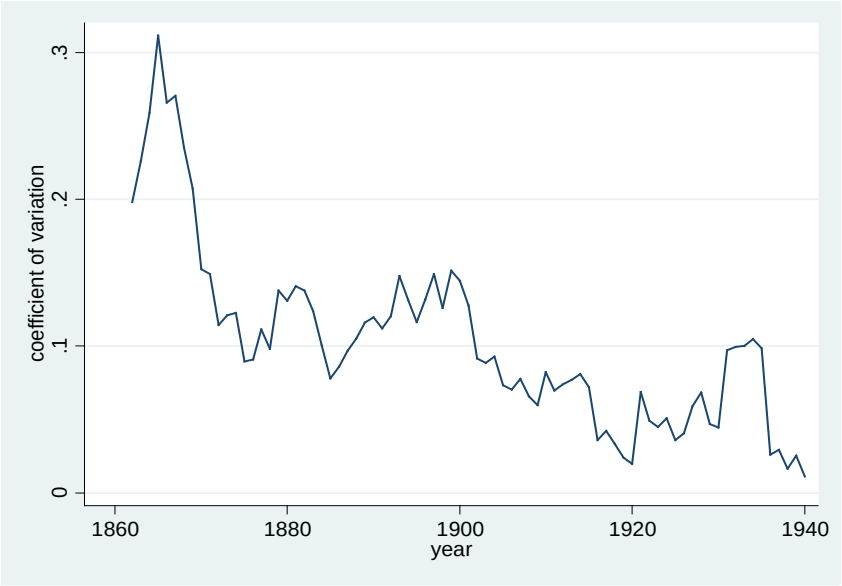
diarrhoeal diseases[53] with Canterbury having the lowest incidence of epidemic diseases, and Otago the lowest number of deaths from diarrhoeal diseases. During 1900-20 both epidemic and diarrhoeal diseases largely retreated in all Provinces. Infant deaths from diarrhoeal disease in Otago remained the lowest even in the 20th century, while the incidence of epidemic diseases remained higher (at Auckland's level).

The steep decline in infant deaths in Auckland in the early 1870s (Figure 5-5) occurred immediately after the epidemics in 1864 (the peak reached 214 infant deaths per 1000 live births) and 1875 (measles epidemic when 147 infants died per 1000 live births). New Zealand regions were quite isolated, especially the Auckland region, as it was not connected to the rest of the North Island by a landline until the main trunk railway was built in 1909[54]. Therefore, the spread of infectious diseases was often contained within a region (Newman, 1882). The infant mortality gap between Otago and other Provinces is particularly noticeable during the period 1880-1900. It appears that the dispersion in infant mortality across Provinces was particularly high in the 1860s (Figure 5-6). The coefficient of variation (based on the four Provincial series) shows a significant decrease in the series dispersion in the 1870s, followed by cyclical increases in the 1880s, 1890s, and 1930s (Figure 5-6). Notably, in Chapter 4, it was identified that in the late 1870s-early 1880s and 1890s there was a rise in the earnings inequality as well as substantial increases in the unemployment level.

[53] Please refer to the Appendix C, Table C-2 and Table C-3 (descriptive statistics for the cause-specific infant deaths for two periods: 1872-1899 and 1900-1920)

[54] The railway construction began in South Island (Canterbury and Southland). "The route network began as a series of short lines radiating from each major city and remained fragmented for a long time. Christchurch, Dunedin, and Invercargill were connected in 1879; Wellington and New Plymouth in 1885; Wellington and Napier in 1891 and Wellington and Auckland in 1909." (Bloomfield, 1984)

Figure 5-6. The coefficient of variation among the four Provincial infant series



Infant rates only seem to converge by the mid-1900s (see Figure 5-6 and Table 5-1), where Provincial infant mortality rates were all highly correlated (1900-40) relative to the 1861-99 period. In Chapters 3 and 4, I identified that New Zealand commodity and labour markets also became better integrated by 1900.

Table 5-1. Pearson's correlations: provincial infant mortality rates

Period	Auckland	Canterbury	Otago	Wellington
1861-99				
Auckland	1.00			
Canterbury	0.25	1.00		
Otago	0.56**	0.39**	1.00	
Wellington	0.01	0.57**	-0.08	1.00
1900-40				
Auckland	1.00			
Canterbury	0.90**	1.00		
Otago	0.79**	0.82**		
Wellington	0.82**	0.85**	0.86**	1.00

*,** significant at 10 and 5% levels respectively

The above analysis shows that there were some persistent regional differences that existed prior to 1900. Variation in the living standards, climate, urbanization,

education of women etc. could be responsible for the difference in infants' health outcomes, which I explore further in the next sections.

5.4 Infant mortality and its determinants

At the aggregate level, I presented a New Zealand specific socio-economic and health environment that set it apart from Australia. Separating factors included: a more favourable climate, lower level of urbanization (less crowded living), the geographic isolation of regions, the absence of nation-wide epidemics (apart from the 1918 influenza) and general prosperity. Others such as the empowerment of women (the right to vote, female education), fertility transition and infant health care were not identified as unique to New Zealand, at least for the period when the key changes in infant mortality took place. In this section, I examine some of the determinants at the disaggregate level, and establish whether any of them varied by Province.

5.4.1 Diarrhoeal diseases and climate

In Sections 5-1 and 5-2, I briefly outlined the importance of climate and its effects on infant mortality. In other countries, the direct effect of harsh weather conditions has been shown to have an impact on mortality changes/epidemiological changes (e.g. pre-industrial England and Europe). Lee (1981), for example, examined the relationship between short-run variations in weather and mortality fluctuations in England, and found that the temperature in winter and early spring had a strong negative effect on mortality, showing that colder weather was associated with higher mortality. Summer temperature had a strong positive effect on mortality. France is another example, where the main causes of infant deaths in cities until the 1930s were diarrhoeal diseases, which tended to be exacerbated during hot summer months. In New Zealand, according to Neale (1925), during 1920-1930, among the four most populous Provinces – Auckland, Wellington, Canterbury and Otago, the infant mortality from diarrhoea and enteritis increased regularly from the colder south to the warmer north. On average, deaths from diarrhoeal diseases were higher in the North (Auckland and Wellington) than in the South (Canterbury and Otago) during 1872-1920 (see Appendix C, Table C-2 and Table C-3).

Figure 5-7 presents the annual changes of average summer temperature and infant mortality from diarrhoeal diseases. Infant mortality fluctuations are much higher, generally coinciding with milder fluctuations of summer temperatures. It can be observed from Figure 5-8 and 5-9 that changes in the average summer temperature are positively correlated with changes in diarrhoeal disease incidence, while the exact opposite is true for the winter temperatures. Otago's lower incidence of diarrhoeal diseases could also be partly attributed to its cooler climate (See Appendix C, Table C-4 for the descriptive statistics). It would be preferable to analyse the relationship between diarrhoeal disease incidence and summer temperatures using all Provinces, however data on diarrhoeal diseases is of limited use for other (peripheral) Provinces. Peripheral Provinces were mainly rural, and the incidence of diseases was much smaller and not consistently reported.

Figure 5-7. Differenced summer temperatures and the incidence of diarrhoeal diseases

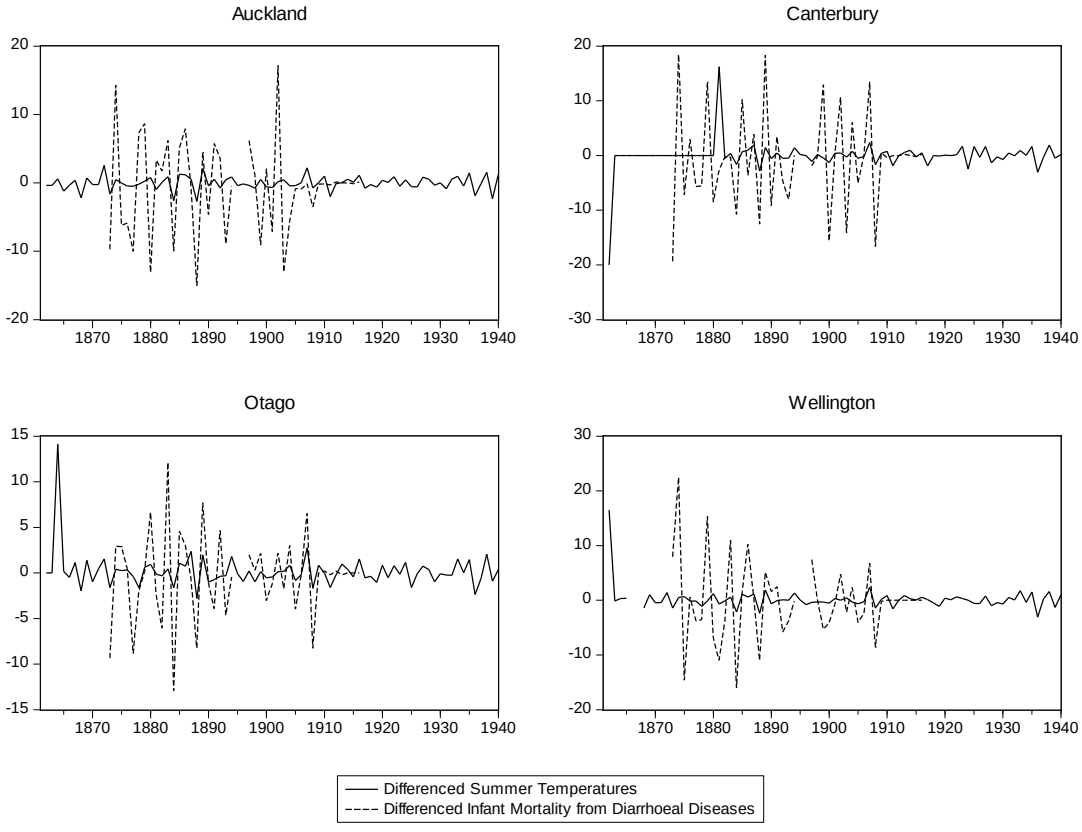


Figure 5-8. Changes in summer temperature on changes in diarrhoeal disease incidence, 1873-1916

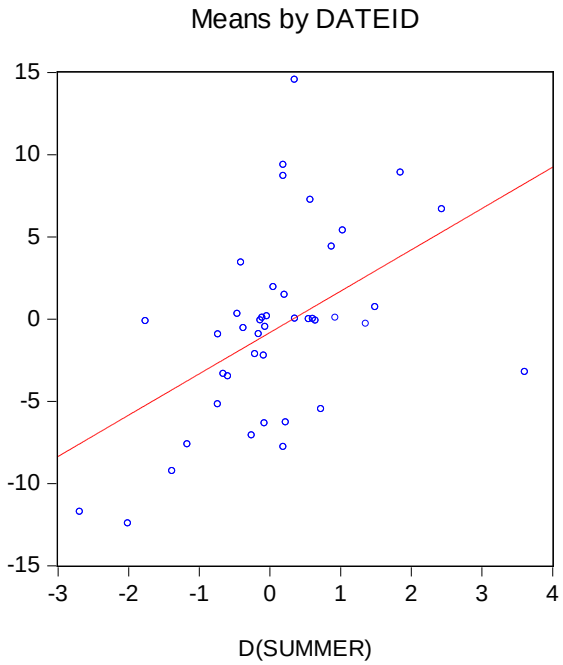
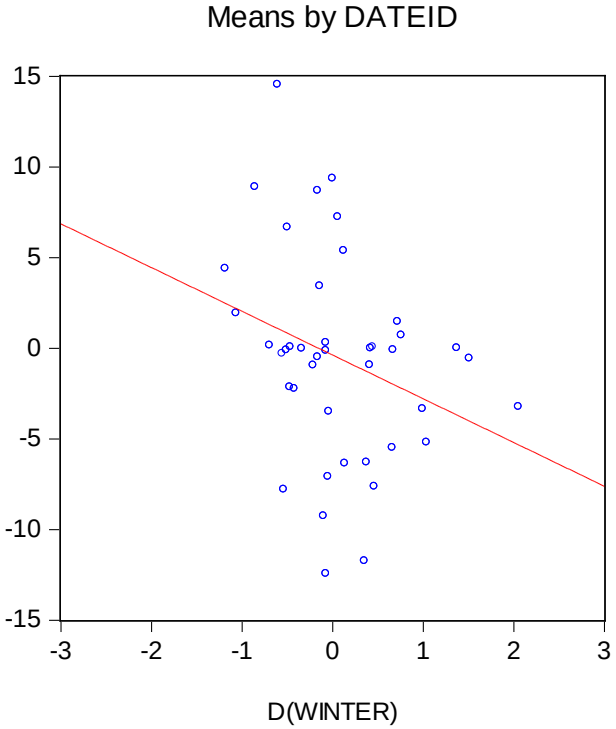


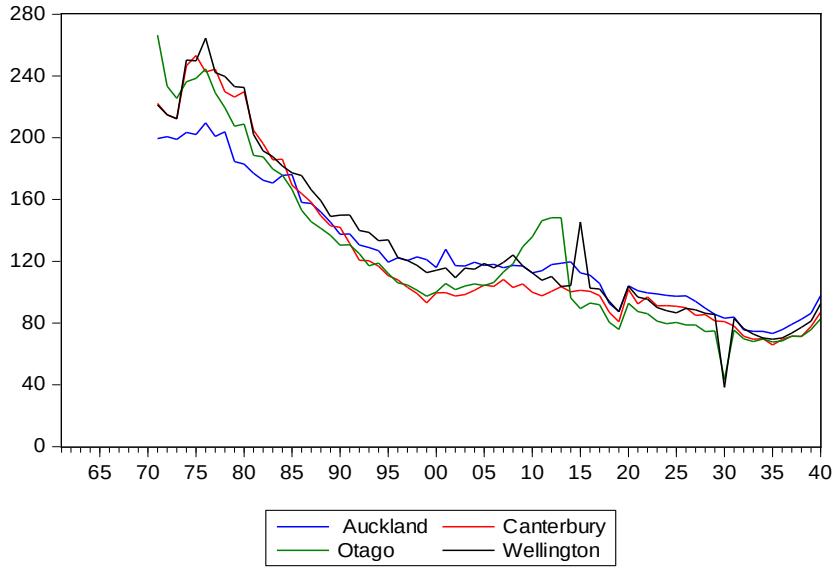
Figure 5-9. Changes in winter temperature on changes in diarrhoeal disease incidence, 1873-1916



5.4.2 Infant mortality and demographic determinants

Very high fertility[55] was one of the factors, apart from infectious diseases, which was directly associated with the heightened infant mortality (Pool & Cheung, 2003; van de Walle, 1979; Woods et al., 1989). The crude birth rate was extremely high during the early decades of systematic colonization from 1861 (38.5 per 1,000 live births) through to 1889 (30 per 1,000). These factors gave New Zealand one of the highest fertility rates of any industrialized country over this period (Cameron, 1985). Prior to 1878 there were, on average, 6 births per married woman, which subsequently declined to 2.4 by 1900 and reached a low point in the 1930s during the economic depression (Pool et al., 2007). Figure 5-10 shows that fertility trends move much closer together than infant mortality trends. It is interesting that fertility in Auckland was slightly lower compared to elsewhere in New Zealand (the decline in infant mortality was the most dramatic in Auckland) and from Figure 5-10, it is evident that the Provincial variations in fertility did not appear to exist to the same extent as was the case for infant mortality.

Figure 5-10. General fertility rate (number of registered births over the number of women of child-bearing age per 1,000)

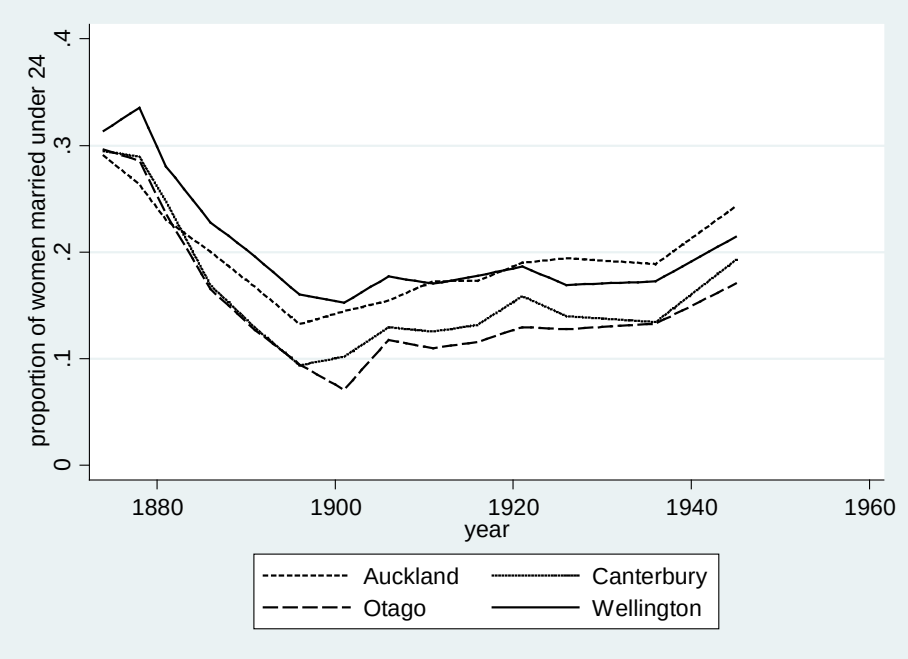


[55] In this chapter I refer to General Fertility Rate (GFR) when I refer to fertility, which is computed as the ratio of the number of registered births (every year) over the number of women of child-bearing age (15-44) every census year multiplied by 1,000

Fertility and infant mortality can be both considered as outcomes of various socio-economic and socio-cultural conditions. Pool and Tiong (1991), in their paper on sub-national fertility trends, presented an analytical framework of a fertility change mechanism, where they identified that almost two-thirds of the fertility transition was attributed to the shifts in patterns of nuptiality, with the underlying rational of this mechanism being a change in the values of women and couples. The channel of causation was described as follows: infant mortality is affected by changes in fertility driven by changes in the patterns of nuptiality, which is the outcome of socio-economic changes. Figure 5-11 shows a steady decline in the proportion of married women aged 16-24 (calculated as the proportion of married women to the total number of women in each respective age group) in the 1880s, which also coincided with the decline in fertility. During the time of depression in the 1880s, the rates of early marriage began to fall drastically for all Provinces, with marriage rates in Canterbury and Otago decreasing the most of the four Provinces (between 1880 and 1900 the proportion of women married under the age of 24 declined from 0.3 to less than 0.1). It appears that the number of females in the labour force also more than doubled between 1886 and 1901, while the economically active male population only increased by 45% (Thorns & Sedgwick, 1997). The more important role of females in the labour force and an increase in the age at first marriage (an increasingly lower proportion of women married under 24) was not uncommon for countries in the early stages of industrialization[56]. The changed social position and gender identity of women clearly influenced the mean age at first marriage during the second half of the 19th century (Matthijs, 2002).

[56] The concept of the "European marriage pattern" was introduced by Hajnal in 1965 (Hajinal, 1965) and refers to two basic characteristics: high age at first marriage and a large proportion of people remaining unmarried (Moreels & Matthijs, 2009).

Figure 5-11. Proportion of women married under 24 years of age



5.4.3 Female education

Fertility decline in New Zealand and elsewhere, is generally attributed to increased child costs and the requirement that children go to school. Female education is one variable that can directly impact on both the mother's skills of infant care through increased awareness and knowledge, and decisions regarding marriage and having children. Before the abolition of the Provinces, each of the Provincial governments made some provision for primary education in its district, although it varied greatly in character and efficiency across Provinces (Irvine, 1902). Enrolment statistics in primary and secondary schools were published in the Annual reports (Various years), but the wider Census-based data was not collected until much later in the 20th century. It is clear from Figure 5-12 that in 1861 female enrolment (proportion of females enrolled in the total population of girls) was higher in Otago (82%) and Canterbury (76%) and lower in Auckland (71%) and Wellington (69%). These Provincial differences largely dissipated by 1877, when free, compulsory primary education was introduced in New Zealand, with attendance being compulsory between the ages of 7 and 13.

The ratio of female to male students is an indicator of inequality in education, but also is a proxy for the increasing role of women and their empowerment. In 1873 the

proportion of females enrolled in primary schools constituted at least 70% that of boys in Auckland and Wellington, and was even higher in Canterbury and Otago (around 80%) (Figure 5-13). By 1880 the primary school attendance of girls practically matched that of boys. A common fall in girls' attendance is marked for the 1930s where the ratio fell during the economic depression, mainly due to the increased number of boys attending boys' schools, and the shortage of teacher's colleges for girls to attend. The data on secondary education was limited and not consistent. Before 1900, the number of children receiving a secondary education was not large, especially in rural areas, where there were only a few local secondary schools (Ash, 1990).

Figure 5-12. Female primary education participation rates, 1861-1916

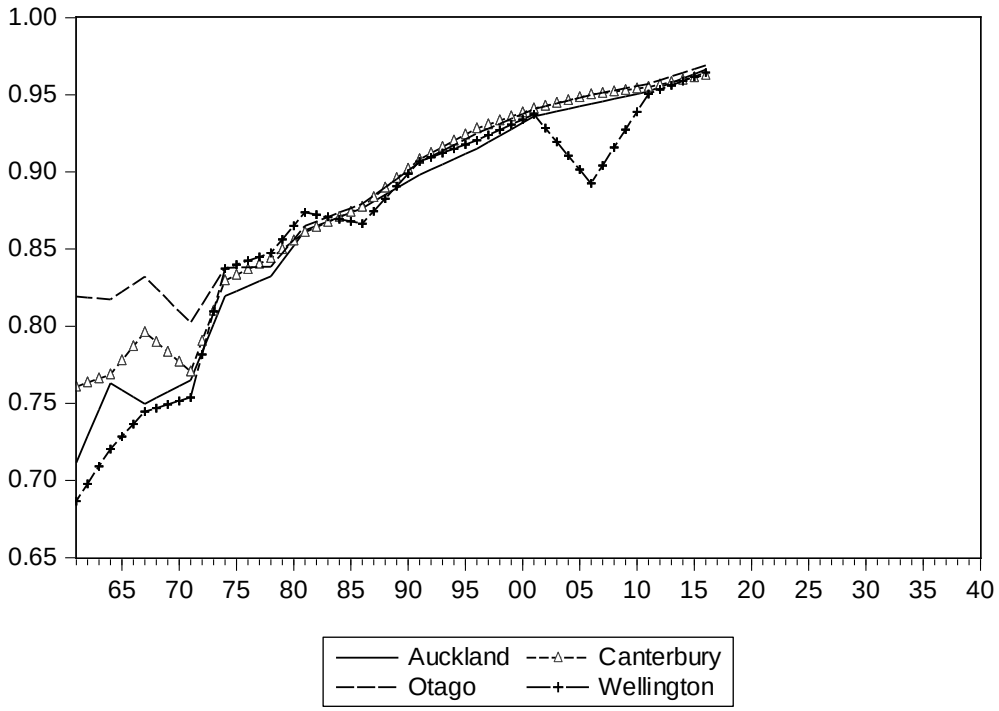
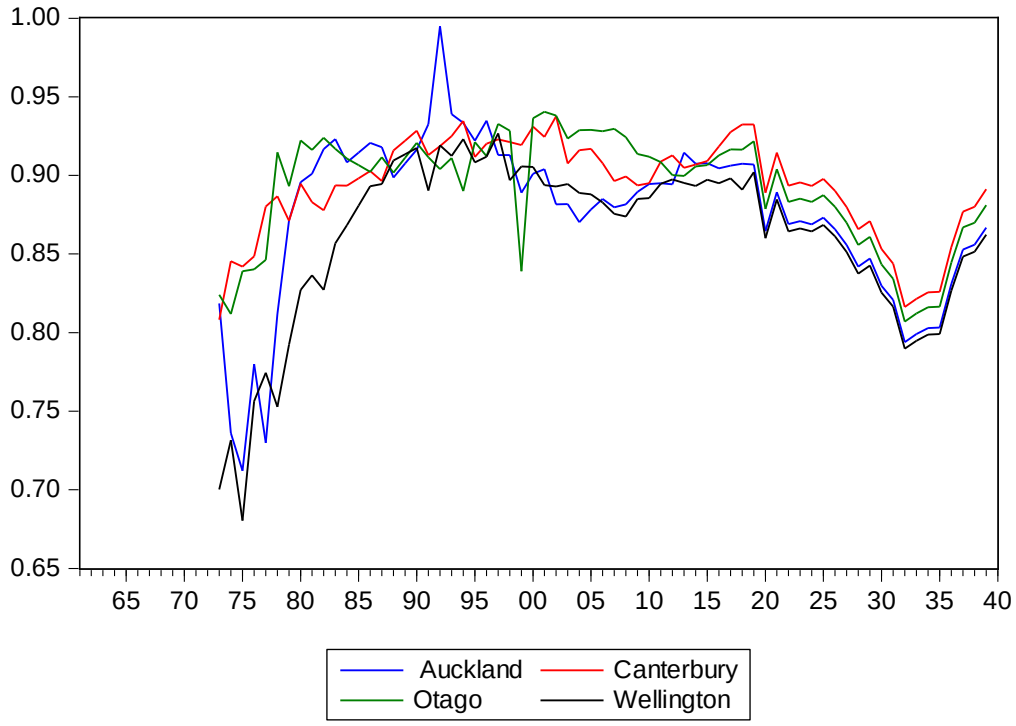


Figure 5-13. Female-male enrolment ratio, 1873-1940



Source: Statistics New Zealand Annual Publications, 1873-1940

The above analysis clearly suggests that the literacy rates for females improved absolutely and relatively to the rates for males after primary education was made compulsory. Two Provincial trends arise: Canterbury-Otago, characterized by a higher starting point and a gradual increase in the enrolment ratio, and Auckland-Wellington, which underwent a more rapid increase in the ratio from a lower starting point.

5.4.4 Infant mortality and Provincial real wages

Income plays a fundamentally important role in determining health outcomes. Hypothetically, rising living standards should reduce mortality, at the same time the pattern may be complicated. For instance, the 19th century Norwegian results did not identify a straightforward and robust correlation between economic resources and infant mortality (Edvinsson & Others, 2008). It is often the case, historically, that economic data, for example real wages, is not readily available in a consistent form or does not exist at all during the early years of development. However, in New

Zealand, it was possible to compile an annual wage series that is consistently measured (at least from 1873) and can be constructed for each of the four major Provincial districts using the regional deflator series derived in Chapter 2[57]. Chapters 3 and 4 were devoted to the discussion of Provincial prices and real wages. with a number of limitations pertinent to the derived real wage series being identified. The composite real wages presented here did not account for unemployment in each respective Province as there was no reliable information on New Zealand's unemployment figures, apart from the number of unemployed assisted by the *Bureau of Industries* and the unemployment of New Zealand carpenters (only available at the national level). Seasonal and semi-permanent workers seemed to be also under-represented in the published labour force figures (Robert James Campbell, 1976).

In section 5-2, I reviewed the aggregate trends of composite real wages in relation to Australia. It appears that the economic conditions were generally favourable for New Zealand, especially with the introduction of refrigeration. Post-Settler New Zealand was always an exporter of primary products and, because of this, the "long depression" from the late 1870s to the early 1890s did not seem to hit the economy as hard as was the case in Europe. For example, English prices at the beginning of the 1890-1899 decade, declined more rapidly than in New Zealand and, given that food comprised a relatively large proportion of the New Zealand deflator series, real wages increased. Provincial data enabled me to consider whether there were significant differences in real wages across provinces and whether they had any discernible effect on the observed infant mortality.

In Section 5.3.2, it was identified that regional inequalities in infant mortality rates were increasing in the 1870s, 1890s, and 1930s. In an earlier chapter on prices and real wages, it was also recognized that, in the late 1870s-early 1880s and 1890s, there was a rise in earnings inequality and a substantial increase in the unemployment level (Chapter 4). Compared to the demographic determinants, where there has been little regional variation observed, the regional volatility in real wages

[57] Please refer to the Appendix B for details on the construction of composite Provincial real wages and Table B-7 for the data.

closely approximated regional differences in infant mortality. Moreover, the observed convergence across regional labour and commodity markets post-1900 also coincided with the convergence of Provincial infant mortality trends (Section 5.3.2).

It is evident from Figure 5-14 that, for the most period, real wages trended upwards while infant mortality was falling. On average, higher real wages corresponded to lower infant mortality rates, both in the series levels and differences (Figures 5-15 and 5-16).

Figure 5-14. Provincial means 5-year moving averages infant mortality and real wages, 1873-1940

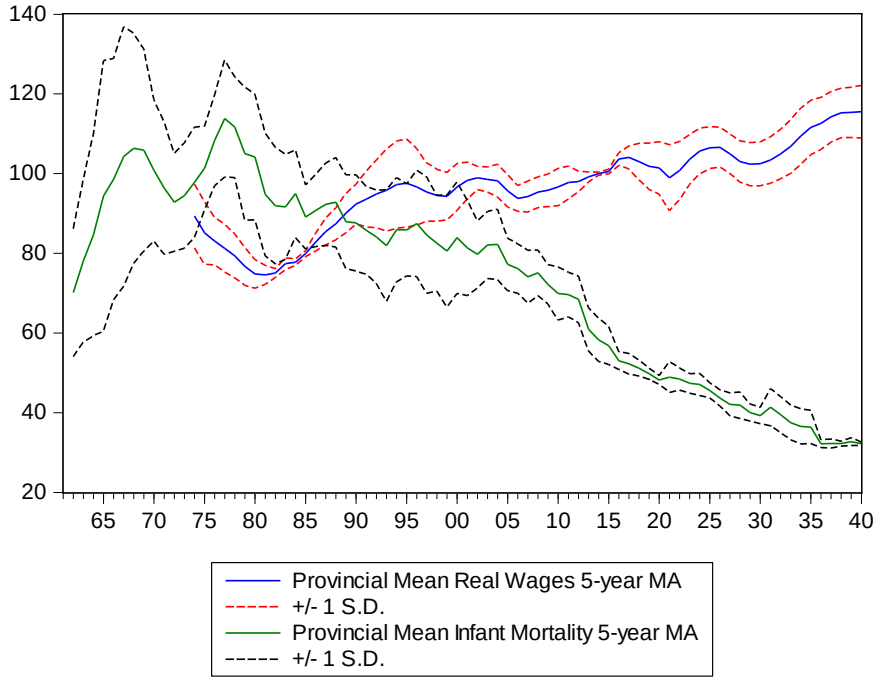


Figure 5-15. Scatterplot of the relationship between infant mortality and real wages (in levels), 1873-1940

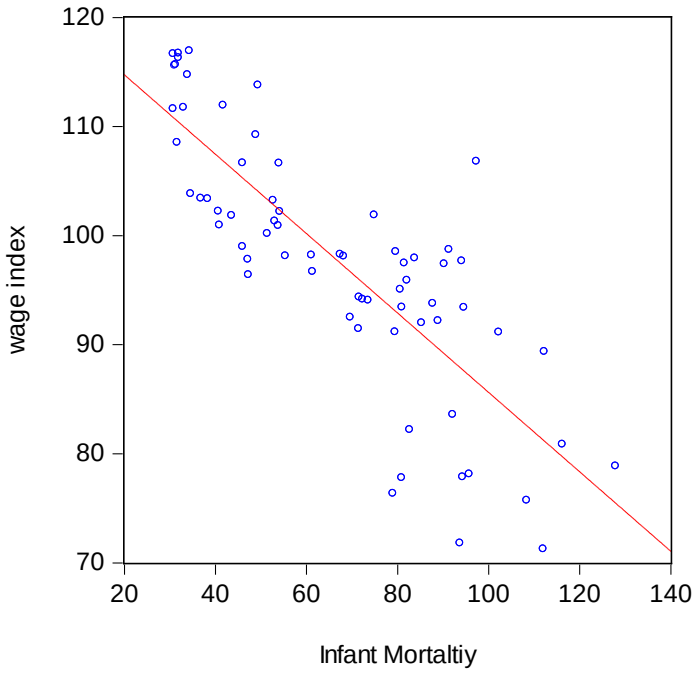
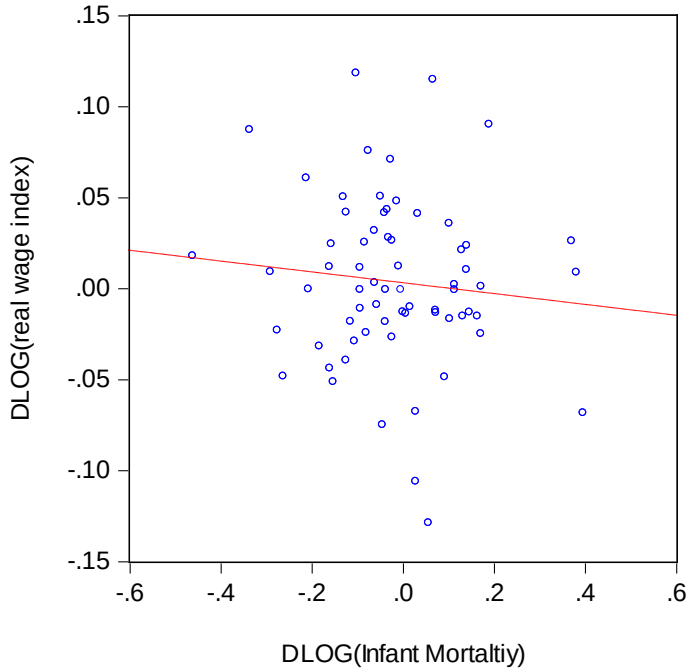


Figure 5-16. Scatterplot of the relationship between infant mortality and real wages (in first differences), 1873-1940



5.4.5 Urbanization, urban mortality and expenditure on public works

Unlike the more direct socio-economic measures, such as real incomes or female education, urbanization and public works set the underlying conditions into which infants are born. The urban environment not only played a crucial role in determining these conditions, but also provided greater opportunities for women, thereby affecting their decisions regarding marriage and family formation.

The "peasant" or "rural-labourer" farming family structure had largely disappeared in New Zealand by the 20th century (Pool et al., 2007). Even by the end of the 19th century, despite the image of pastoral democracy and dependence on primary exports, New Zealand was an urbanized society (Pool & Bedford, 1997). New Zealand urbanized quite rapidly during the period 1860-1940, where the urbanization percentage jumped from 20% to 55-60 %.[58] Urbanization (urban population as a percentage of the overall population) in New Zealand was the slowest in times of economic depression, most notably in the late 1880s and the early 1890s and again during the late 1920s and early 1930s (Figure 5-17 a).

Perhaps the more interesting measure that has a direct impact on the early-life conditions is population density. Descriptive statistics demonstrate that both the urban proportion and persons per dwelling (the measure of population density, see Appendix C, Table C-1) were the highest in Wellington during the 1870-1920 period (Table 5-2). Generally, over time there was more variation in urban proportion than persons per dwelling and Figure 5-17 (a) shows that between 1861 and 1894, the four main Provinces were not urbanizing at the same rate. It seems that the urban proportion was actually falling in Auckland (until 1882) and Otago and Canterbury (until 1894), whereas the urban proportion in Wellington was relatively constant, apart from increases in 1910 and 1925. It is interesting to note that from 1894 persons per dwelling was increasing in Auckland, but falling in Canterbury and

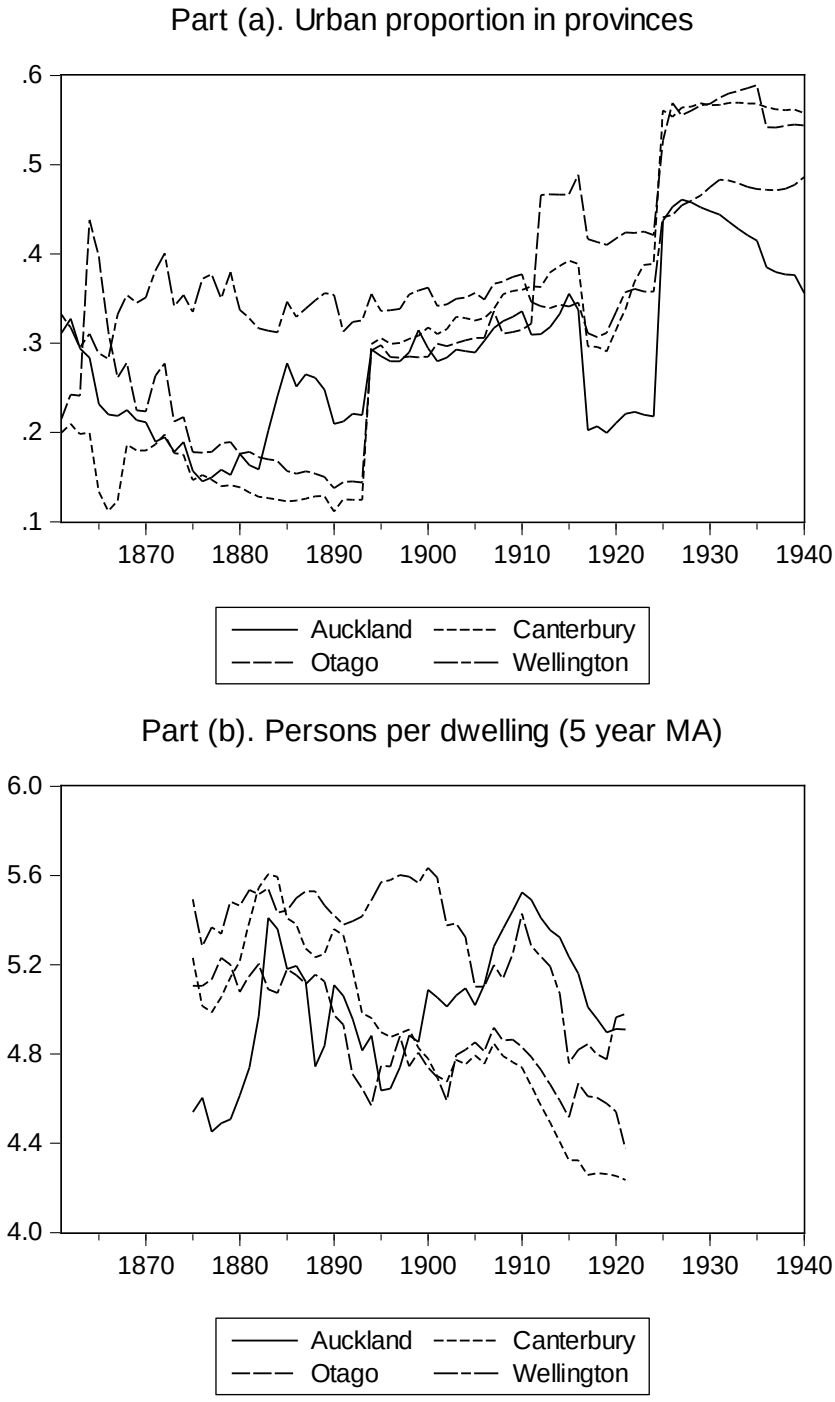
[58] An increase in the urban proportion in New Zealand up to 1901 partly due to reclassification (central city boroughs included additional suburban boroughs): from 1861 to 1901 the number of places with populations of 1,000 or increased from 8 to 52 (the combined effect of differential natural increase and migration was negligible) (C. Gibson, 1973).

Otago (Figure 5-17b), while urban proportion equalized across Provinces around the same time. It appears that although the proportion of urbanized population in each Province rose to Wellington's level in 1894 and post 1900, dwelling density was decreasing across all Provinces. However, there was a clear differential between the North and South island Provinces (Figure 5-17b).

Table 5-2. Descriptive statistics: Urban proportion in provinces and persons per dwelling in the main boroughs (1870-1920)

Variable	mean	se(mean)	sd	min	max	cv
			Auckland			
Urban Proportion	0.25	0.01	0.06	0.15	0.36	0.25
Persons per dwelling	5.02	0.07	0.48	4.15	6.81	0.10
			Canterbury			
Urban Proportion	0.24	0.01	0.10	0.11	0.39	0.42
Persons per dwelling	4.87	0.07	0.48	4.02	5.69	0.10
			Otago			
Urban Proportion	0.27	0.01	0.10	0.14	0.49	0.38
Persons per dwelling	4.84	0.05	0.36	4.15	5.52	0.08
			Wellington			
Urban Proportion	0.35	0.00	0.02	0.31	0.40	0.06
Persons per dwelling	5.31	0.05	0.36	4.20	6.06	0.07

Figure 5-17. Urban Proportion and dwelling density by province



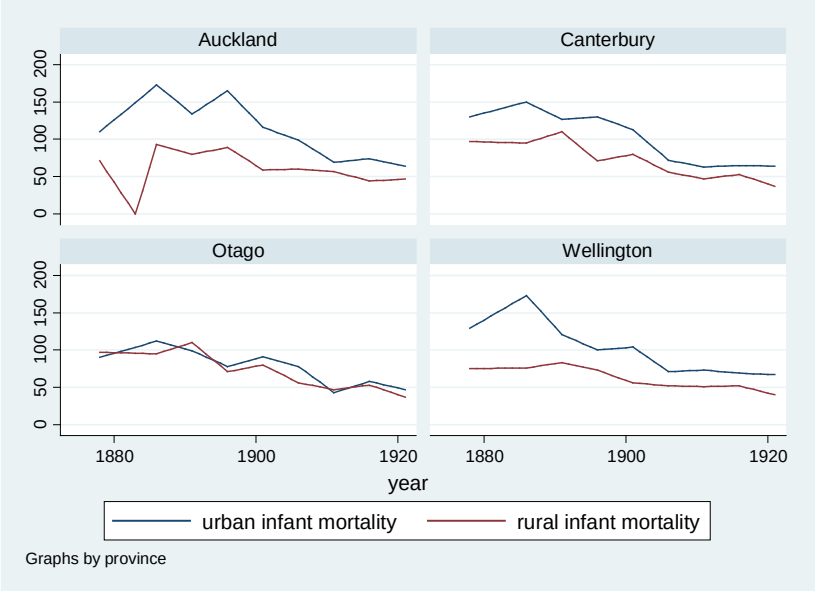
A low population density in the cities, coupled with detached or semi-detached dwellings in New Zealand, represented a completely different picture to that found in the large European cities (Pool et al., 2007), which represented places where the spread of disease was rife and the incidence of diarrhoeal diseases was frequent. Despite this, urban-rural differences in infant mortality did exist in New Zealand

until approximately 1920. The negative effect of urbanization on health (infant mortality) is often referred to in the literature as an "urban penalty" or the price one may have to pay for an opportunity to earn higher wages in the city, basically implying a much higher mortality rate in urban than in rural areas. Generally, the excess urban mortality diminished from the late 19th century onwards, with the improvement in diet, public health measures and overall living standards. The sustained US decline in mortality, which commenced in the early 1870s, was greatly enhanced by the construction of waterworks and sewers and other public health measures (Haines & Steckel, 2000).

In New Zealand, the urban penalty existed at least during the period 1878-1920 (Figure 5-18).Urban infant mortality rates validated the advantageously lower infant mortality in Otago and its early decline, but did not hold for other Provinces. Urban-rural differentials began to diminish in the mid-1900s, but did not reach full convergence to rural rates until 1920[59]. Earlier, it has been noted that Otago had the lowest incidence of diarrhoeal diseases among the four Provinces throughout 1872-1940 (see Appendix C, Table C-2 and Table C-3). Most of the decline between 1872 and 1920 was due to a decline in gut and intestinal infections (established at the aggregate level), thus affecting post neonatal deaths. As argued by many (e.g., Bryder, 2003; Maclean, 1963) the Plunket Nurses played an important role in providing care for infants and teaching mothers the methods of infant feeding. The Karitane hospital opened in Dunedin for the treatment of sick and malnourished infants, and as a training school for Plunket Nurses (Bryder & Royal New Zealand Plunket, 2003). The net Provincial population outflow in Otago, beginning with 1886, could have also set it apart from other Provinces (Appendix A, Table A-4 presents annual rates of net interprovincial migration during 1886-1911). Higher urban mortality in Auckland and Wellington could also be related to overcrowding in the cities, where dwelling density was higher than in Canterbury and Otago from the mid-1890s.

[59] The urban-rural infant mortality figures published by Tiong (1988) are only available for the 1878-1920 period.

Figure 5-18. Urban vs. Rural Provincial Infant Mortality Rates, 1878-1920



Source: Extracted from Tiong (1988)

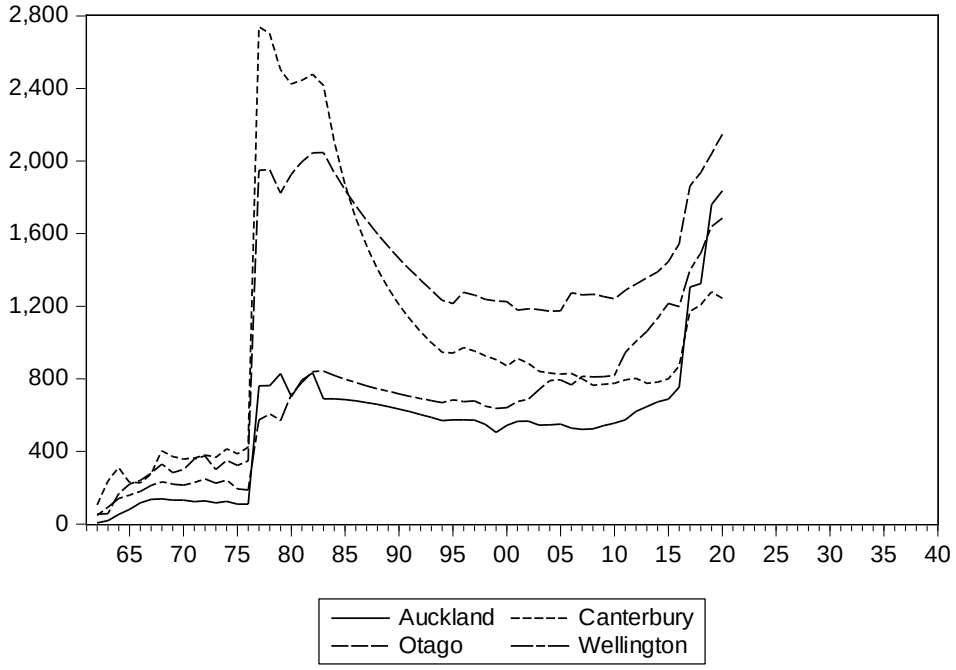
Improvements in infrastructure, initiated by greater per capita real public works expenditure, led to the creation of sewerage and water works systems. Sewerage systems were completed in Dunedin in 1908, Wellington in 1899, and Auckland in 1914. Christchurch's system was the first to be completed in 1882, but a high-pressure city-wide water supply only arrived there in 1909 (New Zealand. Ministry for Culture & Heritage, 2003). Unfortunately, the data on various kinds of public works only became available after 1914, which limits any further analysis on the relative contribution of sewerage, water works, and roads expenditure in different Provinces. In Chapter 4 (Figure 4-10), it was demonstrated that public works expenditure per person in each respective borough was on the rise in the 1870s. Between 1880-94 there was a massive decline in the funds available for financing public works in the Provinces, which did not begin to increase until 1900.

The cumulative measure of public works expenditure[60] also shows that infrastructure development was booming in the second half of the 1870s through to 1885, followed

[60] Hypothetically, building infrastructure, once in place, only requires funding for maintenance. Since, the public works expenditure here includes construction of buildings, waterworks, sewerage systems, road maintenance etc., I assumed the average depreciation rate of 20%, which is probably too high. However, it is unclear what the

by a substantial decrease (Figure 5-19). Only in 1915 did expenditure on public works start to return to the pre-depression levels. The accumulated expenditure was highest in Canterbury and Otago throughout the whole period, but particularly apparent between 1875 and 1885, which was also consistent with the largest number of persons employed in the building sector in those Provinces (Chapter 4, Section 4.2.2).

Figure 5-19. Cumulative public works expenditure (real values in shillings) 1873-1920



5.5 Estimated model and results

In the previous section, I reviewed the socio-economic correlates of infant mortality in New Zealand. To explore the underlying effects of socio-economic variables on infant mortality, I utilized the existing data from the four Provincial districts in a panel setting. As discussed above, the model expresses infant mortality as a function of annual summer temperature (changes in the average annual summer temperature), fertility (changes in GFR), female education (proportion of females relative to males enrolled in primary education), real wages (standards of living), cumulative

relative contribution of various public works projects (management, tramways, slaughterhouses, lightning, waterworks, drainage, streets, footways, bridges etc.) was to the total expenditure.

expenditure on boroughs' infrastructure (changes in real public works expenditure in per capita terms), and dwelling density (persons per dwelling)[61]. Since the structure of a panel data implies large T (time) and relatively small N (number of Provinces), the time-series properties of the data needed to be considered. I tested separate time-series for stationarity in the panel setting[62].

In this section, to quantify and test some of the hypothesized relationships between infant mortality and New Zealand's socio-economic and urban environment empirically, I present the results from a panel fixed effects regression model. Since for this sample T>N (number of time series observations is greater than the number of panels) or 46>4, I utilized cross-section fixed effects (established by information criteria tests) and GLS weights (cross-section SUR) to estimate cross-sectional parameters. The estimation also included the White cross-section coefficient covariance method to achieve more reliable hypothesis testing.

Table 5-3 presents the panel results, where infant mortality is the dependent variable. I estimated two specifications: one that includes lagged values of infant mortality and one that does not. The dependent variable (infant mortality) follows a first order autoregressive process (based on the auto and partial correlation functions), including the lagged term will thus pick up the first order serial correlation. The lagged term can also serve as an additional proxy for missing or omitted variables and allow explanatory variables to have effects that extend beyond the current period.

[61] Please refer to the Appendix C, Table C-1 for the sources and data coverage.

[62] Except for fertility and accumulated public works, all other variables are stationary or trend stationary, see Appendix C, Table C-5 for results. Basically, a stationary series never wanders far away from its mean or trend (if trend-stationary), the effects of shocks/errors decay over time, while the effect of errors in non-stationary series is permanent. Thus, it is necessary for the variables identified as 'non-stationary' to be transformed into the first differences. Despite the non-stationary property of the fertility series, this is probably a sample rather than a population effect as it is unlikely that fertility, for example, has a 'real' unit root. The way the demographic variables were constructed creates certain problems when it comes to equation testing (both fertility and infant mortality include the number of births). The two-way causality and simultaneity of fertility and infant mortality previously noted by Pool may lead to biased results.

To remove spuriousity from the regression (see Table C-5), I have taken the first differences of some of the independent variables, based on their statistical properties. The first specification identifies that the effects of changes in fertility[63], accumulated public works expenditure, and average summer temperature on infant mortality are insignificant. Both real wages and the number of females per 100 males enrolled have a negative and significant (at 1%) influence on infant mortality. Alternatively, an increase in dwelling density is associated with a significant increase in infant mortality. The results conform to the theory, discussed in Section 5.4.

Similar to specification (1), specification (2) shows that the effects of real wages and female enrolment ratio on infant mortality are negative: higher living standards and an increased participation of women in primary schools relative to men are associated with lower rates of infant deaths. The coefficient of dwelling density on infant mortaltiy also remains positive and significant. Both specifications describe the model adequately: the distribution of standardized residuals is close to Normal in both specifications (Normality is not rejected at the 5 % significance: Jarque-Bera statistics - see Appendix C, Figures C3 and C-4), F-statistics is significant, and adjusted R^2 ranges between 35 and 45%. However, according to the DW Statistics the regression residuals appear to be autocorrelated in the first specification, but not in the second, where I included the lagged values of the dependent variable.

[63] Including the proportion of married under 24 instead of fertility did not generate significant results, once other explanatory variables were included.

Table 5-3. Panel EGLS (Cross-section SUR) estimates, 1874-1919

Infant Mortality	(1)		(2)	
	Coefficient	P>|t|	Coefficient	P>|t|
GFR (first difference)	0.05	0.64	-0.05	0.70
Female enrolment per 100 males	**-1.02**	**0.00**	**-0.56**	**0.09**
Persons per Dwelling	**8.33**	**0.00**	**4.62**	**0.02**
Real Wages (index)	**-0.44**	**0.00**	**-0.37**	**0.02**
Accumulated Public Works Exp (first difference)	-0.01	0.24	-0.01	0.10
Summer temperature (first difference)	0.86	0.14	0.85	0.24
Infant Mortality (t-1)	-	-	**0.36**	**0.00**
Constant	169.71	0.00	111.82	0.01
F-statistics	12.07	0.00	15.77	0.00
Durbin-Watson (DW) Statistics	1.59		2.22	
Jarque-Bera (Normality test)	2.31	0.32	5.50	0.06
Total Panel observations	184		184	
Number of cross-sections	4		4	
Total Periods	46		46	
Adjusted R^2	0.35		0.45	

Using Provincial data from the period 1874-1919 I have been able to show that improvements in real wages and an increased proportion of women relative to men receiving primary education corresponded to lower infant deaths and thus better health outcomes, while increased dwelling density created unfavourable conditions for infants' chances of survival.

5.6 Conclusion

In this chapter, I reviewed the health transition in New Zealand and its likely determinants from a broad, socio-economic perspective. The close comparison with Australia identified many similarities in terms of disease environment, socio-economic circumstances and medical care interventions and policies. In both Australia and New Zealand the fall in post-neonatal mortality (mostly due to reduction in gastric and intestinal diseases) was responsible for a great proportion of the decline in infant mortality between 1872 and at least 1920. The two countries experienced an early reduction in the magnitude of year-to-year variations, which is also indicative of the common epidemiologic transition that began in the 1900s when many infectious diseases (such as diarrhoeal and respiratory) retreated. Relatively higher urban mortality was prevalent in Australian and New Zealand cities, at least

until the 1920s. In terms of socio-economic conditions, the Trans-Tasman labour market was well integrated in the period 1873-1913 (commonality of composite real wages - see Greasley and Oxley, (2004)). The common introduction of welfare measures at an early stage, (e.g. free, compulsory, secular education introduced in 1877) and infant welfare schemes that began in the 1900s, also contributed to favourable health outcomes.

Despite such great similarities, New Zealand's relatively low urban mortality, modest infectious disease incidence, mild climate, cheap food and primary produce orientation created advantages relating to better health outcomes for infants towards the end of the 19th and mid-20th centuries compared to Australia and other British colonies. Some of the more traditional explanations (e.g. "healthy migrant effect") did not stand up to scrutiny when a more thorough analysis was undertaken. It was no accident that New Zealand's infant rates were lower than in Australia, but rather a combination of positive environmental factors.

The second objective of the chapter was to analyse regional health inequalities using new and existing Provincial data. The analysis of regional inequalities in health outcomes concentrated on the four largest Provinces: Auckland, Canterbury, Otago and Wellington. The relative isolation of the New Zealand regions prevented the extensive spread of infectious diseases in early years, which resulted in sequestered peaks in the Provincial infant mortality series. Infant mortality across provinces was particularly volatile between 1862 and 1875. On average during 1872-1899, Auckland had the highest incidence of both epidemic and diarrhoeal diseases [64] while Canterbury had the lowest incidence of epidemic diseases and Otago had the lowest number of deaths from diarrhoeal diseases. During 1900-1920 the incidence of both epidemic and diarrhoeal diseases significantly diminished across all Provinces. Infant deaths from diarrhoeal diseases in Otago remained the lowest, even in the 20th century. The timing of the decline also varied across Provinces. The

[64] Please refer to the Appendix C, Table C-2 and Table C-3 (descriptive statistics for the cause-specific infant deaths for two periods: 1872-1899 and 1900-1920)

decline in infant rates in Auckland and Otago occurred around 1870, while the decline in Canterbury and Wellington was not marked until 1880.

Provincial infant mortality appeared to be quite volatile in the 1860s with the highest degree of dispersion of around 30%. A significant decrease in the Provincial dispersion occurred in the 1870s, followed by minor increases in the 1890s and the beginning of the 1920s and 1930s. Notably, in Chapter 4, it was identified that in the late 1870s-early 1880s and 1890s there was a rise in the earnings inequality as well as a substantial increase in the unemployment level. The observed convergence across regional labour and commodity markets post 1900 also coincided with the convergence of Provincial infant mortality trends.

According to the previous results for New Zealand and other countries, infant mortality was greatly influenced by changes in fertility and various "more remote" socio-economic circumstances (population density, infrastructure in the cities, standards of living, and the role of women in the society). Provincial disparities in fertility were negligible, thus were unlikely to account for the infant mortality volatility across provinces. The timing of decline in fertility was also universal (around 1880). The regression results also showed that changes in fertility did not have any significant effect on infant mortality, once other socio-economic variables are controlled for (Table 5-3).

The greater role of women in society (women in New Zealand gained the right to vote in 1893; greater labour force participation) was one of the characteristics of a more urbanized and industrialized New Zealand by the end of the 19th century. The proportion of females enrolled in primary schools did vary across provinces prior to 1877, with higher proportions in Canterbury and Otago and lower in Auckland and Wellington. The female literacy rates improved absolutely and relative to males, after primary education was made compulsory in 1877, when provincial disparities dissipated. Historical demographers often associate the role of women with demographic changes (changes in the patterns of nuptiality). In New Zealand the number of females in the labour force more than doubled between 1886 and 1901, while the economically active male population only increased by 45% (Thorns &

Sedgwick, 1997). The increased role of females in the labour force and an increase in the age at first marriage (an increasingly lower proportion of women married under 24) in New Zealand was not uncommon. In North America and Europe, such demographic changes also occurred during the early stages of industrialization. Panel regression estimates validated the importance of women empowerment through education (an increased participation of women in primary schools relative to men) on demographic changes.

Some reservations with regards to urbanization and urban mortality, expressed at the aggregate level, were validated at the Provincial level. Urban infant mortality rates confirmed the advantageously lower infant mortality and the early decline in Otago as opposed to other Provinces. During the 1870-1920 period, the urban proportion in Otago was higher than in Canterbury or Wellington, while dwelling density was the lowest. Overall, the urban-rural differential began to diminish in the mid-1900s, but did not reach full convergence to rural rates until 1920. It appears that sewerage systems were only in place in the early 1900s in the main centres (earlier in Christchurch and Wellington), which could be the reason why the health benefits of living in the cities (i.e. availability of hospital care and medical supplies) were not realized till later. Panel regression estimates also showed that the effect of overcrowding, as expressed by dwelling density, was particularly important. Such results are consistent with the findings on other countries (Smith & Frost, 1994).

Most importantly, despite the limitations pertinent to the derived real wage series, it was identified that, on average, during 1874-1919 improvements in real wages corresponded with lower infant deaths and thus better health outcomes. In Section 5.4.4., it was demonstrated that the negative relationship between infant mortality and real wages became particularly apparent post 1900. The negative relationship between infant mortality and real wages has been previously signified in the demographic literature on mortality decline (Pool & Cheung, 2005).

It is widely acknowledged elsewhere that a population's welfare is closely related to its health. The more important issue is how income disparities affect inequalities in health and vice versa. Regional inequality is a type of inequality that considers

disparities across regions, thus it becomes possible to explore the regional/provincial characteristics that deviated from the general trend. In this chapter, the analysis of disparities in income, health and other socio-economic characteristics contributes to the understanding of provincial characteristics that ultimately shaped the development of those regional economies at the end of the 19th – mid-20th centuries.

Chapter 6

6 Early childhood environment and heights of New Zealand soldiers who served in WWI

6.1 Introduction

In the previous chapters, standard economic and health measures were used to study the living standards of the past from a spatial perspective. I found that, even after the abolision of the Provinces in 1876, regional economies experienced dynamics that often deviated from the general trends identified in the literature. An analysis of commodity price markets showed that the general price level was falling during 1885-94 (some deviations included an increase in prices in 1889), with the prices of meat and dairy only falling in the 1880s due to external influences (decline in gold and wool prices worldwide). Apart from the consistently lower commodity prices (meat, dairy, and agricultural produce) in Canterbury, regional dynamics were not consistent. In the 1890s Provincial price divergence was particularly high and commodity price markets were shown to be better integrated in the South than in the North prior to 1900. Similarly, disparities in real wages were high in the 1870s and 1890s, particularly the mid-1890s, which was more apparent in the rural than urban sector. The percentage increase in real wages was also higher in the rural sector between 1873 and 1913 across all Provinces.

Provincial results showed that, in terms of economic living standards, real wages in the building sector were the lowest in Auckland and the highest in Otago during 1873-1913. The dynamics were the exact opposite in terms of health outcomes: Auckland on average had the highest incidence of infant mortality, while Otago had the lowest, which was particularly apparent for urban areas. The relationship was further reinforced via panel regression estimation. It was demonstrated that during the period 1874-1919 improved socio-economic conditions (improvements in real wages) corresponded to lower infant deaths and thus better health outcomes. Alternatively, an increased dwelling density created unfavourable conditions for infants' survival chances. Similar to the results on prices and real wages, there was a convergence in infant mortality trends post 1900.

The last quarter of the 19th century in New Zealand was a period of rapid change both in terms of economic and demographic indicators. Prior to the universal convergence of the existing monetrary-based measures of wellbeing across Provinces, there were some apparent disparities in the commodity price and real wage series, as well as urban-rural differences in occupation-specific real wages and infant mortality trends. In addition, the shortfalls (e.g. no reliable unemployment figures) in the compilation of living standard indicators have complicated the analysis for certain time periods.

According to Inwood, Oxley et al. (2010), biological living standards seemed to deteriorate in the late 19th century. Although their work represents an important piece of evidence of the worsening conditions in New Zealand in the 1890s, no further investigation has been made to explain the reasons for this decline. In this chapter, the results, presented in Inwood, Oxley, and Roberts (2010), are re-estimated using the extended data set with additional Provincial variables (i.e. income, urbanization, cost of protein, expenditure on public works, disease and climate measures) derived in the previous chapters. These factors have been consistently identified as having an effect on future growth (Bosch, Bozzoli, & Quinatana-Domeque, 2009b; Bozzoli, Deaton, & Quintana-Domeque, 2009a; Hatton, 2011b; Peracchi, 2011).

In Section 6.2 I introduce descriptive statistics of the micro data sample (WWI individual records). In Section 6.3 I present a theoretical model of adult stature and its environmental characteristics in New Zealand's context. Regression results are reported in Section 6.4 with some discussion in Section 6.5.

6.2 Micro Data

The micro data in this chapter comes from the medical examination records of New Zealand-born WWI volunteers and conscripts (born between 1865 and 1900). The genealogical sample has been constructed from the personnel records of New Zealanders serving in WWI, which only became available to the public in 2005 (Inwood et. al, 2010). Inwood et al. (2010) further explained that:

> "Both the original paper schedules and microfilm copies of 122,357 personnel files have been transferred from the New Zealand Defence Force (NZDF) to Archives New Zealand. These files cover 95 per cent of the men who served in New Zealand forces in World War 1. "

In New Zealand conscription was not introduced until 1916, yet between 1914 and 1916, 90,324 men volunteered out of a population of 232,492[65] men aged between 20 and 50 (Inwood et al., 2010). By the standards of anthropometric analysis applied to European data, the sample used here is relatively small in absolute terms; however, relative to New Zealand's population it is quite significant. The total number of usable (after adjusting for age and missing values) height observations in the WWI data for New Zealand born enlists includes 8805 records. This is almost three times larger than the original data set (3,051 records), presented in Inwood et al. (2010). Although not a perfectly representative sample of the male population, the wartime medical examinations are the most comprehensive source available prior to the advent of nationally representative health and fitness surveys first undertaken in 1977 (Inwood et al., 2010).

Individual records contain information on height, weight, occupation, birth place, birth year, conscription year, medical examination year, marital status and education. Marital status and education represent the descriptive characteristics of the sample, but are not included in this analysis. Free, compulsory primary education (ages 7-13) was introduced in New Zealand in 1877. On average during 1870-1900, 92.3% of enlisted men were educated The reported level of "education" implies at least year-4 certification. WWI Army Service records also included some quantitative information on individual recruits who were unfit or fit only for service in New Zealand. However, this represented a relatively small sample of observations (total 4277 records: 274 were identified to have some medical issues or as unfit for service, leaving 4003 fit for service). The following codes (Table 6-1) were used to establish whether a recruit was fit or unfit. Basically, anyone identified other than A1 or C1 were qualified as 0 or 'unfit/medical treatment required'.

[65] New Zealand Census, 1916 (Chapter 24)

Table 6-1. Level of fitness code, WWI

Code	Abbreviation stands for
A1	Fit for Active Service
B1	Able to be made fit by medical treatment
C1	Likely to become fit for service overseas after special training
C2	Permanently unfit for Active Service but fit for service in NZ
D	Permanently Unfit

Source: New Zealand Defence Force, http://www.nzdf.mil.nz/personnel-records/nzdf-archives/resources/WWI-army-service-records.htm

It appears that unfit recruits were, in fact, significantly shorter than the fit recruits (based on the difference of means t-test). The percentage of unfit recruits is slightly higher for the 1860-74 and 1895-99 cohorts (Table 6-2). It is evident from Table 6-3 that the proportion of unfit recruits is also marginally higher in urban than rural areas.

Table 6-2. Number of fit and unfit recruits across cohorts

Cohort	Fit	Unfit	% of unfit
Born 1860-74	61	8	13.11%
Born 1875-79	202	20	9.90%
Born 1880-85	361	23	6.37%
Born 1886-89	583	50	8.58%
Born 1890-94	1010	46	4.55%
Born 1895-99	319	35	10.97%
Total	2536	182	7.18%

Table 6-3. Number of fit and unfit recruits in urban and rural areas

Area	Fit	Unfit	% of unfit
Urban	60	684	8.77%
Rural	121	1,839	6.58%

Similar to Inwood et al. (2010), I excluded men who enlisted before they reached the age of 21 or were older than 49. It is clear from Table 6-4 that the number of records becomes smaller when only the New Zealand born are included, which is further reduced when the birth Province/city and other restrictions are specified.

Table 6-4. Sample exclusion due to missing fields

	Number of records	Why excluded
All records	19670	Only males, women (who were mostly nurses) excluded
Known to be NZ born	10849	I only considered the NZ born recruits
Aged 21–49 and $\geq$ 64 inches	8805	Minimum height requirement of 162.5cm (64 inches at the time) in the New Zealand Expedionary Force (NZEF) and age bias
Including occupation, cities and Provinces	7911	Sample is reduced when specific province or city of birth specified
The above age and height restrictions + fit-code	2718	Only 182 – unfit and 2536 - fit

Evidence from Inwood, Oxley et al. (2010) showed that the average stature not only declined in the late 19th century, similar to other developed countries, but also did not begin to increase until after WWI. Figure 6-1 (updated sample) shows mean height by year of birth for the New Zealand born recruits aged 21-49. It is evident from Figure 6-1 that the mean height was declining during the years 1871-1876 and 1894-1898. Fluctuations of the mean height appear to be quite volatile between 1880 and 1890, with no particular trend in the series. The tallest individuals were born in 1870 with an average height of 68.95 inches (175.133 cm), and the shortest were born in 1898 with an average height of 67.17 inches (170.61).

Figure 6-1. Mean heights at birth: all cohorts, 1860s-1890s

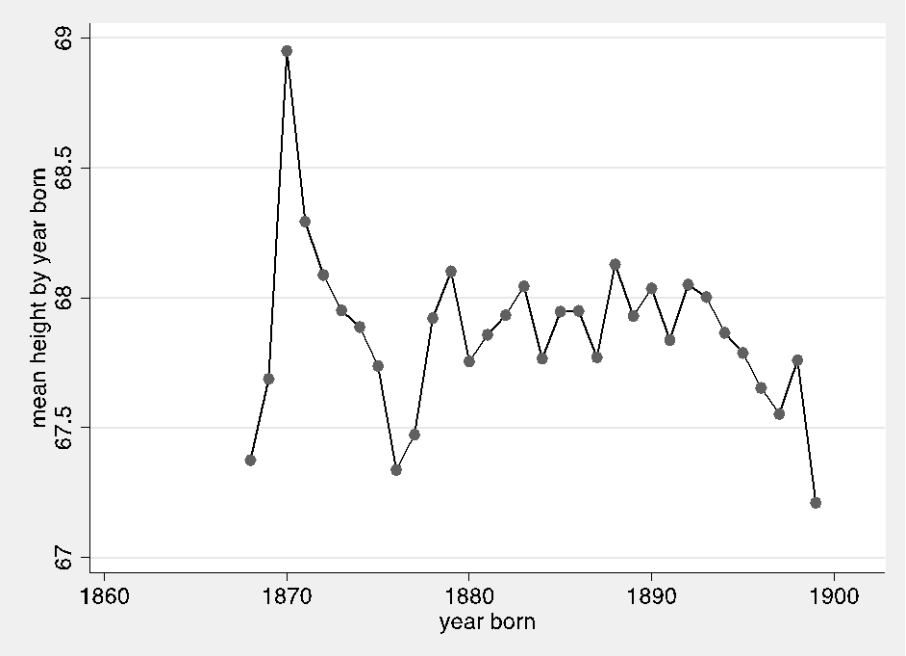


Table 6-5 shows the mean height of enlisted men across the 5-year cohorts. In this case, descriptive statistics are based on individual observations and not yearly means. It appears that data are skewed to the left for the earlier cohorts, especially for those born between 1865-69, also characterized by a larger kurtosis and lower number observations than the later cohorts. Alternatively, the distribution for those born between 1885 and 1894 is slightly skewed to the right. These statistics serve as an indication of a truncation that occurred both for the shorter and taller cohorts. The dominating proportion of observations (91.1%) is concentrated in the 1880s and 1890s cohorts.

Table 6-5. Height Statistics by birth cohort

5-year Cohorts	N of obs	mean	se(mean)	skewness	kurtosis	min	max	cv
Born 1865-69	12	67.58	0.70	-0.77	3.54	62	71	0.04
Born 1870-74	163	68.07	0.19	-0.08	2.52	62	73.5	0.04
Born 1875-79	635	67.76	0.09	-0.02	3.06	60.5	77	0.03
Born 1880-84	1258	67.87	0.07	0.21	3.19	60	78.5	0.04
Born 1885-89	2105	67.95	0.05	0.11	3.67	60	83.5	0.04
Born 1890-94	3595	67.97	0.04	0.16	4.08	55.25	84.5	0.03
Born 1895-99	1348	67.71	0.06	-0.01	2.93	60.25	75.5	0.03

Table 6-6 shows that the manufacturing and farming sectors have the highest number of people employed (32 % and 34 %, respectively). General labourers (building trades) also constitute a large proportion of the overall sample (around 16%). These proportions remained relatively constant across time (the coefficient of variation within each province is 3-4%). According to the *New Zealand Census Statistics (1874-1901),* farmers and farm labourers constituted around 30-40% of the total labour force, the manufacturing sector varied from 16 to 20% , and the building trades from 8 to 20% (see Appendix B, Tables B-1 to B-6).

Table 6-6. Occupational composition of the sample

Occupation group	N of obs	mean	se(mean)	skewness	kurtosis	min	max	cv
Professional or	406	68.17	0.12	-0.13	3.23	60.5	76	0.03
Clerical	631	68.22	0.10	-0.20	2.97	60	75.5	0.04
Sales	378	67.69	0.12	0.17	2.84	61.5	74	0.04
Service	147	67.27	0.20	-0.01	2.51	62	73	0.04
Manufacturing	2956	67.64	0.04	0.23	3.78	58.75	83.5	0.04
Labourer (not farm)	1425	67.76	0.06	-0.05	3.47	56	76	0.03
Farmer or farm manager	2058	68.23	0.05	0.11	4.22	55.25	84.5	0.04
Farm labourer	1053	67.98	0.07	0.29	3.33	62	78.5	0.04
Unknown or not in labour force	62	68.38	0.26	-0.07	2.14	64	72.5	0.03

Apart from the recruit's occupation, the information on father's occupation is also included in the sample.This could be useful in estimating the degree of occupation mobility across generations (Table 6-7). There are only 987 records that have a father's occupation out of 9116 records with only recruit's occupation. Out of the 987 records, 33.74% of the recruits match their fathers' occupations. As expected, farming has the lowest occupation mobility across generations. Manufacturing industries also had lower than average occupation mobility, with 37.16% of recruits following their fathers' footsteps.

Table 6-7. Matched Recruit's and father's occupation

Father's occupation	Total Number	Matched with recruit's occupation	Percentage
Professional or managerial	71	7	9.86%
Clerical	15	-	-
Sales	37	4	10.81%
Service	31	-	-
Manufacturing, utilities, transport	331	123	37.16%
Labourer (not farm)	129	23	17.83%
Farmer or farm manager	300	162	54.00%
Farm labourer	47	14	29.79%
Unknown or not in labor force	26	-	-
Total	987	333	33.74%

The availability of birth place (i.e. birth Province or city) enabled some reference to regional variation in heights. The number of height records that also report a birth Province or a city is significantly smaller than when only general characteristics are considered (born in New Zealand or elsewhere, see Table 6-4). I have created dictionaries for the unique birthplace towns and Provinces, however it was easy to identify the metropolitan centres (Auckland, Christchurch, Dunedin and Wellington), which were automatically classified as urban. It was more challenging to code Provinces (assign various locations to Provinces) as some of the location names were misspelled, recorded as a street name or a suburb, or no longer exist. Unrecognized town names were classified as 'Other rural or small town', given that those records had already been identified as NZ born, as demonstrated in Table 6-8.

Table 6-8. Example of the recorded birth town for NZ born recruits

Recorded birth town example	N of obs	Area code
arrotown	1	Otago
arrowtown	16	Otago
garston	3	Other rural or small town
arthurton	1	Canterbury
asburton	3	Canterbury
granity	3	Other rural or small town
dunedin	938	Dunedin
hull	3	Other rural or small town

The number of observations in each Province is not distributed evenly (Table 6-9) with a large number of recruits born in the four largest Provinces and Hawkes Bay (54% of the total sample). For example, there were only 72 people born in Marlborough in the sample, where the Provincial average was the highest and the coefficient of variation across time the lowest. Almost 27% of enlisted men came from the four urban centres (Auckland, Christchurch, Dunedin and Wellington) and 9% of the sample were identified to be from other rural or small towns. It appears that, on average, those recruits born in urban areas were shorter than those born in Provincial towns or rural areas. It is also interesting that recruits born in Christchurch were, on average, the shortest in the overall sample (based on the difference of means t-tests).

Table 6-9. Number of height records for each province and the four largest cities

Area code	N of obs	mean	se(mean)	skewness	kurtosis	min	max	cv
Other rural or small town	750	68.11	0.09	0.07	2.96	61.5	76	0.03
Auckland	619	67.87	0.10	0.07	3.15	60.25	76	0.04
Wellington	516	67.81	0.10	-0.03	2.96	61	75	0.03
Christchurch	549	67.51	0.10	-0.05	3.07	60	76	0.04
Dunedin	507	67.66	0.10	0.13	2.89	61.5	75.5	0.03
Auckland Province	850	68.11	0.09	0.27	7.12	55.25	84.5	0.04
Canterbury	995	67.92	0.07	0.22	3.07	60.3	75.75	0.03
Otago	1021	68.08	0.08	0.15	3.20	61	78.75	0.04
Wellington Province	706	67.67	0.09	0.01	3.75	58.75	78.5	0.03
Taranaki	294	67.65	0.15	0.10	2.78	62	76	0.04
Westland	247	67.78	0.15	-0.34	2.80	61.5	73	0.03
Nelson	162	68.05	0.19	-0.19	3.02	60.5	74	0.03
Marlborough	118	67.94	0.22	0.28	3.23	62.5	75.5	0.04
Hawkes Bay	839	67.85	0.08	0.24	3.05	61.5	76.25	0.03
Not identified or not in NZ	24	67.87	0.55	-0.48	2.75	61	71.5	0.04
Total	8197	67.88	0.03	0.12	3.67	55.25	84.5	0.04

Figure 6.2 shows the density distribution of individual heights by Province. Shapiro-Wilk tests for Normality showed no significant departure from Normality in the main cities and some provinces (Taranaki, Nelson and Marlborough). However, Normality was rejected for the four main Provinces (excluding the main cities), Hawkes Bay and Westland. As is evident from Table 6-5, the data in the four provinces are skewed to the right, implying that the effect of the minimum height requirement had some effect on the density distribution of these Provinces. Similar to Inwood et al. (2010), I excluded individuals shorter than the threshold of 64 inches and used a maximum likelihood truncated regression instead of the ordinary OLS (see Section 6.4).

Figure 6-2. Density distribution of individual heights (NZ-born conscripts) between ages 21 and 49

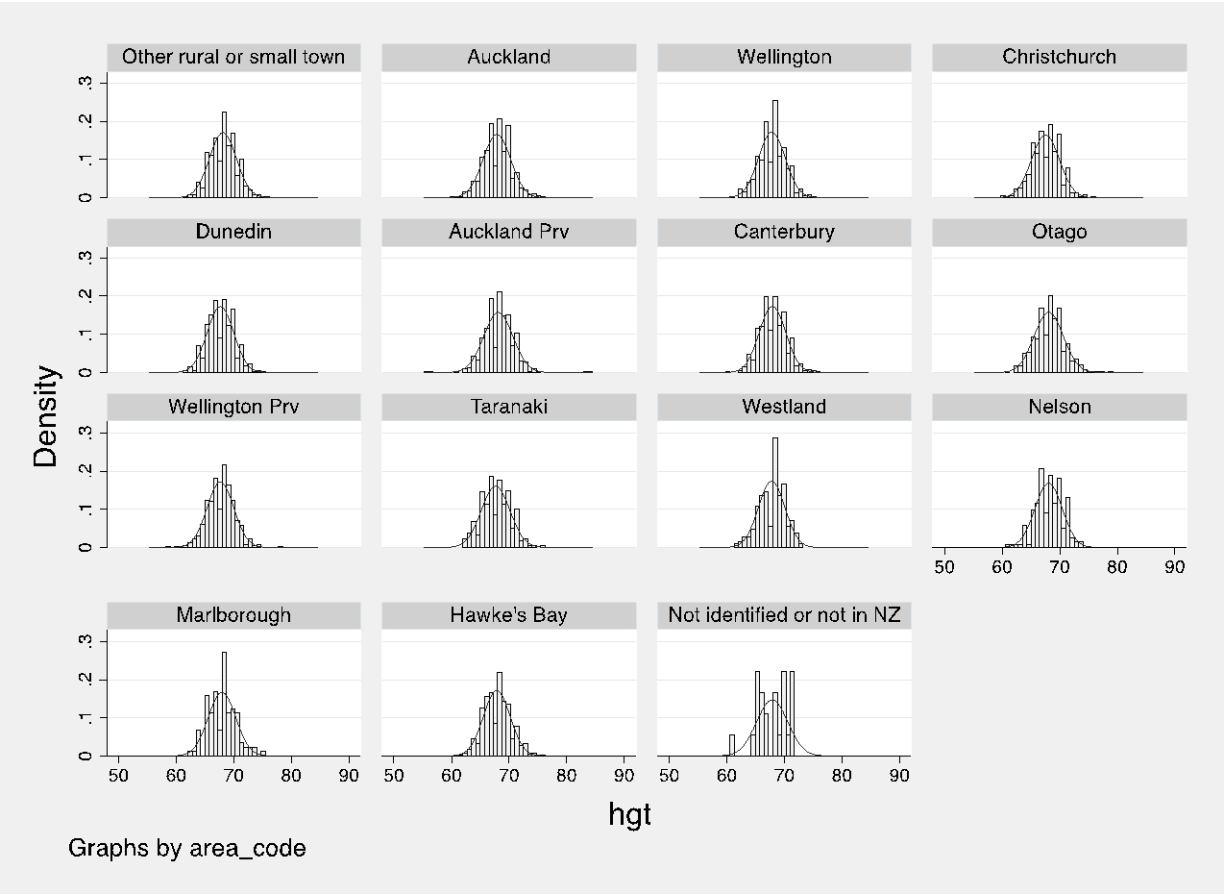
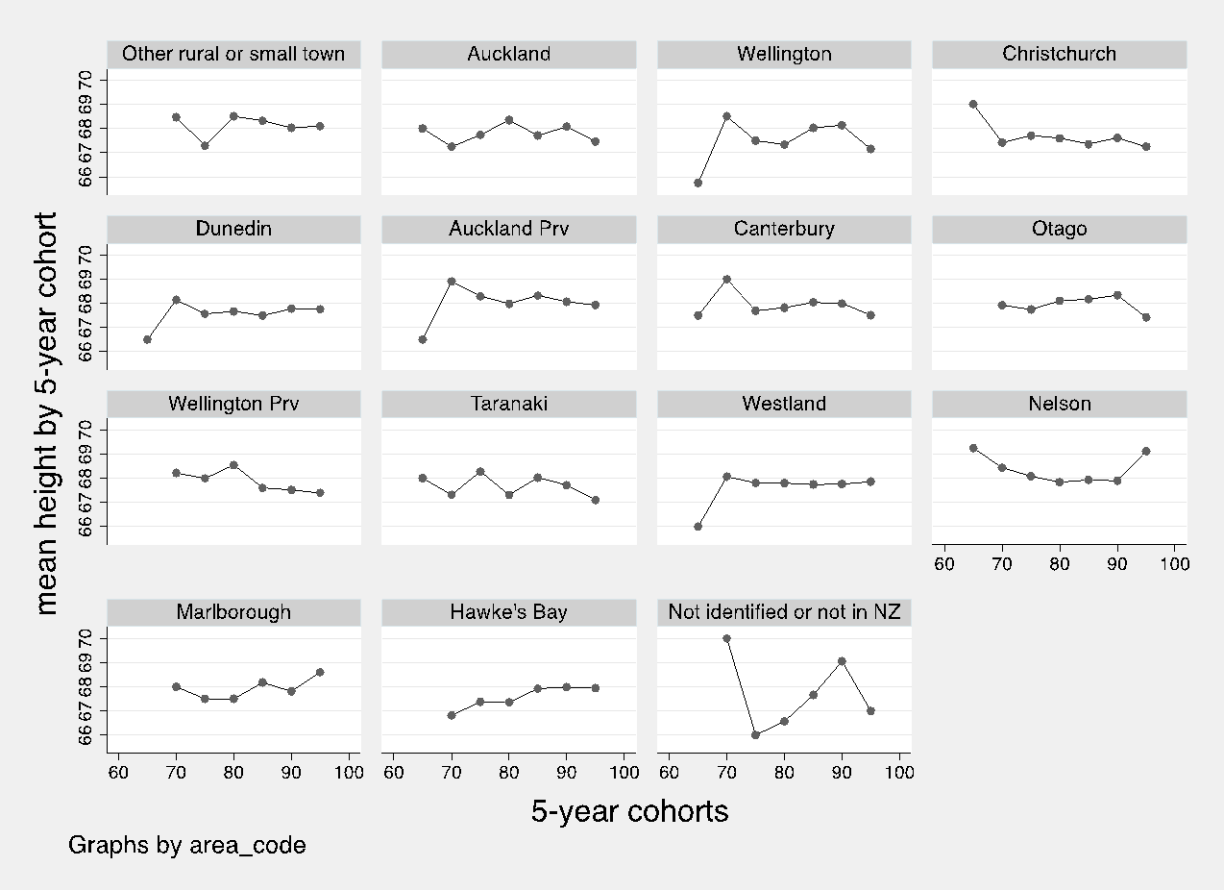


Figure 6.3 shows the annual fluctuations of the city, rural and Provincial town mean heights. The difference of means t-tests showed that mean height across different localities is not the same. The urban-rural differential is particularly apparent within the main Provinces. It appears that there was no single pattern of stature decline during 1871-1876 and 1894-1898 as was observed in Figure 6-1 (the aggregate version). It can be seen from Figure 6-3 that during the period 1870 -1895 a gradual decline in stature occurred in some cities (Christchurch and Dunedin) and Provinces (rural areas) (Auckland, Canterbury, Wellington and Nelson). There were Provincial areas (mostly rural) where mean stature actually increased i.e. Marlborough and Hawkes Bay.

Figure 6-3. Mean individual heights by area (urban cities and provincial towns or rural areas), 1873-1898



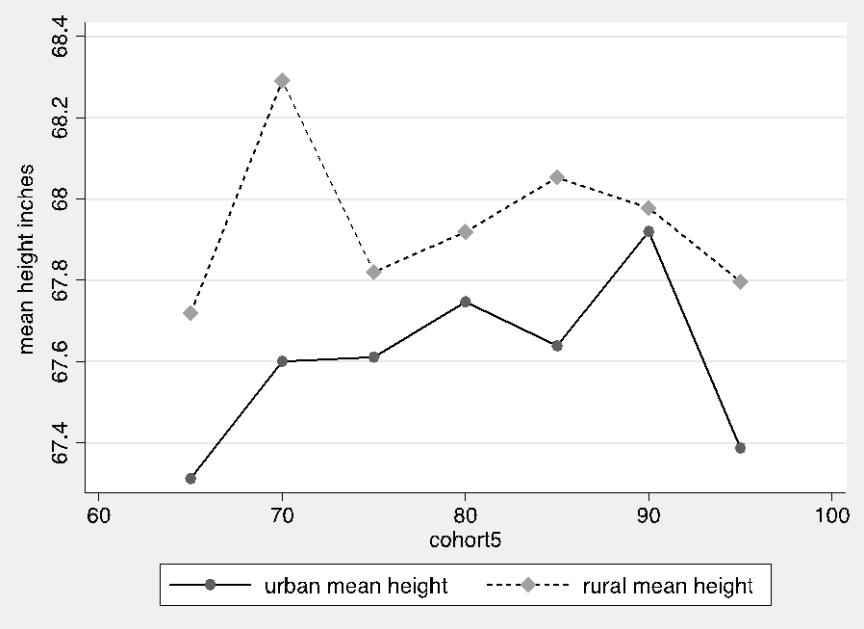
On average, recruits born in rural areas were taller compared to those born in urban areas across all cohorts (Table 6-10). Two-sided t-tests with unequal variances identified the difference in means as significant for 1870-74, 1885-89 and 1895-99 cohorts (see Figure 6-4). Skewness/kurtosis tests for Normality did not reject the null hypothesis of Normality: the distribution of heights for all cohorts (from 1870) appears to be approximately symmetric. The distribution of urban cohorts born in 1870-74 is slightly negatively skewed, which means there is a slight under representation of enlisted men who are taller than average.

Table 6-10. Average heights in urban and rural sectors across cohorts

Small town and provincial cities	N of obs	mean	se(mean)	skewness	kurtosis	min	max
Born 1865-69	8	67.72	1.01	-0.86	3.08	62	71
Born 1870-74	110	68.28	0.23	0.09	2.41	62.5	73.5
Born 1875-79	445	67.82	0.11	-0.03	3.19	60.5	77
Born 1880-84	876	67.93	0.08	0.25	3.16	61	78.5
Born 1885-89	1561	68.05	0.06	0.14	3.89	60.5	83.5
Born 1890-94	2838	67.97	0.05	0.17	4.28	55.25	84.5
Born 1895-99	1063	67.80	0.07	0.04	2.93	60.3	75.5
All rural cohorts	6901	67.95	0.03	0.15	3.76	55.25	84.5
Urban Centers							
Born 1865-69	4	67.31	0.73	0.10	1.43	65.75	69
Born 1870-74	52	67.60	0.34	-0.33	2.35	62	72.5
Born 1875-79	189	67.61	0.17	-0.01	2.78	62	74
Born 1880-84	375	67.75	0.13	0.15	3.21	60	76
Born 1885-89	539	67.64	0.10	0.02	3.00	60	76
Born 1890-94	748	67.92	0.08	0.11	3.10	61	75.5
Born 1895-99	284	67.39	0.15	-0.13	2.80	60.25	74.25
All urban cohorts	2191	67.72	0.05	0.03	3.05	60	76

It is clear from Figure 6-4 that the mean height dynamic in urban areas was very different from that of rural. The mean stature of urban cohorts was increasing for the 1865-80 and 1885-89 cohorts and decreasing for the 1880-84 and 1890-98 cohorts. It appears that a considerable increase in rural heights occurred around 1870, followed by a subsequent decrease. It is also evident from Figure 6-4 that the rural mean height began to decline earlier than the urban mean height. Urban and rural mean heights were not significantly different in 1890, which could also be an indication of mean height convergence. Urban mean height dropped by a half an inch in less than a decade, while a decrease in the rural mean height was not as dramatic (only a quarter of an inch).

Figure 6-4. Urban vs. rural mean height[66] (inches)



In the following section, I discuss the relationship between early childhood environment and adult stature. Findings in this section, i.e. differences in stature across regions (Provincial, urban/rural areas) and occupations, are supplemented by the use of socio-economic and disease environment variables.

6.3 Stature and early life determinants

The height of an individual is directly related to net nutrition - mainly determined by the amount of calorie intake, physical exertion and exposure to disease, during childhood (Steckel, 1995). Availability of nutrition (i.e. cost of nutrition, income - ability to buy nutritious goods) and disease environment (infant mortality) are the two most commonly identified early childhood characteristics having a direct impact on terminal heights (Bosch et al., 2009b; Bozzoli et al., 2009a; Hatton, 2011b; Peracchi, 2011). Income, relative cost of nutrition and proximity to nutrition (urban versus rural living) are often identified as proxies for consumption of nutrients (Craig & Weiss, 1998; Haines et al., 2003; John Komlos, 1987; Zehetmayer, 2011).

[66] Urban includes the four major (in terms of population) urban centres: Auckland, Christchurch, Dunedin and Wellington. Rural included rural areas and Provincial cities of all Provinces.

While nutrient consumption is positively related to growth, childhood diseases may impair nutrient absorption and prevent food intake, which may lead to malnutrition and growth retardation. Diseases make a claim on nutrition, and the resulting malnutrition predisposes the child to disease (Brush, Harrison, & Waterlow, 1993; Silventoinen, Lahelma, Lundberg, & Rahkonen, 2001). For instance, the increased prevalence of diarrhoea or pneumonia during childhood may have directly impacted future growth and resulted in stunted stature (Checkley et al., 2008; Hadi, Stoltzfus, Moulton, Dibley, & West, 1999; Martorell et al., 1975; Moore et al., 2001). Infant mortality is often used as a proxy for the general disease environment and its effect on stature is hypothesized to operate through selection (lower infant mortality leading to less healthy and hence shorter survivors) and scarring[67]. Many have found evidence for a scarring effect, but not selection (Bozzoli et al., 2009a; Hatton, 2011a; Klemp & Weisdorf, 2012; Peracchi, 2011) where the results generally confirm that improvements in the disease environment are associated with better health outcomes and improved growth during childhood.

In this Chapter, adult stature is expressed as a function of individual-level and Provincial-level characteristics that control income, disease exposure, urban environment and the cost of nutrition. Essentially the model can be represented as follows:

$$Height_{ipt} = \alpha + \sum_{t=1870}^{1900} \delta^{c} \chi_{c} + \gamma^{\xi} X_{i} + \beta^{\mathrm{T}} \mathbf{X}_{pt} + \sum_{p=1}^{4} \phi^{p} \chi_{p} + e_{it}, \qquad (1)$$

Where $\sum_{t=1870}^{1900} \delta^{c} \chi_{c}$ is a dummy variable for the 5-year cohort, $\gamma^{\xi} X_{i}$ are individual-level occupation dummies, χ_{pt} is a vector of regressors that captures the effects of disease environment/infant mortality during early childhood, income/real wages, dwelling density (number of persons per room in each of the four main boroughs[68]),

[67] Pearson (1912) was one of the first to suggest that the fall in infant and child mortality could lead to adverse health outcomes for the survivors. Alternatively, proposed by Bozzoli et al. (2009a), a scarring effect, where infant mortality acts as a proxy for the disease environment, finds more support in recent literature (Hatton, 2011a; Klemp & Weisdorf, 2012; Peracchi, 2011).

[68] Boroughs in this case refer to the main urban centres.

cost of nutrition, and climate variables[69]; $\sum_{p=1}^{4} \phi^{p} \chi_{p}$ is an urban centre specific dummy.

6.3.1 Stature and income

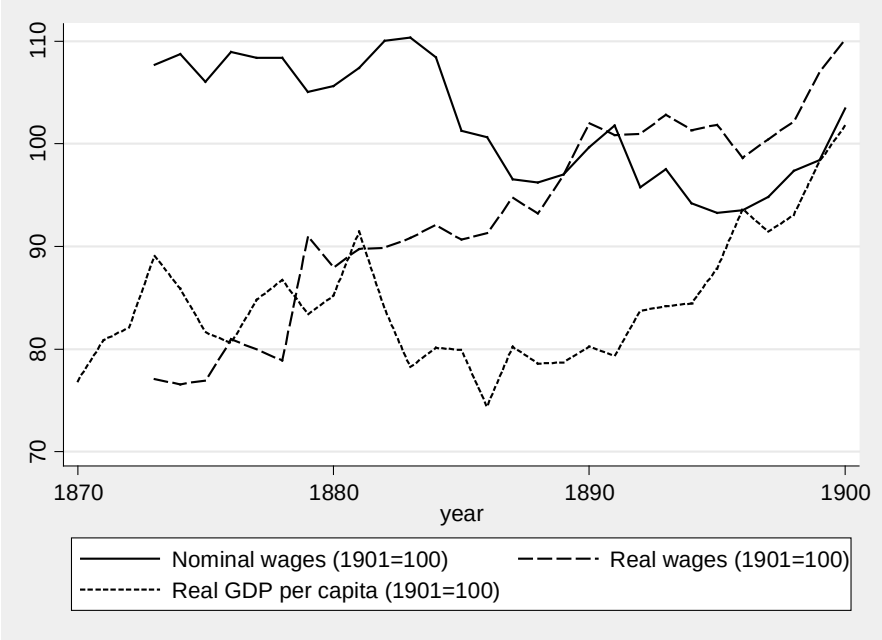
The interdependence between income and stature was first recognized in the 1980s (Fogel, 1997). During the early industrial growth period, rising per capita income was not always associated with rising biological well-being of the population. Such evidence exists for various countries (e.g. US, Australia). In the US, the 1830-60 period is often referred to as an 'antebellum puzzle', when income was increasing and health was deteriorating. In Australia, living standards stagnated between 1890 and 1940. During that same period life expectancy increased, the average working week declined and housing stock improved (Nicholas, Gregory, & Kimberly, 1998). In both cases anthropometric measures represented a more robust indicator of population welfare.

In Section 6.2, Figure 6-1 showed that biological living standards stagnated between 1870 and 1875. This was actually driven by a rapid fall in the rural mean heights from the higher point in 1870. The latter half of the 1870s saw an improvement in biological living standards, which remained constant until the decline in the mid-1890s. In terms of aggregate income, GDP per capita increased in the beginning of the 1870s, then fell between 1873 and 1875. In 1876, GDP per capita increased till 1880, then it subsequently plummeted during the 1880-94 economic depression. The period 1895-1913 showed a marked improvement in real GDP per capita growth rates, however, post-1890 this increase in the aggregate production was not reflected in the rise in real wages (Figure 6-5). GDP per capita and real wage trends were diverging during 1873-1890 and post 1890 - the period of the refrigeration era. It appears that during the period when average stature was increasing in the late 1870s, both GDP per capita and real wages were also on the rise. However, during the period 1880-1890, all three indicators (stature, real wages and GDP per capita)

[69] Please refer to the more detailed summary of the data sources and the period of compilation, presented in the Data Section of this thesis.

diverged. Post 1895, while real wages and GDP per capita were increasing, average stature was falling.

Figure 6-5. Wages vs GDP per capita (composite series), 1870-1900



Source: GDP series - extracted from Greasley and Oxley (2000a, 2004)

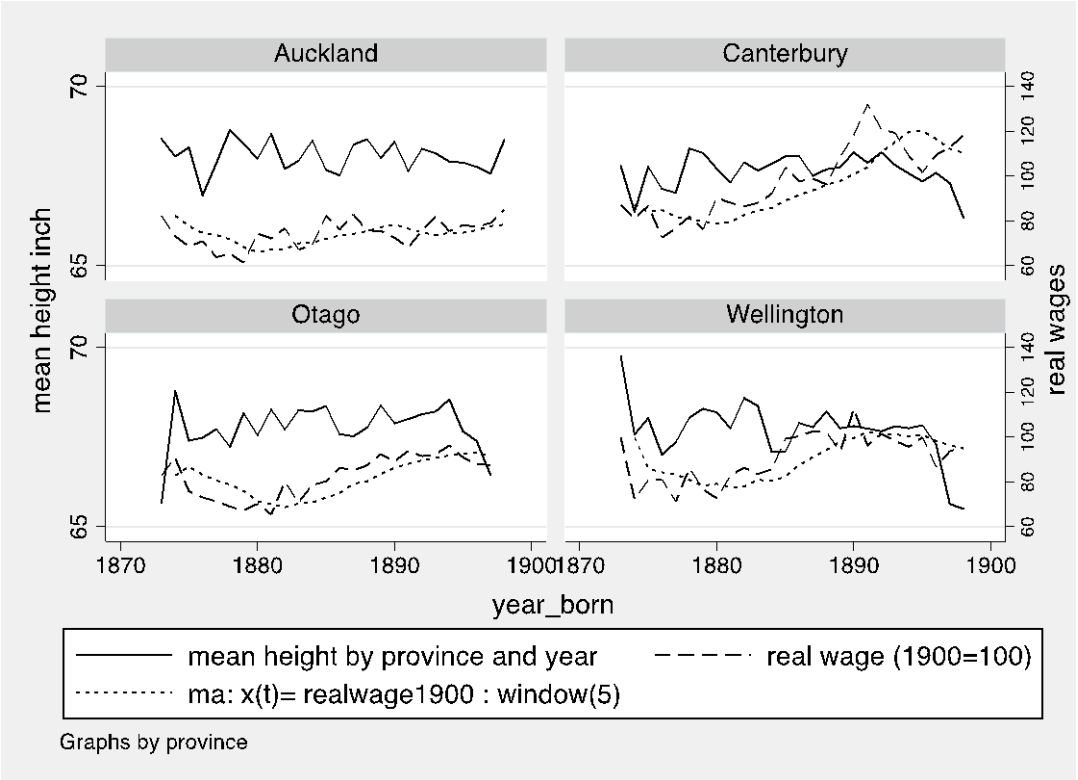
Real wages are perhaps a more useful indicator of the average worker's living standards than GDP per capita. Even during the depression period in the 1880s when average wages were falling, real wages were increasing. Although real incomes were increasing, unemployment and inequalities were also rising (See Chapter 4). Given that the real wage data is available by Province (presented in Chapter 4 and Appendix B, Table B-7), it becomes possible to consider how Provincial real wages are related to the Provincial stature trends. Figures 6-5 and 6-6 show plots of the Provincial real wages (composite) and mean stature. Since the Provincial mean height represents the average of urban and rural heights, the mid-1870s increase is not as apparent in Figure 6-5 as it is in Figure 6-4. Provincial real wages (separately for the main and peripheral Provinces) are plotted on the opposite axis of Figures 6-6 and 6-7.

It appears that real wages in Canterbury, Otago and Wellington were falling between 1873 and 1880, followed by an increase between 1880 and 1895. The 1895 decline in the mean stature is more apparent in Otago and Wellington than in Canterbury

(the 5-year MA of the series did show a decline), where the decline in stature also coincided with the decline in real wages. Auckland did not experience a decline in real wages, which was consistent with a slight increase in the mean stature in that Province in 1896-7. Auckland's economy was less reliant on pastoral produce, therefore it is not surprising that the dynamics in stature and real wages are slightly different from other provinces.

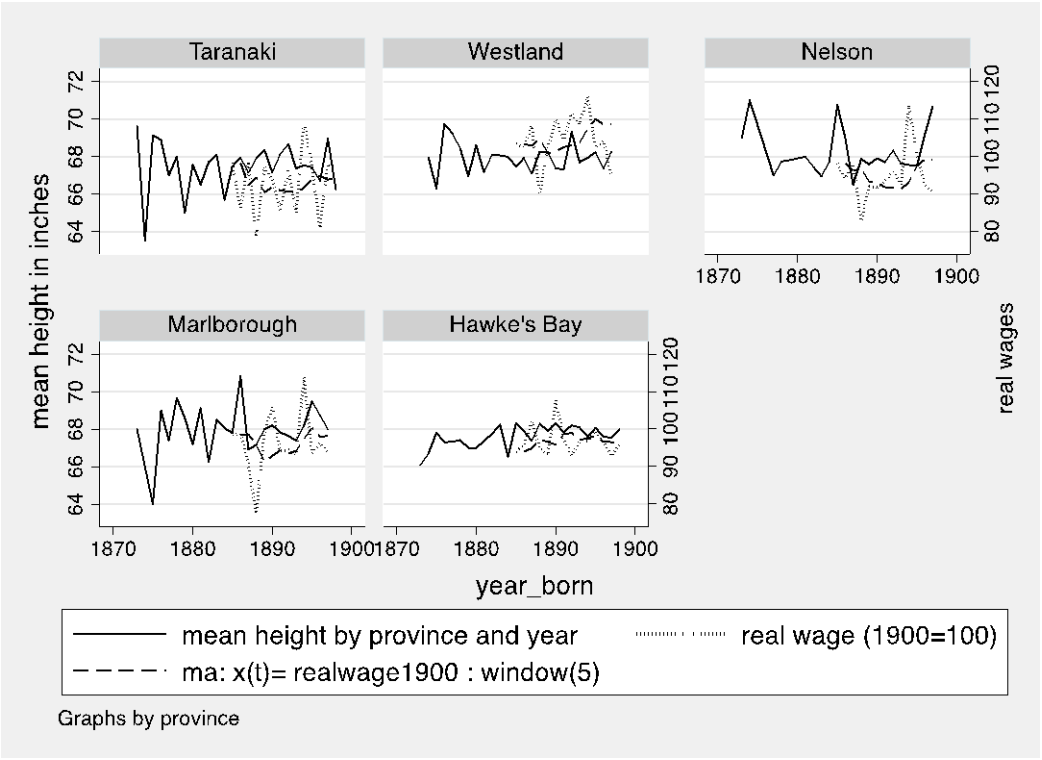
The most marked discrepancy between mean stature and composite real wage trends occurred in the 1880s. The 1880s increase in real wages was particularly apparent in Canterbury and Otago, where unemployment was supposedly higher (Martin, 1995), and earnings distribution between skilled and unskilled workers was unequal compared to other Provinces (See Chapter 4, Section 4.4).

Figure 6-6. Mean stature and composite real wages in the main provinces, 1873-1900



Due to fewer observations[70] and a higher frequency of annual fluctuations in the real wage series across peripheral Provinces, it is not easy to determine whether there was any correlation with the mean stature.

Figure 6-7. Mean stature and real wages in the peripheral provinces, 1885-1900



Explicitly correlating real wages and adult height generated some positive results (Table 6-11). In levels stature and real wages are positively and significantly correlated in most Provinces. The positive relationship also holds for the first differences [71] (except Otago and Westland).

[70] Real wage data for peripheral provinces was only constructed from 1885.

[71] Please note that as in previous Chapters, real wages showed to be trend-stationary. Therefore trend was removed from the series to avoid spurious correlations.

Table 6-11. Pearson's correlations between real wages and average stature in each province

	levels		first differences	
Province	coef	p-value	coef	p-value
Auckland	-0.06	0.02	0.06	0.04
Canterbury	0.33	0.00	0.17	0.00
Otago	0.24	0.00	-0.17	0.00
Wellington	0.01	0.00	0.21	0.00
Taranaki	0.22	0.00	0.43	0.00
Westland	-0.04	0.61	-0.17	0.02
Nelson	-0.23	0.03	0.10	0.41
Marlborough	0.31	0.00	0.31	0.00
Hawke's Bay	0.12	0.00	0.19	0.00

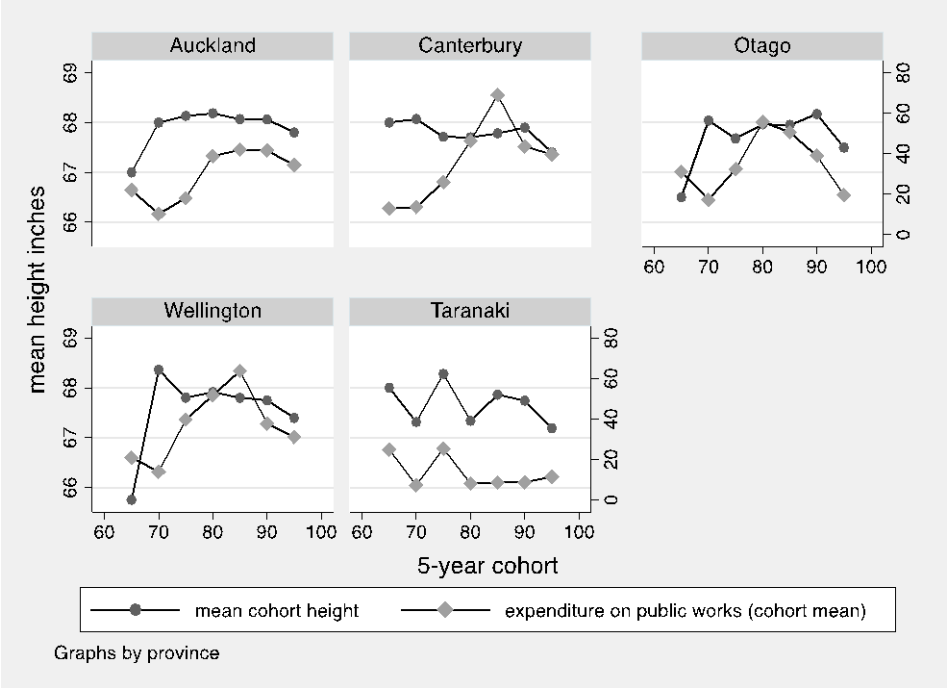
There are some limitations to the use of real wages as a measure of living standards. Although the series included a wide range of representative occupations, they did not adjust for unemployment or seasonality of certain occupations (see discussion in Chapter 4). From the mid-1890s wages in New Zealand also became subject to minimum wage setting (granting of 'awards') and other regulations.

In previous chapters, I used public works expenditure to proxy for the infrastructure, road and railway development. Unfortunately, the data on various kinds of public works only became available after 1914, which limits any further analysis on the relative contribution of sewerage, water works, roads, building etc. to expenditure in different provinces. Improvements in infrastructure, initiated by an increase in per capita in real public works expenditure, led to the creation of sewerage and water works systems only later in the 1900s. Therefore the positive effect of urban infrastructure on health did not become important until later, given that the effect of public works on infant mortality was negative but not significant during 1873-1919 (see Chapter 5, Sections 5.4.5 and 5.5).

In Chapter 4, it was suggested that any influx of building sector jobs was dependent on the government's expenditure on public works. Despite an increase in real wages in the 1890s, the number of people employed in the building sector reached a low point in 1896 and only began to recover only in 1906. This corresponded to a massive decline in the funds available for financing public works in the Provinces during 1883-1900. Expenditure on public works can also be used as a proxy for the

level of urban employment in the main provinces. It is evident from Figure 6-8 that mean stature and public works both decline in the 1890s.

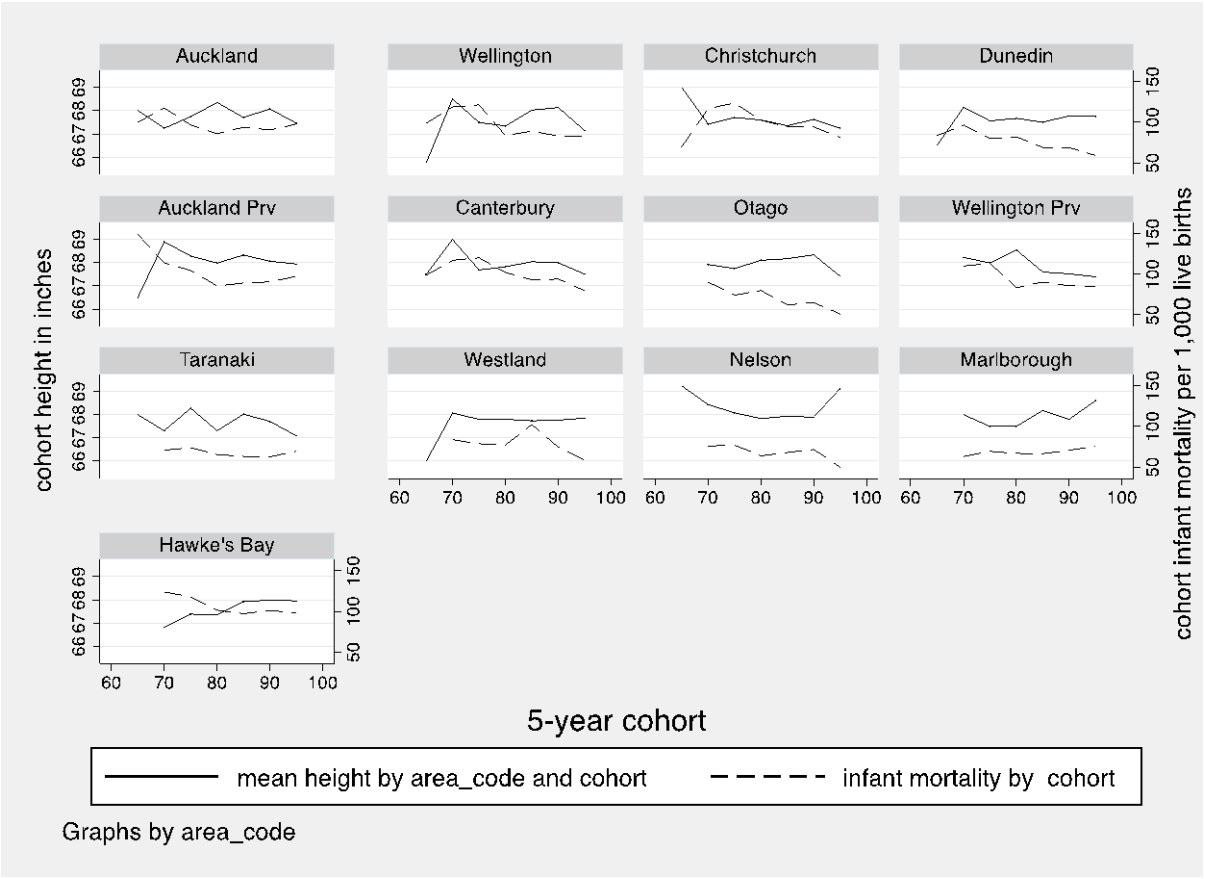
Figure 6-8. Mean cohort trends in stature and expenditure on public works



6.3.2 Stature and health

The expected negative relationship between average height and infant mortality can be observed for some Provinces and time periods, but not for others (Figure 6-9). For instance, in Auckland city and Hawkes Bay, infant mortality trended in the opposite direction to average height across all cohorts. During 1875-1890, infant mortality in Otago was falling and the average cohort height was on the rise. The decline in infant mortality in Otago between 1880 and 1900 was the most drastic among Provinces, where it had the lowest incidence of infant deaths overall and the lowest number of deaths from diarrhoeal diseases (Chapter 5).

Figure 6-9. Height in inches and infant mortality per 1,000 live births (5-year moving averages)



Earlier, it was established that individuals born in rural areas were significantly taller than those born in the main cities (Figure 6-4). The mean stature of urban cohorts was decreasing during 1880-84, when urban infant mortality underwent an increase. The exact opposite was true for rural or small towns: the 1880-84 increase in stature coincided with a fall in infant mortality. Despite an overall decreasing trend in infant mortality in the mid-1890s, the rate of decline in infant mortality slowed, which was particularly evident in the urban infant mortality trend (Figure 6-10).

In New Zealand, the "urban penalty" existed at least during the 1878-1920 period (Chapter 5, Figure 5-18). The urban-rural differentials began to diminsh in the 1900s (Figure 6-10), but it is clear that the urban environment had some effect on persistent differences in both average stature (Figure 6-4) and infant mortality (Figure 6-9).

Figure 6-10. Urban vs. rural infant mortality rate per 1000 live births

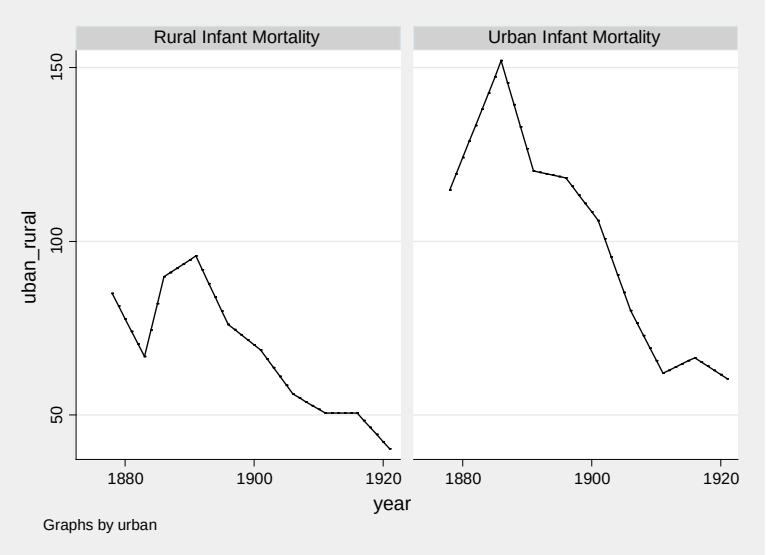
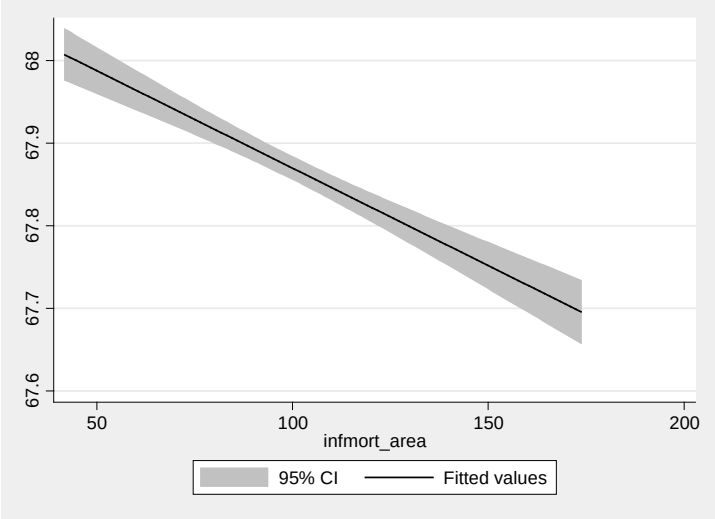


Figure 6-11 shows a clearly negative relationship between stature and infant mortality. Reducing infant mortality by 100 deaths would only achieve a third of an inch increase in average stature at most.

Figure 6-11. Linear prediction plot of the provincial heights by infant mortality



It could be the case that, because New Zealand had a low level of infant mortality to begin with, a decline in the late 1870s-1880s did not have as dramatic an impact as perhaps was the case in some other European countries (Chapter 5). Another explanation could be that general infant mortality (disease environment) was not as important as was nutrition. In New Zealand declines in infant mortality during the

1872-1926 period were mainly attributed to a decrease in gastric and intestinal diseases. However, the reduction in neonatal deaths between 1872 and 1926 contributed little to the decline in infant mortality (Fraser, 1928). In fact, the number of infant deaths from malformation and diseases of early infancy increased during 1887-1902 (Appendix C, Figure C-1). Possibly, deaths in early infancy (all of pre-natal origin - premature birth, congenital debility etc.) were more closely related to nutrition and health of the mother, and thus could be reflective of poor nutrition.

6.3.3 Stature, urban environment and cost of nutrients

Another measure of adverse environmental conditions for infants, linked to urbanization, is dwelling density. Haines et al. (2003) argued that the relative proximity to food or rural living had been more important than family income in determining height. From Figure 6-12 it is evident that dwelling density patterns differed between the North and South Islands. Table 6-12 shows that, among the four urban centres, dwelling density was the highest and average height was the lowest in Wellington. It can also be observed that dwelling density increased in all Provinces (especially evident in Wellington) but Canterbury in the second half of the 1890s. In Chapter 5, it was established that higher dwelling density was associated with higher infant death rates. The expectation is that the increase in dwelling density would also result in the decrease in the average stature.

Table 6-12. Average height and dwelling density (persons per each dwelling)

province	variable	mean	cv	min	max
Auckland	height	67.94	0.04	55.25	84.50
	ppdwelling	4.90	0.10	4.15	6.81
Christchurch	height	67.77	0.03	60.00	76.00
	ppdwelling	5.09	0.09	4.39	5.69
Dunedin	height	67.88	0.04	61.00	78.75
	ppdwelling	4.89	0.08	4.15	5.52
Wellington	height	**67.72**	0.03	52.50	78.50
	ppdwelling	**5.52**	0.03	5.07	6.06

Figure 6-12. Persons per dwelling (5-year moving averages)

Apart from disease and adverse living conditions, the consumption of nutrients (and their relative cost) during childhood is hypothesized to have an impact on stature as an adult (Craig & Weiss, 1998; Haines et al., 2003; John Komlos, 1987; Zehetmayer, 2011). Fogel (1997), for instance, demonstrated that between the middle of the eighteenth century and today, caloric intake per person increased by more than a third, and the height of most Europeans increased by at least ten centimetres (Fogel, 1997). The availability of digestible milk was particularly important for physical growth and the effect of protein on growth has been thoroughly investigated. Leighton and Clark (1929); Orr (1928) found that supplementary milk was associated with higher growth among schoolchildren in England. More recently, Joerg Baten (2009) identified a significant measurable influence of milk production on nutritional status in the 19th century where, in particular, he found that milk producing areas achieved higher nutritional status than grain or potato producing areas.

In New Zealand, milk constituted a relatively large weight in the food expenditure basket (based on the 1893 Census). Both the relative price of milk and average height were falling from 1890 until 1898. In Figure 6-13 average height is plotted

against the average price of milk. The relationship is not clear from the graph, but trend-wise looks positive (due to falling prices between 1890 and 1898). Changes in milk prices seem to be negatively related to changes in the average height in some years: 1877, 1883-84, 1887, 1892-93. Perhaps milk prices are not the best proxy for the nutrient consumption cost as milk prices remained relatively constant apart from a few observed fluctuations (See average prices in Appendix A, Table A-6).

Figure 6-13. Mean stature and the relative price of milk index

6.3.4 Stature and climate

Finally, average yearly temperature is included in the regression (Section 6.4) to capture the fact that fluctuations in certain food prices are affected by changes in climatic conditions. Extreme weather conditions are generally not good for crops or for pastoral production. For example, grain harvests, and therefore flour prices, were highly dependent upon favourable/unfavourable weather conditions. Baten, J. (2003), Komlos, J. (2003), and Koepke, K. (2005) all argue that climate has a direct impact on stature. Steckel, R., and Rose, J. (2002) identified that climate acts both directly and indirectly (through food, mortality and other aspects) as a cause of stature decline or increase.

In Chapter 5, it was suggested that changes in the average yearly temperature are negatively correlated with changes in the incidence of diarrhoeal diseases. New Zealand's milder climate and the absence of a summer maximum (hot summer weather was associated with diarrhoea) was often identified as favourable for the health of infants (Neale, 1925). Both historical (R. Lee, 1981; Neale, 1925) and more recent medical literature (Davie et al., 2007)[72] have presented related evidence on the significant effect of summer and winter temperatures on disease incidence. In the case of the average stature-temperature relationship (Table 6-13), it appears that, generally, changes in summer temperature are positively correlated with the changes in average height, while the reverse is true for the winter temperature. This could imply that summer temperature has an effect on stature through the disease channel.

Table 6-13. Pearson's correlation: temperature and average height

	First Difference Provincial heights	
	Coefficient	P-value
D.Summer	-0.11	0.00
D. Winter	0.08	0.00

6.4 Results

To compare with earlier results from Inwood et al. (2010), I re-estimated their original model using an updated and extended WWI sample. The regression results, presented as Table 6-14, are consistent with their findings, where recruits born in 1860-74 appear to be taller (but not significantly so), while those born in the 1890s - shorter (1885-1889 is the reference cohort). Occupation effects are positive and significant for farmers, farm labourers, and professionals/clerks compared to manufacturing and textile workers. Inclusion of urban centre dummies identifies that those born in urban centres are likely to be shorter than those born elsewhere. The

[72] Davie et. al. (2007) found that for the period 1980-2000 winter mortality rates, mostly responsible for deaths from circulatory and respiratory diseases, were 18% higher than expected from non-winter rates

urban coefficient is negative for all provinces, except Auckland, where the dummy coefficient is insignificant and positive.

Table 6-14. Maximum likelihood estimation of stature of the New Zealand-born soldiers 21-49 years at enlistment or medical examination

New Zealand-born	(1)		(2)	
Height, inches	Coefficient	P>|z|	Coefficient	P>|z|
Born 1860-1874	0.17	0.45	0.13	0.59
Born 1875-1879	-0.19	0.15	-0.14	0.31
Born 1880-1884	-0.11	0.32	-0.04	0.71
Born 1885-1889	Reference			
Born 1890-1894	-0.04	0.60	-0.02	0.78
Born 1895-1899	**-0.27**	**0.01**	**-0.32**	**0.00**
Auckland			0.02	0.90
Wellington			-0.09	0.51
Christchurch			**-0.40**	**0.00**
Dunedin			**-0.33**	**0.02**
Farmer	**0.71**	**0.00**	**0.65**	**0.00**
Farm labourer	**0.42**	**0.00**	**0.41**	**0.00**
Labourer other than farm	**0.19**	**0.05**	**0.19**	**0.07**
Professional/clerical	**0.46**	**0.00**	**0.50**	**0.00**
Manufacturing	Reference			
Constant	67.47	0.00	67.52	0.00
Sample size	8805		7678	
BIC	38217.62		33335.35	
Wald Chi^2	88.17**		88.62**	

To assess the effects of early childhood conditions during infancy on the individual heights of recruits equation (1) is estimated (see *Stature and Early Life Determinants* section). The estimated model includes individual, Provinicial, non-monetary and climate characteristics. The individual characteristics include: occupation, birth cohort and urban dummies, while the Provincial characteristics consist of monetary measures includingincome (real wages), expenditure on public works (real terms per capita) and the relative price of nutrition (relative price of milk). Non-monetary characteristics include: disease environment (infant mortality), dwelling density, and the climatic characteristic is the average summer temperature.

In Section 6.2 differences in stature trends were observed among Provinces and it is possible that some explanatory variables would have a similar impact on all Provinces, while some characteristics would remain Province-specific. To account for covariates that vary by cluster (Province) but are homoscedastic within each cluster, I used the robust cluster variance estimator[73]. To check stability of the key parameters, I used various model specifications (Table 6-15).

Specification 2 in Table 6-14 is utilized as the benchmark to which other Provincial-level characteristics are added. With specification 3, Table 6-15, in addition to the standard set of individual characteristics, I included the three key environmental variables: economic (real wages), health (infant mortality) conditions and the cost of nutrients (relative price of milk) [74]. The number of observations fell from 7911 (in Table 6-1) to 6447, this is attributed to fewer observations being available for the real wage series (see Appendix C, Table C1). I removed the trend from the real wage series to avoid spurious correlations (results of the ADF unit root tests showed that real wages are trend-stationary).

Dummy variable controls (occupation, cohort and city) have similar effects on stature in Table 6-15 (3) as in the benchmark model Table 6-14 (2). Occupation effects are again positive and significant for farmers, farm labourers, and professionals/clerks compared to manufacturing and textile workers. Cohort effects appear to be stronger in the model with Provincial controls. Those born in 1860-74 and 1880-84 appear to be significantly taller than those born in 1885-89. An increase in stature for those cohorts can also be observed in Figure 6-1. Consistent with the benchmark model, cohort results and the observed decline in Figures 6-1 and 6-4 show recruits born between 1895 and 1899 were shorter than those born in 1885-89.

The more interesting effects, however, are those of the 'key' environmental variables on stature. The relationship between average stature and income (real

[73] Exact same models were estimated without clusters. The standard errors were slightly larger for the simply robust case, which occurs in a case of a negative correlation of residuals within cluster.

[74] The relative price of milk and real wages are indices (base 1900=100).

wages) is expected to be positive. It has been observed, in Figure 6-5 and Table 6-11, that for most Provinces the relationship is positive, however, an increase in real wages in the 1880s (particularly evident in Canterbury and Otago) is not apparent in the mean stature across Provinces. Removing the trend from the real wage series due to statistical and theoretical (see discussion in Section 6.3.1) reasons has resulted in a positive relationship between de-trended real wages and stature. This indicates that the improvement in economic conditions during childhood has been positively related to stature outcomes later in life.

Another important 'early life determinant' is health. The common practice is to use infant mortality as the measure of the general disease environment ('scarring effect'). In Section 6.3.2, the linear prediction plot showed the negative relationship between average Provincial height and infant mortality. The extent to which infant mortality in early childhood affected adult stature outcomes appears to be quite negligible (Table 6-15, specification 3). The coefficient on infant mortality is negative, but small and only marginally significant at 5% (an increase in infant mortality index by 50%, relative to 1900, would result in only 0.15 inch decline in adult stature on average across provinces in a given year). A rapid decline in infant mortality from the mid-1870s did not seem to have a significantly large increase on adult stature. As discussed in Section 6.3.2, it is possible that disease and death in early infancy (0-3 months) could be more directly related to the nutrition level and health of the mother. This could explain the relatively poorer net nutrition outcomes by the end of the 1890s, which are not captured by the average infant mortality rate.

As discussed in Section 6.3.3, the price of milk can be used to proxy for the cost of nutrition, however, the relatively stable price of the milk series does not seem to have a significant effect on fluctuations in stature (the effect is negative, but small and insignificant). In future research, I might consider a different measure to proxy for the cost of nutrition.

For Table 6-15 (4), in addition to the key Provincial measures (income and health), I included dwelling density, expenditure on public works in shillings (in real terms per capita), and summer temperature. Dwelling density and public works per capita are

only available for the four main Provinces, thus the model is reduced to four clusters (Provinces), with the number of observations falling to 5066. The coefficient on de-trended real wages remains significant, while infant mortality is no longer significant at conventional levels. Overcrowding (dwelling density) is a more accurate measure of urban environment and adverse living conditions for infants than both infant mortality and urban dummies. Here the coefficient on dwelling density is relatively large. An increase in the number of persons per dwelling by just one more person would be associated with approximately quarter of an inch decrease in stature. Alternatively, an increase in public works, even by 100 shillings per person would, on average, increase the stature of an adult by only 1/10th of an inch. Expenditure on public works did vary considerably between 1865 and 1899, with a low of 2-7 shillings and a high of 137 shillings. In this case, expenditure on public works acts as a proxy for employment maintenance in the building sector (see Section 6.3.1).[75]

As an alternative to stature, a fitness code can also be used to identify recruits' health status. Fitness/unfitness represents a direct measure of physical fitness and health of recruits and is expected to be positively correlated with stature. The number of records containing information on recruits' physical health is relatively small (2718 records after adjustments), which represents only one third of the sample in specification (3) Table 6-15. Although most of the recruits are identified as relatively fit (only 182 – unfit and 2536 – fit), the ones that are unfit appear to be more than a third of an inch shorter than the fit recruits. It is possible to utilize this information on the level of fitness once a larger data set becomes available (once the WWII records are included). The Fitness code can potentially be used to substitute for height to check for consistency in the results on height, which can further highlight the importance of adult stature as a health measure. At this point, the sample is not large enough to make such comparisons.

[75] I also used the accumulated measure of public works expenditure as a proxy for infrastructure development, which did not show to be significant in the model, therefore was not included.

Table 6-15. Maximum likelihood estimation of stature of the New Zealand-born soldiers 21-49 years at enlistment with Provincial controls (cluster adjusted standard errors)

New Zealand born	(3)		(4)	
Height, inches	Coefficient	P>|z|	Coefficient	P>|z|
Born 1860-74	**0.63**	**0.022**	**1.03**	**0.00**
Born 1875-79	0.23	0.304	0.16	0.61
Born 1880-84	**0.17**	**0.002**	**0.18**	**0.00**
Born 1885-89		Reference		
Born 1890-94	-0.03	0.672	-0.04	0.57
Born 1895-99	**-0.34**	**0**	**-0.43**	**0.00**
Farmer	**0.71**	**0**	**0.71**	**0.00**
Farm labourer	**0.45**	**0**	**0.47**	**0.00**
Labourer other than farm	**0.28**	**0**	**0.32**	**0.00**
Professional/clerical	**0.50**	**0**	**0.48**	**0.00**
Manufacturing		Reference		
Auckland	**0.32**	**0**	**0.22**	**0.03**
Wellington	0.07	0.104	**0.19**	**0.00**
Christchurch	**-0.23**	**0**	**-0.27**	**0.00**
Dunedin	**-0.34**	**0**	**-0.36**	**0.00**
De-trended real wages	**0.009**	**0.008**	**0.007**	**0.00**
Infant mortality	**-0.003**	**0.049**	-0.003	0.24
Relative prices of milk index (1900=100)	-0.002	0.554	-0.003	0.43
Yearly summer temperature			0.018	0.48
Dwelling density			**-0.28**	**0.03**
Public works expenditure p.c.			**0.001**	**0.06**
Constant	67.97	0.00	69.09	0.00
Sample size	6447		5066	
Truncated	230		176	
Number of clusters	9		4	
BIC	27950.61		21981.62	

There are some limitations related to the estimation results in this section. One is the use of a recruit's occupation to control for socio-economic status. An alternative would be to use father's occupation based on the assumption of intergenerational persistence, however the use of soldier's occupation is a relatively common practice in the anthropometric literature. In Section 6.2 Table 6-7, it was demonstrated that 33.74% of the recruits followed their father's footsteps. The highest persistence was among farmers - 54% and the second highest was among manufacturing workers - 37.2%. From Figures 6-14 and 6-15, it is evident that fathers' occupations were

almost equally dominated by manufacturing and farming. Figure 6-14 shows that there was an increase in the percentage of those involved in manufacturing and clerical work compared to the previous generation.

The number of total father occupations after adjusting for minimum age and birth place is not very large, and only represents 10% of the recruit occupation records. Table 6-16 shows the percentage of recruit occupations that were linked to father occupations. Downward occupational mobility was insignificant, and most occupations gravitated towards manufacturing or farming (being a farm labourer or owning a farm). Some upward mobility is observed for soldiers whose fathers were farm labourers or labourers, but only within the farming sector. It is interesting that the percentages for professional or managerial (non-farm) occupations were low across all occupation groups.

Figure 6-14. Father's occupation composition: number of records in each occupation category

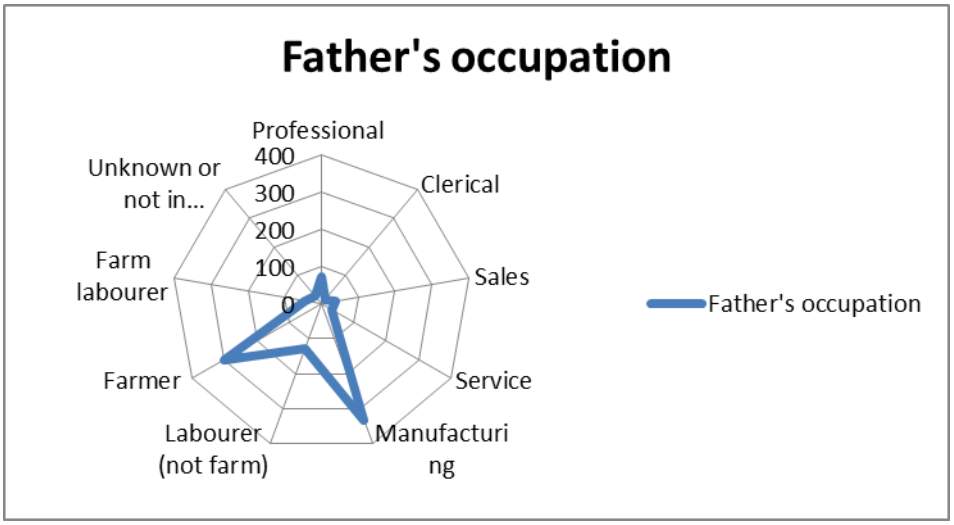


Figure 6-15. Soldier's occupation composition: number of records in each occupation category

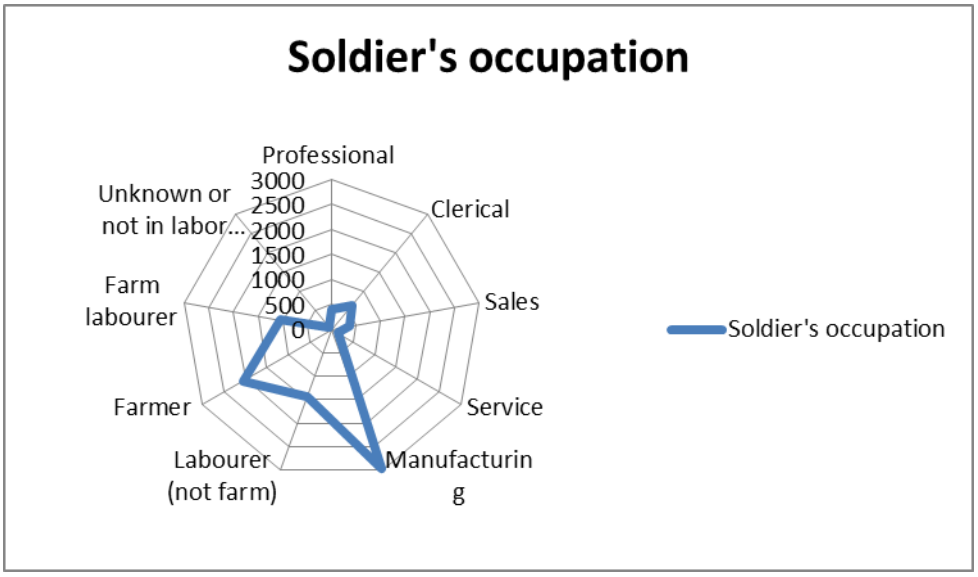


Table 6-16. Occupational generational mobility (soldiers' occupation as a percentage of fathers' occupations)

	Father's occupation								
Soldier's occupation	Professional	Clerical	Sales	Service	Manufacturing	Labourer (not farm)	Farmer or farm manager	Farm labourer	Unknown
Professional or	9.86%	13.33%	8.11%	9.68%	3.93%	1.55%	0.33%	4.26%	
Clerical	7.04%		8.11%	6.45%	7.85%		3.00%		7.69%
Sales	5.63%	20.00%	10.81%	3.23%	4.53%		1.33%	4.26%	
Service	1.41%				1.51%	2.33%		2.13%	
Manufacturing	33.80%	26.67%	27.03%	45.16%	37.16%	24.81%	14.00%	19.15%	15.38%
Labourer (not farm)	1.41%		2.7%		8.76%	17.83%	9.00%	10.64%	26.92%
Farmer or farm manager	28.17%	33.33%	32.43%	22.58%	19.64%	29.46%	54.00%	29.79%	19.23%
Farm labourer	11.27%	6.67%	8.11%	12.90%	16.62%	22.48%	18.00%	29.79%	30.77%
Unknown or not in labor force	1.41%		2.70%			1.55%	0.33%		

The above evidence demonstrates that occupational inheritance was relatively high in the farming sector, which is consistent with findings in other countries i.e. US and Canada (Cranfield & Inwood, 2012; Guest, Landale, & McCann, 1989). The occupational structure among recruits was slightly different from their fathers and gravitated more towards manufacturing, although farming remained important, but

the trend towards manufacturing was consistent with the increased urbanization and improved infrastructure in the cities.

Cranfield and Inwood (2012) argue the importance of taking socio-economic status from the father's occupation if possible and since the father's occupation is available for some recruits (although the sample is very small), I substituted recruit's occupation with father's occupation[76]. To make a direct comparison between father and recruit occupation, I restricted the sample of recruits to those that only included father's occupation. From Table 6-17, it is evident that the results are very similar. Significance and direction of the cohort and urban dummy coefficients are the same for both models (father's and recruit's occupation, respectively). The 1895-99 cohort effect remains negative and significant. The urban dummy for Auckland city is also negative and significant. The effect of father's socio-economic status is similar for farmers, farm-labourers and professionals, however, some differences are apparent. Professional workers appear to be significantly taller and manufacturing workers significantly shorter compared to general labourers in the model with the father's occupation. In the model with the recruit's occupation, professionals are also taller but the coefficient is not significant, while manufacturing workers are significantly (only at 10%) shorter than general labourers. The reason why recruits whose fathers were labourers were relatively shorter has to do with the fact that some of those 'labourer' occupations were gold or ore miners. Recruits who were identified as labourers were mostly general labourers. Despite that, both manufacturing and labouring are urban sector occupations, therefore it is expected that their effects on stature would be similar. To summarize the above, it appears that the use of a recruit's occupation instead of a father's should not make much difference in terms of the impact on adult stature.

[76] A model with provincial controls (as in specification 3) was also estimated using father's occupation, however provincial variables appeared to be redundant, and therefore the results were not reported here.

Table 6-17. Maximum likelihood estimation of stature of the New Zealand-born soldiers 21-49 years at enlistment using father's occupation

New Zealand born	Father's occupation		Recruit's occupation	
Height, inches	Coefficient	P>|z|	Coefficient	P>|z|
Born 1860-74	-0.25	0.73	-0.13	0.87
Born 1875-79	0.41	0.29	0.51	0.19
Born 1880-85	0.01	0.98	0.01	0.98
Born 1885-89		Reference		
Born 1890-94	-0.01	0.98	0.03	0.90
Born 1895-99	**-0.85**	**0.00**	**-0.74**	**0.01**
Farmer (father/recruit)	**0.91**	**0.00**	**0.55**	**0.08**
Farm labourer (father/recruit)	-0.09	0.83	-0.12	0.73
Labourer (father/recruit)		Reference		
Professional (father/recruit)	**1.15**	**0.00**	0.35	0.50
Clerical (father/recruit)	0.00	1.00	0.29	0.53
Sales (father/recruit)	-0.72	0.19	-0.23	0.70
Manufacturing (father/recruit)	**0.49**	**0.06**	**-0.58**	**0.07**
Auckland	**-0.72**	**0.04**	**-0.61**	**0.08**
Wellington	-0.13	0.75	-0.03	0.95
Christchurch	-0.24	0.48	-0.14	0.68
Dunedin	-0.27	0.53	-0.34	0.38
Constant	67.65	0.00	68.05	0.00
Sample size	927		927	
Truncated	33		33	
Wald Chi ^2 (15)	43.1		43.65	
BIC	4108.46		4108.73	

6.5 Discussion

In the preceding Chapters of this thesis, I used both monetary and non-monetary measures to study living standards from a spatial perspective. In this Chapter, I included Provincial characteristics to explain the variations in biological living standards. Stature is a net nutrition measure, (in a simplified form: consumption of nutrients minus claims on those nutrients i.e. diseases, stress, physical activity)

which is affected by both income and health variables during the growth period. The relationship between stature and income can often be complicated by the presence of inequality and measurement issues (not adjusting for the level of unemployment or labour market structure). Apart from the 1880s where there was an increase in real wages in Canterbury and Otago, average stature and real wages fluctuated closely together. For instance, the observed decline in mean stature during 1893-98 coincided with a slight decline in real wages, when regional divergence in both prices and real wages was the highest. The stature model included controls for both Provincial real wages and occupation-specific differences and the estimation results showed that in New Zealand, on average, the improvement in economic conditions during childhood was positively related to stature outcomes later in life for the period 1873-1900. Although, real wages were not adjusted for unemployment (due to data limitations), expenditure on public works per capita was identified to be closely related to the level of employment in the building sector and was also positively correlated with the average height (an increase in public works even by 100 shillings per person would, on average, increase stature of an adult by 1/10th of an inch). Generally speaking, socio-economic conditions played an important role in determining adult stature outcomes.

Given that improvements in real wages corresponded with lower infant deaths and thus better health outcomes (Chapter 5), it was expected that the relationship between infant mortality and stature would also be negative. However, the extent to which infant mortality in early childhood affected the adult stature outcomes was negligible. An increase in the infant mortality index by 50%, relative to 1900, would result in a 0.15 inch decline in adult stature, on average, across provinces in a given year. As demonstrated in Chapter 5 (Figure 5-1), New Zealand's level of infant mortality, even in 1865, was already relatively low compared to other developed countries and it appears that most of the decline prior to 1900 was attributed to the decline in the 'crises' mortality (infectious diseases and epidemics). The number of infant deaths from malformation and diseases of early infancy actually increased during 1887-1902. This could explain the relatively poorer net nutrition outcomes by the end of the 1890s, which are not captured by the average infant mortality rate.

It appears that the urban effect is particularly important in understanding the decline in stature in 19th century New Zealand. Diminution of urban-rural infant mortality differentials was consistent with the decrease in the average urban-rural stature differences. The rural advantage was reflected in the individual-level characteristics i.e. farm labourers and professionals were taller than manufacturing workers, and provincial results, i.e. dwelling density, was negatively related to stature. An increase in the number of persons per dwelling by just one more person would be associated with approximately a quarter of an inch increase in stature. Therefore, dwelling density had a much stronger effect on stature than infant mortality. An "urban penalty" did exist in New Zealand during the 19th century. Consistently higher infant mortality and lower mean height in urban areas compared to rural areas were indications of this. In Chapter 5, it was established that, on average, during 1874-1919 increased dwelling density created unfavourable conditions for infants' survival chances. It appears that overcrowding and general economic conditions are both important in determining stature outcomes as well.

Other results, with respect to the individual-level characteristics, were consistent with the results on cohort and occupation dummies from Inwood et. al (2010). Matching the father's occupation with the recruit's occupation showed a greater occupational inheritance in the farming and possibly manufacturing sectors, which is consistent with findings in other countries i.e. US and Canada (Cranfield & Inwood, 2012; Guest et al., 1989). Overall, the impact of including the recruit's occupation instead of the father's in the model is very small.

Adult stature captures the net outcome of nutrition and disease environment over the first 20 years of life. In this chapter, only the environmental conditions in the first year of life were considered. However, it was demonstrated that stature represents a much more robust measure of living standards for the period under examination.

Chapter 7

7 Concluding Summary

Wellbeing is a very broad notion that encompasses both qualitative (i.e. subjective wellbeing such as the level of satisfaction and happiness, safety and security) and quantitative (such as income (GDP), unemployment, and real wages) aspects of life, which can be measured both at the individual and population levels. Measuring population wellbeing using just one indicator, for example GDP, is highly selective and does not adequately assess the wellbeing of a population (Eisler, 2007; Sen, 1985, 1999; Stiglitz et al., 2009). This becomes particularly relevant for historical data that is often subject to inconsistency, infrequency and lack of availability.

Wealth and welfare trends in New Zealand underwent many transformations during the second half of the 19th and the early 20th centuries. Real GDP growth rates were high during the gold rush era (1860-1870) and averaged around 14.5% per annum, but subsequently plummeted during the 1880-95 economic depression (Briggs, 2003). The period 1895-1913 showed a marked improvement in real GDP per capita growth rates, however, post 1890 this increase in the aggregate production was not reflected in a rise in real wages. GDP per capita and real wage trends diverged during the 1873-1890 and post 1890 periods of the refrigeration era (Greasley and Oxley, 2005). During the 'long depression' in New Zealand, infant mortality and fertility rates fell rapidly. Thus, the population's 'health', expressed in terms of infant mortality and life expectancy, was certainly improving, while anthropometric measures of health (i.e. average stature and BMI) were deteriorating (Inwood et al., 2010). These contradictory dynamics of health and income measures created ambiguity in the interpretation of wellbeing trends in New Zealand during the last quarter of the 19th century.

Monetary measures (i.e. GDP per capita and real wages) are subject to several limitations (e.g. they do not account for unemployment or inequality). Information on sub-national measures of health are also limited and it is unclear what the

relationship between socio-economic, health and anthropometric measures was during the period of rapid change in New Zealand, and which of these environmental conditions during childhood played an important role in shaping terminal stature outcomes.

The main objective of this thesis was to address such limitations and, where possible, fill in the gaps in the existing literature in order to gain a broader perspective on wellbeing and welfare of New Zealanders in the past. This was undertaken by collecting, collating and analysing new economic, social and anthropometric data that represented various aspects of wellbeing in the New Zealand context. The first specific objective of my thesis was to analyse and construct monetary indicators of living standards from a spatial perspective. Monetary measures included real wages by occupation and region, which were derived as extensions to the aggregate measures of Greasley and Oxley (2004, 2005) in order to examine provincial and urban-rural disparities in real wages during the 1873-1913 period. Analysis of the new price indices by region enabled consideration of issues related to commodity market integration and the changing relative cost of staples. The second specific objective was to analyse sub-national health measures from the socio-economic perspective. Health measures included the data on mortality/morbidity rates by region, which were combined with the derived provincial economic measures to estimate the effects of socio-economic factors on infant mortality in New Zealand. Examination of any urban penalty and the timing of infant mortality decline across different provinces were also considered. Finally, anthropometric data (extending the sample used by Inwood et al. (2010) was used alongside traditional monetary and health indicators to answer the major question of interest: *'What was the relationship between socio-economic, health and biological living standards?'*

The particular focus of this thesis was on the four largest New Zealand provinces (Auckland, Canterbury, Otago and Wellington). The period under examination varied due to data limitations, but generally included the last quarter of the 19th century and the beginning of the 20th. This particular period in New Zealand history was previously identified with the beginning of the refrigeration era, intensive

urbanization and economic depression (during 1879-1880s and slow recovery in the 1890s), as well as the beginning of demographic transformation in the 1880s.

Prior to this research, New Zealand's economic performance in the 19th and even 20th century has been evaluated exclusively using aggregate measures such as GDP per capita and real wages (Arnold, 1982a; Clinkard, 1919; Greasley & Oxley, 2000, 2004, 2005; G. Hawke, 1975; Rankin, 1992). Based on the available GDP and real wage data, 19th and mid-20th century New Zealand was a relatively wealthy country. However, it has not been established whether the New Zealand provinces were equally wealthy or whether commodity price markets of the leading New Zealand sectors were well integrated across provinces. Lack of readily available provincial data for 19th century New Zealand has prevented researchers from examining such questions.

The challenge in deriving measures of regional living standards, i.e. real wage series, has been the unavailability of an appropriately constructed deflator prior to its compilation and publication by the *Department of Statistics* later in the 1900s. Fraser (1915) was perhaps the only statistician, who compiled regional deflator series from prices collected in the four chief centres (Auckland, Wellington, Christchurch, and Dunedin) over the 1891-1914 period. However, the Fraser series had its limitations (e.g. a limited expenditure basket, unofficial estimates of retail prices), and thus was re-estimated by Arnold (1982b) who used annual average returns of prices reported in *Statistics New Zealand* from 1870 to 1919. For many, this Arnold series has been regarded as the most reliable series for that period. As an extension to Arnold's (1982) aggregate CPI series, I constructed a new CPI series for the four largest New Zealand provinces (see Chapter 2).

In the following chapter (Chapter 3), I utilized the constructed regional sub-index series to address the question of commodity market integration and spatial causality of price changes, which may also be useful in explaining regional variation in stature or living standards at the time. Statistically, I found that both meat and dairy price series (traded goods) either exhibited convergent behaviour in the long run (meat series) or 'catching up' (dairy series). Most prominent was the central role of

Canterbury and Otago prior to 1898, which was typified by low retail prices of traded commodities (meat, dairy and some grocery items i.e. bread, flour). In fact, Canterbury dairy prices led the dairy sector and Otago led the meat sector prices. My results are consistent with the previously expressed views of economic historians. Hawke (1985), for example, identified that the response of dairying to refrigeration was less rapid than for the meat industry, and that initially the response to intensive dairy farming occurred in the far south (Otago/Southland), while the better suited lands in Wanganui, South Auckland and Taranaki joined only after 1900. Greasley and Oxley (2005) further explained that, in the 1880s, New Zealand's economic activity centred in the South Island (wool exports), thereafter, the economic frontier, stimulated by the export of dairy products and meat made possible by refrigeration, shifted northwards and was accompanied by a rise in the social depth of land ownership.

The quantitative analysis of provincial price series and the degree of integration of commodity price markets, undertaken in Chapter 3 of this thesis, is new for New Zealand's economic history research. Using convergence tests, I statistically tested for the existence of a South-North gradient in the dairy and meat commodity prices, demonstrating that the refrigeration boom that initially benefitted the South gradually involved the North. I also identified that the spread of the railways, connecting various parts of the country, reduced provincial disparities across all price series by 1900. These provincial results can be used to draw comparisons with other countries. During the period 1870-1914 in Australia there was no clear trend towards greater integration of commodity markets with the exception of selected food items (McLean, 1999). Thus, it is likely that the timing of the emergence of a national market for goods in New Zealand was different from that in Australia, suggesting that greater persistent disparities existed among Australian regional markets well into the 20th century.

To complement the analysis of convergence patterns in prices and to complete the first objective of this thesis, I examined labour force movements and real wages of the two representative urban and rural sector occupation categories (farming and building), with a view to ascertaining whether there were any persistent disparities

across provinces within urban and rural environments between 1873 and 1913. In Chapter 4, it was established that labour force movements in New Zealand were characterized by a South-North gradient existent in both rural and building sectors. This was consistent with the net provincial migration figures and the urban population growth which also acquired a South-North gradient.

In terms of regional patterns, I found that real wages in both sectors were increasing at the beginning of the 1880s and fluctuated around a constant mean during the period 1885-1895. Regional experiences, however, varied considerably prior to 1900 where disparities were particularly apparent among rural wage-earners in the 1870s and during the 1885-1898 period. For instance, the 1880s increase was most apparent in Canterbury and Otago (the fall in prices in the 1880s in Canterbury and Otago was more dramatic compared to other provinces). However, the 1880s were a time of general depression for New Zealand's economy, when unemployment, in particular, worsened. Furthermore, earnings inequality was also increasing in the late 1870s-early 1880s and 1890s, potentially understating the overall increase in real wages during that period (Martin, 1995). The higher skill premium (both sectors) in Canterbury and Otago during 1873-1913 was also an indication of the unequal earnings distribution compared to Auckland or Wellington. Similar to the results on prices, occupation-specific and composite real wages all exhibited convergent behaviour towards the beginning of the 20th century: real wages in both urban and rural sectors were converging to the provincial average and skill premiums significantly diminished by 1913. The distribution of earnings across provinces and occupations also became equal post-1900. As Pool and Sceats (2003) expressed earlier (p.342): *"NZ was to become a pioneer welfare state through its industrial Conciliation and Arbitration Act, 1894, and the underlying ideology of "social wage" sufficient to sustain a working man and his family."*

Prior to my work, some historical literature on fluctuations in aggregate wages (Arnold, 1982a; Clinkard, 1919) and labour market conditions (Crowley & Salmond, 1950; Dowie, 1966; Fairburn, 1975; Martin, 1995) has been available, however, historians did not examine regional disparities in real wages over time or regional variations within occupations. Similar to the CPI series, the new real wage series by

province and occupation represent an extension to Arnold's work on aggregate real wages, the only publication on the construction of historical real wages for New Zealand for the 1873-1911 period.

Despite an almost uninterrupted increasing trend in aggregate real wages during 1873-1913, there were some apparent provincial disparities in the commodity price and real wage series, as well as urban-rural differences in occupation-specific real wages. In addition, the shortfalls (e.g. no reliable unemployment figures) in the compilation of the living standard indicators have complicated the analysis for certain time periods. Thus, the 'lack of extremes in wealth and poverty in New Zealand' claims (Taylor & Parsons, 1904) could only be established for the period post-1900. Alternatively, health measures (i.e. infant mortality) are perhaps more reliable than monetary measures in terms of their measurement and construction. However, there could be other limitations such as exclusion of certain population groups (e.g. ethnic minorities) in the statistics and under-reporting of infant deaths.

In terms of health measures, it has been widely acknowledged that New Zealand was comparatively healthy, and had the lowest infant mortality rates both in the 19th and mid-20th centuries. As opposed to more conventional demographic methods (Pool, 1982, 1991b, 1993, 1994; Pool et al., 2007), I took a different approach to examining the health environment in New Zealand. To satisfy the second objective, I used provincial measures of infant mortality (not including Maori) and their socio-economic correlates to try and understand different patterns of decline across provinces as well as the common socio-economic factors that influenced the decline and fluctuations in infant mortality rates.

I established that, at the Provincial level, infant mortality outcomes varied across Provinces, but particularly between urban and rural localities. Urban-rural differentials began to diminish in the 1890s, but did not reach full convergence to rural rates until 1920. Data on infrastructure expenditure (public works) did not reveal significant differences across provinces, although the real per capita public works expenditure experienced an increase around 1880 when fertility and infant mortality rates were falling rapidly. Panel regression estimates showed that, on

average, during 1874-1919 improvements in real wages and a decline in education inequality (between females and males) corresponded with lower infant deaths and thus better health outcomes, while increased dwelling density created unfavourable conditions for infants' survival chances.

Despite the fact that New Zealand was relatively healthy (lower incidence of infant deaths) compared to other countries such as Australia, during the 19th - mid 20th centuries, it did not escape the negative externalities of urbanization and socio-economic changes that came with the refrigeration era. Moreover, exclusion of the Maori population in the reported statistics prior to the 1920s perhaps resulted in under-representation in the number of infant deaths in New Zealand.

In terms of anthropometric measures, average stature was relatively high in the beginning of the 1870s (1870-74), with taller recruits born in 1860-74 and 1880-84 and shorter recruits born in 1895-99. There was no single pattern of stature decline across provinces during 1871-1898, or between urban and rural areas, where disparities were particularly apparent. A significant decline in the average stature during 1895-99 is consistent with the earlier findings of Inwood et al. (2010) - the only existing study on historical anthropometric measures in New Zealand. In Chapter 6 of this thesis the results presented in Inwood et al. (2010), have been re-estimated using the extended micro data on height with additional provincial controls (i.e. income, urbanization, cost of protein, disease and climate measures), which have been consistently identified as having an effect on future growth (Bosch et al., 2009b; Bozzoli et al., 2009a; Hatton, 2011b; Peracchi, 2011).

Estimation results have shown that in New Zealand, on average, the improvement in economic conditions during childhood was positively related to stature outcomes later in life during the period 1873-1900. The relationship, however, only became positive after the trend had been removed from the real wage series. The reasons were statistical, but also theoretical. An increase in real wages in the 1880s, particularly evident in Canterbury and Otago, did not correspond to an increase in mean stature. As was established in Chapter 4, a rise in unemployment and earnings inequality in the 1880s potentially understated the overall increase in real wages.

Although real wages presented here are not adjusted for unemployment, expenditure on public works per capita was identified to be closely related to the level of employment in the building sector, and was also shown to be positively correlated with the average height (an increase in public works even by 100 shillings per person would, on average, increase stature of an adult by 1/10th of an inch).

While there is some ambiguity as to the economic conditions in the 1880s, health measures (i.e. infant mortality) have clearly shown an improvement. However, the extent to which infant mortality in early childhood affected the adult stature outcomes seems negligible. An increase in the infant mortality index by 50%, relative to 1900, would result only in a 0.15 inch decline in adult stature on average across provinces in a given year.

It appears that the urban effect was particularly important in understanding the decline in stature in 19th century New Zealand. Diminution of urban-rural infant mortality differentials was consistent with the decrease in the average urban-rural stature differences. The rural advantage was reflected in the individual-level characteristics i.e. farm labourers and professionals were taller than manufacturing workers. Provincial-level results also showed a statistically negative relationship between adult stature and dwelling density. Compared to other socio-economic and disease controls, the coefficient on dwelling density was relatively large. An increase in the number of persons per dwelling by just one person was associated with approximately a quarter of an inch decrease in stature. These results are consistent with the results found in Chapter 5, where it was also identified that higher dwelling density created unfavourable conditions for infants' survival chances.

This thesis has contributed some new insights into the various aspects of wellbeing in New Zealand in the 19th and 20th centuries from a spatial perspective. New methods have also been applied to analyse New Zealand's economic history, where appropriate. These methods included time-series tests for convergence and causality. The traditional view of the healthy and wealthy New Zealand expressed in the introduction could only be established at an aggregate level, during a certain time

period and for a certain ethnic group (New Zealand European only). Data obtained from each different approach contributes to a better understanding of New Zealand's socio-economic environment during the 19th and early 20th centuries. Provincial data on monetary indicators enabled the analysis of regional inequalities among commodity price and labour force markets. Analysis of regional infant mortality data and its socio-economic correlates highlighted some important province specific effects. In addition, the connection between demographic changes and economic changes has been drawn more explicitly than in the previous demographic studies (Pool, 1982, 1991b, 1993, 1994; Pool et al., 2007). I presented the analysis in Chapters 3, 4, and 5 to support some of the existing views on New Zealand's living standards, and provided some new statistical evidence for future research and international comparisons. The most original contribution of this thesis, however, is the use of anthropometric measures. It has been demonstrated that stature represents a much more robust measure of living standards than real wages or health indicators on their own, at least during the 1870-1900 period. The type of analysis undertaken in this thesis provides a much broader insight into the wealth and health aspects of New Zealand's life, as well as their relative importance.

The prospects for future research are immense. For instance, the regional CPI series could be expanded and the aggregate CPI series could be updated using new time series estimation techniques. This year, Statistics New Zealand published the first regional GDP series for 15 regions of New Zealand, which is indicative of the growing interest in regional data. Expanding the provincial indicators of living standards (real wages) beyond 1940 is another possibility. The newly collected provincial data also enables more explicit comparisons between Australia and New Zealand such as creating urban-rural health profiles over time, effects of urbanization on Australian and New Zealand cities, an analysis of the regional price markets and whether convergence of prices in Australia were driven by similar factors as in New Zealand. Basically, was New Zealand similar to Australia, did it follow a similar development path, and what lessons can we learn from that?

Future researchers might consider utilizing additional data from WWII to check the robustness of the results on stature. One of the drawbacks in using only the year of birth environmental conditions to predict adult stature outcomes later in life is that the controls for health, disease and living conditions that would likely impact on growth between the first year of life and the age of 21, when a person generally reaches terminal height, are not included. Construction of such 'growth curves' (inclusion of individuals younger than 21 who were dropped from the sample earlier) may single out the effects of certain events or shocks (e.g. harvest fail or epidemics) on growth. Another possiblity for future development of anthropometric measures could include Maori-Non-Maori comparisons i.e. looking at the long-term Maori-Pakeha BMI evolution which would incorporate the modern health survey data.

Appendix A

Table A-1. Expenditure basket (based on 1893 Household Expenditure Survey – Labour Department)

	%		%
Bread (2 lb)	8.955	Housing	10.38
Coffee (lb)	1.45	Clothing	
Flour per 25lb bag	0.995	Clothes	13.14
Rice (lb)	1.87	Boots and Shoes	4.38
Salt (lb)	0.97	Total	17.52
Sugar (56 lb)	4.03	Miscellaneous	
Tea (lb)	4.03	Washing	1.52
Oats (lb)	1.87	Books	2.83
Onions lb	1	Furniture	2.25
Carrots (dozen bunches)	0.2	Friendly Societies	3.56
Turnips (dozen bunches)	0.085	Total	10.16
Cabbages per dozen	0.085	Fuel and Light	
Potatoes per cwt. - retail	1.62	Candles	2.69
Jam lb	1	Coal/Firewood	5.39
Raisins lb	0.4	Total	8.08
Currants lb	0.13		
Dried Fruits lb	0.1		
Beer (hhd)	1.16		
Total	29.95		
Meat			
Beef	5.3088		
Mutton	2.212		
Pork	0.8848		
Lamb	2.212		
Veal	0.4424		
Total	11.06		
Dairy			
Milk	3.39		
Fresh Butter	2.305		
Salted Butter	2.305		
Cheese	1.07		
Eggs	1.31		
Bacon	1.47		
Ham	1		
Total	12.85		

Source: New Zealand Department of Statistics (1873-1935)

Table A-2. Total population for all provincial districts (urban-rural breakdown)

year	urban	rural	Total
1881	291,238	194981	486,219
1886	327328	245612	572,940
1891	352097	270343	622,440
1896	391735	307294	699,029
1901	417596	350202	767,798
1906	458797	424614	883,411
1911	496779	505598	1,002,377
1916	501259	585306	1,086,565

Source: extracted from Thorns and Sedgwick (1997)

Table A-3. Population in provincial districts at successive censuses (exclusive of Maori)

Provincial District	March, 1886	April, 1891	April, 1896	March, 1901	April, 1906	April, 1911
Auckland	130379	133159	153,564	175938	211223	264520
Canterbury	121400	128392	135858	143041	159106	173185
Otago	113702	116088	119990	125341	127877	132402
Wellington	77536	97725	121854	141354	179868	199094

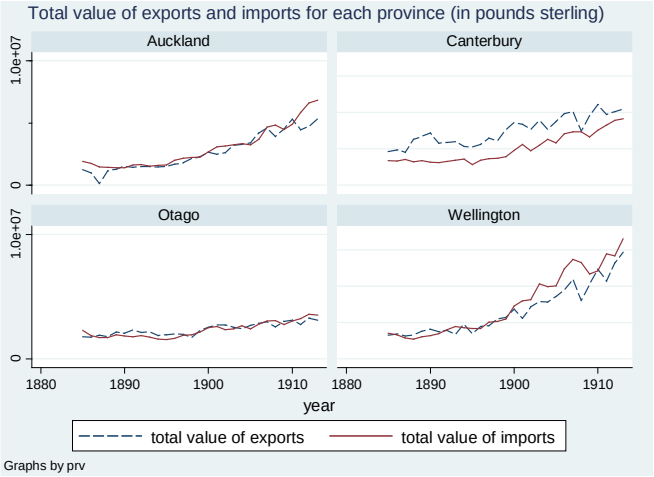
Source: Statistics New Zealand, 1911. Census, April, 1911. – *Population and Dwellings.*

Table A-4. Annual rates of natural increase and net migration, net interprovincial migration and total population increase: 1886-1911

Period	Population migration	Auckland	Wellington	Canterbury	Otago
1886-1891	Natural increase and				
	Net migration	12	20	16	13
	Net interprovincial migration	-11	29	-5	-9
	Total increase	3	45	11	5
1891-1896	Natural increase and				
	Net migration	18	26	21	21
	Net interprovincial migration	5	19	-11	-8
	Total increase	22	43	11	14
1896-1901	Natural increase and				
	Net migration	20	22	17	16
	Net interprovincial migration	7	10	-7	-6
	Total increase	26	30	10	11
1901-1911	Natural increase and				
	Net migration	28	28	24	22
	Net interprovincial migration	13	6	-6	-16
	Total increase	38	33	19	10

Source: Brosnan (1986)

Figure A-1. Overseas trade: total value of exports and imports



A 1. Tariff and Labour legislation changes

Under *the Industrial Arbitration and Conciliation Act* (1894), the regulation of wages in most industries was undertaken by Councils and a Court (this gave a legal recognition to Unions and their ability to dispute wages). Most of the unions benefited from this Act as it gave them the opportunity to dispute rates of pay and minimum working conditions. This led to an increase in wages, which were generally passed-on to the consumer in the form of higher prices for manufactured goods (e.g., clothing, furniture) and other items.

The tariff introduced in 1879 extended the number of items that were charged a duty on an *ad valorem* basis, or as the percentage of the value of the goods. From 1895, there was a steady movement towards a reduction on the duties levied upon imported foodstuffs, and an extension of the tariff levied upon imported manufactured goods. These changes were typically made to protect infant industries. Later, *The Preferential and Reciprocal Trade Act of 1903* of New Zealand introduced preferential rates of duty in favour of the produce of the British Dominions by imposing extra duties on certain imports which were the produce or manufacture of other countries. The list of preferential items was materially extended by the New Zealand *Tariff Act of 1907*, from the 31st March, 1908.[77]

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[77] Official Year Book of the Commonwealth of Australia, tom 47 by Sir George Handley Knibbs, Australia. Commonwealth Bureau of Census and Statistics.

Table A-5. Grocery prices (pence), 1885-1913

Year	Province	Bread (2 lb)	Coffee (lb)	flour (50lb)	Rice	Salt (lb)	Sugar (lb)	Tea _lb	Oats (lb)	Onions lb	Carrots (dozen bunches)	Turnips (dozen bunches)	Cabbages per dozen	Potatoes per cwt. - retail	Jam lb	Raisins lb	Currants lb	Dried Fruits lb	Beer (hhd)	Grocery index
1885	Auckland	3.5	19.5	78	3.75	1	4	30	0.9	2.25	20	20	22	66	5.174	6.88	7.69	8.72	1143	107.33
1886	Auckland	4	20	87	3.5	1	3.25	28.5	0.9375	2.5	26	26	33	102	5.174	7.14	8.79	9.47	1140	114.29
1887	Auckland	3.25	18.5	75	2.5	1	3	25.5	0.7875	2.75	16	16	16	72	5.174	6.52	8.84	8.77	1062	88.8
1888	Auckland	3.75	19.5	84	2	1	3.25	27	1.125	1.5	27	18	27	93	5.174	6.55	8.49	8.04	1020	116.6
1889	Auckland	3.25	20	81	3.25	1.125	3.5	27	0.875	1.75	15	16.5	21	72	5.174	5.73	7.12	8.18	1020	98.27
1890	Auckland	3.5	20	84	3.5	1.25	3.5	28.5	0.8625	2.25	16.5	16.5	16.5	78	5.174	6.61	7.81	7.88	1020	102.73
1891	Auckland	3.75	20	90	3.5	0.75	3.5	25.5	0.7625	2	21	21	21	54	5	8.37	8.02	9.03	1020	92.68
1892	Auckland	3.5	20	57	2.5	0.75	3	30	0.75	1.87	9	9	15	42	5	6.5	5.62	9.23	1038	84.28
1893	Auckland	2.5	20	60	2.75	0.75	3	24	0.75	1.62	12	12	24	60	5	6	5.5	9.3	1020	75.8
1894	Auckland	2.5	20	60	2.5	0.75	2.5	20	0.6	2	9	9	15.5	42	5	6	5	9.03	960	61.27
1895	Auckland	3	20	66	2.75	0.75	2.5	22	0.9	1.37	12	12	18	54	5	5.87	5	8.48	960	85.37
1896	Auckland	3	20	66	3	0.75	2.5	22	0.9	1.75	12	12	18	72	5	6	5	8.26	960	87.91
1897	Auckland	3	20	78	3	0.75	2.5	22	0.825	1.62	12	12	18	72	5	6.87	5.25	8.35	960	83.7
1898	Auckland	3	20	73.5	3.25	0.75	2.375	19.5	0.7875	2.12	18	18	33	108	5	7	5.5	8.35	1200	83.43
1899	Auckland	2.75	20	54	3	0.75	2.625	22	0.7	1.12	15	15	21	69	5	7	5.37	8.61	1020	72.59
1900	Auckland	2.75	20	49.5	2.75	0.75	2.25	21	0.725	1.44	12	12	12	60	5	7.5	6	7.96	1185	71.88
1901	Auckland	2.75	20	54	2.75	0.75	2.625	20	0.8625	1.87	18	18	36	81	5	6.25	6.87	7.44	1080	83.62
1902	Auckland	3.75	18	88.5	2.75	0.75	2.5	20	1.05	1.75	18	18	27	121.5	5	6.25	5.5	8.03	1032	105.86
1903	Auckland	3.5	18	76.5	2.5	0.75	2.75	25	0.725	1.62	16	16	26	66	5	6.5	5	7.86	1056	82.13
1904	Auckland	3.5	18	76.5	2.25	0.75	2.5	27	0.75	1.75	16.5	14	42	54	5	6.75	5	7.54	1050	82.55
1905	Auckland	3.25	18	66	2.25	0.75	2.75	27	0.825	2	18	18	33	171	5	6	5	7.38	1038	92.16
1906	Auckland	3.25	18	66	2.75	0.75	2.75	19.5	0.9	1.37	21	21	30	162	5	6.25	5	8.06	1020	92.94
1907	Auckland	3.75	18	85.5	2.5	0.75	2.25	19.5	1.2	1.62	18	27	27	180	5	6.5	4.75	8.61	951	114.09
1908	Auckland	3.75	18	85.5	2.5	0.75	2.25	19.5	0.9	1.87	18	18	36	126	5	6.12	4	7.56	1104	94.42
1909	Auckland	3.75	18	82.5	2.5	0.75	2.75	20	0.825	1.62	13	16	31.5	93	5	5.25	4	5.4	1035	89.43

Year	Province	Bread (2 lb)	Coffee (lb)	flour (50lb)	Rice	Salt (lb)	Sugar (lb)	Tea _lb	Oats (lb)	Onions lb	Carrots (dozen bunches)	Turnips (dozen bunches)	Cabbages per dozen	Potatoes per cwt. - retail	Jam lb	Raisins lb	Currant s lb	Dried Fruits lb	Beer (hhd)	Grocery index
1910	Auckland	3.5	18	78	2.25	0.75	2.5	18	0.925	1.37	18	18	27	144	5	4.25	4	5.59	1035	92.38
1911	Auckland	3.75	18	70.5	2.5	0.75	2.625	21	1.175	1.25	18	18	27	81	5	5	5	6.91	1035	109.4
1912	Auckland	3.75	18	72.5	2.5	0.75	2.625	16.5	0.975	2.37	16.5	16.5	37.5	120	5	5.25	5	7.34	984	98.39
1913	Auckland	4	18	69	2.5	0.75	2.5	20	1.0875	1.75	18	18	51	57	5	5	4.75	7.01	975	103.95
1885	Canterbury	2.125	19	55.5	2.75	1	3.5	26	0.525	1.5	27	27	15	63	5.512	8.26	7.27	9.97	1032	74.18
1886	Canterbury	2.75	18	69	3	0.875	3.25	27	0.5375	2.25	27	27	15	31	5.512	8.56	8.31	10.82	1020	79.43
1887	Canterbury	2.5	20.75	63	2.25	1	3.25	26	0.4625	1.5	27	27	15	63	5.512	7.82	8.36	10.02	972	70.81
1888	Canterbury	3.25	19	75	2.75	0.875	3	29	1.05	1.5	21	21	12	123	5.512	7.86	8.03	9.19	1096.5	133.98
1889	Canterbury	2.75	18	66	2.75	1	3	24	0.6	1.5	18	18	12	121.5	5.512	6.87	6.73	9.35	1006.5	86.9
1890	Canterbury	2.5	18	60	2.5	1	3	24	0.6	1.5	12	12	12	66	5.512	7.94	7.38	9	1020	80.87
1891	Canterbury	3	18	81	2.5	0.5	3	24	0.55	2	24	24	24	48	5.5	8.8	7.59	8.82	960	79.95
1892	Canterbury	2.5	18	63	2.75	1	3	25.5	0.5625	1.5	21	21	21	18	5.5	6.58	6.88	8.15	1020	73.89
1893	Canterbury	2.5	17	58	2.5	1	2.75	24	0.575	2	18	18	24	66	5.5	5.78	6.42	8.53	900	78
1894	Canterbury	2	18	51	2.5	1	3	24	0.45	1	15	15	27	24	5.5	5.67	5.5	8.68	960	58.61
1895	Canterbury	2.5	24	58	2.5	1.25	3	25	0.625	1	10	10	12	30	5.5	5.81	5.69	8.16	960	79.67
1896	Canterbury	2.5	20	72	2.5	0.75	2.5	27	0.6	1	8	9	12	96	5.5	6.09	5.7	8.05	960	79.99
1897	Canterbury	3	20	78	2.5	1	3	27	0.6	1	12	12	12	32	5.5	7.3	6.55	8.89	960	83.13
1898	Canterbury	3	18	66	3	0.75	2.5	20	0.975	1.5	9	9	10	78	5.5	7.63	6.81	8.8	900	110.4
1899	Canterbury	2.25	20	46.5	2.5	1	2.5	24	0.55	1	12	9	9	90	5	7.06	5	9.05	900	71.51
1900	Canterbury	2	18	46.5	2	1	2.75	20	0.5	2	8	8	12	102	5.25	6.81	5.25	10.05	960	65.13
1901	Canterbury	2.5	16	48	2	0.75	2.5	20	0.7	1.5	6	18	24	70	5	7.5	6.5	8.5	840	80.84
1902	Canterbury	3.75	17.5	97.5	2.25	1	2.5	22.5	0.825	1.5	25.5	24	22.5	123	5	6.75	5	8.41	1128	112.84
1903	Canterbury	3	22	64	2.5	1	2.5	19.5	0.6	1.25	24	24	24	30	5	7	4.5	8.7	960	78.07
1904	Canterbury	3	17.5	70	2.75	1	2.5	23	0.6	2.25	22	22	33	48	5	6	4.25	8.53	960	83.12
1905	Canterbury	3.125	19.5	62.5	2.25	1	2.625	20	0.7	5.5	18	18	24	165	5	5.5	4.25	8.35	978	99.24
1906	Canterbury	3.125	19	63	2.5	1	2.75	20	0.7	1.5	18	18	24	162	5	5.12	4.5	8.49	1050	96.32
1907	Canterbury	3.5	18.5	85.5	2.25	1	2.375	19	1.125	1.75	13.5	13.5	30	120	4.25	6.5	5.5	8.8	1020	128.44

Year	Province	Bread (2 lb)	Coffee (lb)	flour (50lb)	Rice	Salt (lb)	Sugar (lb)	Tea _lb	Oats (lb)	Onions lb	Carrots (dozen bunches)	Turnips (dozen bunches)	Cabbages per dozen	Potatoes per cwt. - retail	Jam lb	Raisins lb	Currants lb	Dried Fruits lb	Beer (hhd)	Grocery index
1908	Canterbury	3.25	20	78.5	2.75	1	2.25	20	0.6875	1.5	18	18	27	69	4	6.25	4.5	7.17	930	90.11
1909	Canterbury	3.5	21	76.5	2.25	1.25	2.875	19.5	0.5375	2	24	18	30	54	4	5.44	4.25	5.9	1170	81.56
1910	Canterbury	3.25	22	69	2.25	1	2.625	17	0.6625	1.75	18	18	30	171	4.5	5	4.25	6.55	1020	92.14
1911	Canterbury	3.25	21	70.5	2.25	1	2.625	22.5	0.8875	2.25	18	18	36	87	4.5	6	4.62	6.78	990	111.59
1912	Canterbury	3.25	21	70	2.25	1	2.625	20	0.7125	3	17	17	21	114	4	7	5	7.71	990	97.83
1913	Canterbury	3.625	20	72	2.25	1	2.75	20	0.9	2.25	15	15	22.5	45	4	6.75	4	7.75	1020	110.47
1885	Otago	3.125	25	66	4	1.5	4	28.5	0.6	2.75	22	20	27	81	4.92	8.33	8.15	11.85	1170	94.64
1886	Otago	3.25	24	71	4	1.5	4.25	30	0.7	2.25	30	31.5	27	72	4.92	8.63	9.31	12.86	1260	106.27
1887	Otago	3.25	21	70.5	3.25	1.25	3.75	30	0.625	2.25	24	21	27	48	4.92	7.89	9.36	11.91	1155	92.21
1888	Otago	3	19	60	3.5	1	3.5	29	1.1	2.5	18	18	15	129	4.92	7.92	8.99	10.92	1159.5	131.59
1889	Otago	2.75	20	71	3.25	1.5	3.5	29	0.65	2	20	18	27.5	86	4.92	6.93	7.54	11.11	1159.5	91.68
1890	Otago	2.75	22.5	66	3.5	1.5	3.5	31.5	0.5125	2	19.5	19.5	27	69	5.1	8	8.27	10.7	1074	79.71
1891	Otago	3.25	21	84	3.5	1	3.25	27	0.525	1.25	24	24	24	48	6.25	8.87	8.5	10.48	1080	79.23
1892	Otago	3	21	66	3	1	3	24	0.5	1.37	15	15	18	27	6.25	7.72	5.81	10.44	1140	69.57
1893	Otago	2.75	21	66	2.625	1	3.375	24	0.675	1.16	15	15	58.5	87	5.75	7	5.72	11.05	1158	87.48
1894	Otago	2.5	21	63	3.25	0.87	3	27	0.5125	1.87	13	16	19	81	5.75	5.91	5.12	10.86	1098	72.68
1895	Otago	3	21	72	3	1	3	22	0.9125	1.09	13	13	19	88.5	5.75	5.81	4.53	9.76	1560	106.3
1896	Otago	3.5	21	87	3	1	3	25.5	0.6625	1.45	16	16	22	84	5.5	5.44	4.59	8.95	1038	92.26
1897	Otago	3.5	21	79.5	3	1	2.75	25.5	0.8125	1.59	12	12	25.5	63	5.5	7.09	4.91	9.44	1410	103.26
1898	Otago	3.5	21	78	3.5	1	3	22.5	0.875	1.67	16	16	28.5	123	5.5	7.06	6.19	9.39	1050	111.87
1899	Otago	2.75	21	69	2.75	1	2.75	22.5	0.675	1.19	16	19	22	81	5.5	7.94	6.56	8.53	990	83.8
1900	Otago	2.25	21	46.5	2.5	1	2.75	21	0.525	1.17	15	15	21	63	5.5	7.79	6.37	9.55	870	64.84
1901	Otago	3.25	21	66	2.75	0.87	2.875	25.5	0.675	1.75	18	18	27	60	5.5	7.56	7.28	10.1	960	88.72
1902	Otago	3.625	21	84	2.25	0.87	2.75	20.5	0.775	1.11	42	42	42	117	5.5	7.28	5.34	8.92	1080	98.78
1903	Otago	3.625	21	70.5	2.5	0.87	2.75	22	0.6375	1	24	24	22	72	5.5	5.97	4.19	8.43	1020	84.68
1904	Otago	3.625	21	70.5	2.5	0.87	2.75	24	0.525	0.97	30	30	24	69	5.5	5.69	4.19	8.35	1020	75.85
1905	Otago	3.5	21	72	2.5	0.87	2.75	19.5	0.6	2.5	30	30	27	186	5.5	6.03	4.5	8.53	1050	86.71

Year	Province	Bread (2 lb)	Coffee (lb)	flour (50lb)	Rice	Salt (lb)	Sugar (lb)	Tea _lb	Oats (lb)	Onions lb	Carrots (dozen bunches)	Turnips (dozen bunches)	Cabbages per dozen	Potatoes per cwt. - retail	Jam lb	Raisins lb	Currant s lb	Dried Fruits lb	Beer (hhd)	Grocery index
1906	Otago	3.125	21	69	2.5	0.87	2.75	18	0.6375	1.47	30	30	30	132	5.5	5.81	4.25	9.3	1140	83.56
1907	Otago	3.875	21	87	2.5	0.87	2.75	18	1.0875	1.06	24	24	24	186	5.5	6.12	4.5	9.48	1140	124.7
1908	Otago	3.5	21	78	2.75	0.87	2.25	18	0.7625	1.56	24	24	30	66	5.5	5.62	4	7.58	1080	90.72
1909	Otago	3.75	21	79.5	2.5	0.87	2.375	21	0.7875	1.12	21	21	36	57	5.5	4.41	3.25	6.8	1350	94.93
1910	Otago	3.625	21	76.5	2.5	0.87	2.5	17	0.8125	1	24	27	30	145.5	5.75	4.5	3.37	6.28	1062	97.63
1911	Otago	3.375	21	73.5	2.625	0.87	3	20	0.875	0.91	18	18	30	97.5	5.75	6.25	4.25	6.83	1086	103.05
1912	Otago	3.5	21	76.5	3	0.87	2.75	19.5	0.825	1.75	21	21	24	123	5.75	6.47	4	8.28	1140	103.58
1913	Otago	3.5	21.5	78	2.5	0.87	3	21	0.8	1.53	24	24	33	42	5.75	5.81	4.06	7.24	1158	96.75
1885	Wellington	3	19.5	75	3.25	1.5	3.75	31.5	0.7625	2.5	25.5	25.5	24	87	4.67	6.06	4.76	8.27	1140	97.21
1886	Wellington	3.5	20.5	84	3.5	1.25	4	27	0.7875	2.5	21	21	21	66	4.67	6.29	5.43	8.98	1080	101.25
1887	Wellington	3.5	20	75	2.75	0.75	3	27	0.75	3	18	18	21	84	4.67	5.74	5.46	8.31	1080	92.61
1888	Wellington	3.5	18.5	84	3	1.25	3	24	0.9875	2	21	21	21	126	4.67	5.77	5.25	7.62	1140	111.79
1889	Wellington	3.5	19.5	72	2.75	1	3.5	33	0.7125	2.75	14	14	15	78	4.67	5.04	4.4	7.76	1020	93.3
1890	Wellington	3.25	21	69	3.5	1.25	3.5	27	0.525	2.5	18	18	22.5	57	5	5.82	4.83	7.47	990	74.32
1891	Wellington	3.75	20	91.5	3	1	3.375	36	0.6	1.63	27	21	21	69	4	6.46	4.96	7.31	1140	86.22
1892	Wellington	3.25	20	76.5	3	1	3.25	33	0.7875	1.62	18	21	18	87	4	7.11	5.87	9.9	1050	96.41
1893	Wellington	3	20	64.5	3	1	4	33	0.7875	1.39	14	13.5	18	63	4	6.11	5.61	10.17	930	93.2
1894	Wellington	2.75	20	57	2.75	1	3.5	39	0.675	1.98	18	18	24	54	4	5.63	4.66	10.02	1140	83.19
1895	Wellington	3.25	20	73.5	2.5	1	2.75	27	0.825	1.31	17	13.5	24	60	4	5.5	4	9	1050	90.21
1896	Wellington	3.5	20	82.5	2.75	1	2.75	24	0.8125	1	18	18	21	69	4	6	4.5	8.43	1086	91
1897	Wellington	3.25	20	81	2.75	1	2.75	24	0.75	1.61	12	12	30	66	4.25	7	4.75	8.85	1020	85.69
1898	Wellington	3.5	20	75	3	1	2.5	22	0.7375	1.9	15	15	18	87	4	8	5.5	9.04	1140	87.05
1899	Wellington	2.5	20	55.5	3	1	2.75	25.5	0.7125	1.26	14	14	21	48	4	8	5	9.05	1080	75.11
1900	Wellington	2.75	20	52.5	2.5	1	2.75	24	0.75	1.4	12	12	33	78	4	7.19	5.87	7.59	960	79.97
1901	Wellington	3	20	54	2.75	1	2.75	22	0.7875	1.94	18	18	15	96	4	5.5	4.25	7.05	1080	86.16
1902	Wellington	3.75	19	96	2.5	1	2.75	22	1.0125	1.5	12	12	24	96	4.25	7	5	7.7	1080	108.23
1903	Wellington	3.5	19	70.5	2.5	1	2.75	24	0.675	1.12	18	18	24	51	4.25	6.87	3.82	6.91	1020	79.06

Year	Province	Bread (2 lb)	Coffee (lb)	flour (50lb)	Rice	Salt (lb)	Sugar (lb)	Tea _lb	Oats (lb)	Onions lb	Carrots (dozen bunches)	Turnips (dozen bunches)	Cabbages per dozen	Potatoes per cwt. - retail	Jam lb	Raisins lb	Currants lb	Dried Fruits lb	Beer (hhd)	Grocery index
1904	Wellington	3.25	19	70.5	2.5	1	2.75	21.5	0.675	1.25	18	18	30	72	4.25	6	4.25	7.39	960	77.68
1905	Wellington	3.25	19	72	2.5	1	2.75	21	0.8875	2.42	18	18	24	180	4.25	6.5	4.25	7.08	900	98.38
1906	Wellington	3.25	19	67.5	2.5	1	2.75	22	0.925	1.42	15	15	30	180	4.25	7	4.5	7.71	1029	100.14
1907	Wellington	3.75	19.33	84	2.5	1	2.25	21	1.2625	1.82	18	18	30	132	4.17	7	4.5	7.4	1029	122.66
1908	Wellington	3.75	19.33	84	2.5	1	2.375	21	0.825	2	18	18	36	84	4.17	6.83	4.33	7.46	1020	92.89
1909	Wellington	3.5	19.33	82.5	2.5	1	2.75	21	0.7875	1.67	15	15	24	87	4.17	5.17	4.33	6.32	1080	89.31
1910	Wellington	3.5	19.33	69	2.125	1	2.125	21	0.95	1.43	18	18	33	132	4.17	5	4.33	6.27	1260	97.84
1911	Wellington	3.25	19.33	70.5	2.5	1	2.75	19	1.1625	1.42	19.5	19.5	27	72	4.17	5.17	4.5	6.95	1203	108.29
1912	Wellington	3.25	20	70	2.5	1	2.5	21	0.9875	2.31	24	24	24	90	4	4.75	4.5	7.4	1236	100.91
1913	Wellington	3.75	20	75	2.5	1	2.625	20	0.95	1.75	18	18	31.5	69	5	4.25	4	6.9	1050	100.35

Table A-6. Dairy prices (pence), 1885-1913

Year	Province	Milk	Fresh Butter	Salted Butter	Cheese	Eggs	Bacon	Ham	Dairy Index
1885	Auckland	3.5	11	10.5	7	12	7.5	9	89.75
1886	Auckland	3.5	11.5	9	7.13	15	8.5	10.25	92.31
1887	Auckland	3.25	10.5	7.5	6.5	11.5	8	9	81.92
1888	Auckland	4	9	7.5	7.5	11.5	8.5	11.5	87.33
1889	Auckland	4	9	7	4.88	9.5	7	9	78.47
1890	Auckland	4	9.5	7.5	5.5	10	7	9	81.42
1891	Auckland	4.5	8.25	6.5	6.5	12	8	9	83.55
1892	Auckland	3	10.25	6	5	10	7	10	73.64
1893	Auckland	3	9	8	5	10	9	11	78.48
1894	Auckland	3	9	6	5	9	7.5	10	71.72
1895	Auckland	3	10	6.5	6	10	7	10	75.47
1896	Auckland	3	11	8	5	12	8	10	81.17
1897	Auckland	3	12	8	6	12	8	10	83.66
1898	Auckland	2.75	9.5	7.5	5	11.5	8	9.25	75.60
1899	Auckland	3	11	7	5	10	7.25	9.25	76.50
1900	Auckland	3	7.75	6.5	5.25	11	6	8	69.54
1901	Auckland	3.5	12.5	8.5	6	12.5	8	9	88.31
1902	Auckland	3.5	13.5	8.5	7.25	12	9	10.25	92.67
1903	Auckland	3.5	11.5	8.5	7.25	10	8.75	10.625	88.39
1904	Auckland	3.5	10	8.5	6.63	12	9.25	11	87.93
1905	Auckland	3.5	10.5	8.75	6.5	11.5	9.5	11.5	89.23
1906	Auckland	3.25	11.25	9.5	8	12	8.5	10	89.71
1907	Auckland	3.5	13	10	7.5	12	8.5	9	93.46
1908	Auckland	3.75	13.5	10	7.75	13	8.5	9.75	97.45
1909	Auckland	3.5	13	11	7.5	12.25	8.75	9.5	95.99
1910	Auckland	3.5	14.75	10	7.5	11.5	7.75	8.5	93.81
1911	Auckland	3.5	13.5	10.5	8.5	13	9.5	10	98.67
1912	Auckland	3.5	14.5	11	8.5	13	10.75	10.75	102.76
1913	Auckland	3.5	14.5	11	10	15	11	13.5	107.82
1885	Canterbury	3.5	10	7.5	4.75	11	8.5	10	82.11
1886	Canterbury	3.5	10	7	5.5	12.5	8	9.5	82.22
1887	Canterbury	3.5	7.5	6	5	11	7	8	72.31
1888	Canterbury	2.75	8.5	6.5	7	10	8.5	8.5	73.61
1889	Canterbury	2.75	7.5	6.5	4.75	9	7.5	9.5	68.71
1890	Canterbury	2.5	8	6	4	8	7	10	64.93
1891	Canterbury	3	10	8	5	10	6	9	75.75
1892	Canterbury	3.25	10	6.5	5	9.5	7.5	9	75.96
1893	Canterbury	3	10	8	5	10	9	9	79.20
1894	Canterbury	3	10	6	5	9	6	8	70.50
1895	Canterbury	3	7	6	4.5	8	6	7	64.11
1896	Canterbury	3	9	6	4	10	6.5	7	68.55
1897	Canterbury	3	8	6	4	7	6	8	64.88

Year	Province	Milk	Fresh Butter	Salted Butter	Cheese	Eggs	Bacon	Ham	Dairy Index
1898	Canterbury	3	8	6	4.5	9	7	8.5	68.64
1899	Canterbury	3	9	7	4	9	6	8	69.87
1900	Canterbury	3	9	9	7	10	7	8.5	78.96
1901	Canterbury	3	12	9	6	9	6	8	79.52
1902	Canterbury	3.5	10.5	8.5	7.5	11.5	8.5	9.5	87.90
1903	Canterbury	3.5	9.5	8.5	6.5	11	8	10.5	85.09
1904	Canterbury	3.5	10	8.5	6.75	8.5	8.25	9.5	83.56
1905	Canterbury	3.5	11.5	9.5	6	11.5	7.5	8.5	87.54
1906	Canterbury	3.5	11.5	10	7.5	10.5	8.5	9.75	91.36
1907	Canterbury	3.5	12.5	9.5	7.5	13	9.5	10.5	95.60
1908	Canterbury	3.5	13.5	10	7.25	13	9	10.25	96.80
1909	Canterbury	3.5	13	11	6.75	13.5	8.75	9.5	96.73
1910	Canterbury	3.5	13	11	7.25	10.5	8.5	9.5	94.56
1911	Canterbury	3.5	14.5	11	7.5	11	9.5	10	98.75
1912	Canterbury	3.5	14.5	10.5	8.5	13	10	10.5	101.55
1913	Canterbury	4	13.5	10.5	8	15	11.5	12	107.54
1885	Otago	4.5	11	10.5	7	12	8.5	22	101.05
1886	Otago	4	10	8.5	8.75	12	8.25	9.75	88.17
1887	Otago	4.5	8.5	7	7	9.5	8	9.5	81.37
1888	Otago	3.5	11.5	10	6.5	11	8	8	85.39
1889	Otago	3.5	10.5	8.75	7	11.5	8.5	10.25	85.09
1890	Otago	4.25	9	9	6.5	10.5	8.75	10	86.29
1891	Otago	3.25	10.5	8	6	10	8	10	79.31
1892	Otago	3	10	8	5.5	10.5	6.5	8.5	74.13
1893	Otago	3.5	10.5	8.5	6.5	11	8	9.5	82.71
1894	Otago	3	10.5	8.75	6	10.5	7.25	8.5	77.46
1895	Otago	3	9.5	9.25	6	12	7.25	8.5	77.87
1896	Otago	3.25	10.5	9.25	6.13	13.5	6.75	8	81.01
1897	Otago	3.25	11	10	4.63	12.5	7	10	82.16
1898	Otago	3	9.5	8	5.75	12	8	9.5	77.11
1899	Otago	3	9.5	9	6.25	13.5	7.5	9	79.32
1900	Otago	3.5	10.5	9	6.5	11.5	7	8	81.59
1901	Otago	4.5	11.5	8.75	7	10.5	7.5	8.75	89.11
1902	Otago	4.25	10	9.75	6.75	12	8	9.5	89.43
1903	Otago	4.5	11.5	9.5	7.75	11	9.25	11	95.47
1904	Otago	4.5	10.5	9.5	7.25	10	8.5	9.5	90.61
1905	Otago	4	11	10	7.25	10	8.25	9.75	89.33
1906	Otago	3.5	13	10.5	7.5	11	8.5	10.5	91.65
1907	Otago	3.5	12.5	8.5	7.75	12	10	11	90.54
1908	Otago	3.5	13.5	10.5	7.5	13.5	10	12.25	97.07
1909	Otago	3.5	13	10	7.75	14.5	10.25	11	95.94
1910	Otago	3.5	13	12	8.5	12	10	11	97.74
1911	Otago	3.5	14	11	8.5	12.5	10.5	11.5	98.79
1912	Otago	3.5	14.5	10.5	9.5	13	11.5	12.5	101.54

Year	Province	Milk	Fresh Butter	Salted Butter	Cheese	Eggs	Bacon	Ham	Dairy Index
1913	Otago	3.5	14.5	11.5	8.5	15	12.5	13.5	105.38
1885	Wellington	3.5	10.5	9	6.75	14	8.75	11.5	90.13
1886	Wellington	4	9	7.5	6.75	13.5	7.5	10.5	85.42
1887	Wellington	3	8	6	5.75	12	7.5	8.5	71.51
1888	Wellington	3.5	8.5	7	6	10	8.75	8.75	77.72
1889	Wellington	4	8	6.5	6.5	10	8	9.25	78.61
1890	Wellington	3.5	8	6	5.25	13	6.5	8.25	73.15
1891	Wellington	3	9	7	6.5	13.5	7.25	10.5	77.76
1892	Wellington	3.5	10	8.5	7	14.5	6.75	9.5	85.18
1893	Wellington	3	10	7.5	7	10.5	7.5	9	78.04
1894	Wellington	3.5	10.5	8	7	10.5	8.25	9.5	84.14
1895	Wellington	2.5	7.5	6.5	6.13	11.5	6.75	8.5	67.66
1896	Wellington	2.5	8	6	5.75	9	6.75	8	65.19
1897	Wellington	2.5	11	6.5	5.75	12.5	7	8.75	73.19
1898	Wellington	2.5	10	7	5.5	8.5	8.25	9.5	71.65
1899	Wellington	3	10.5	7.5	5.5	11	8	9.5	78.47
1900	Wellington	3	10	7.5	6.5	14	7.5	8.5	79.48
1901	Wellington	3.5	11	8.5	6	12	7.5	9	84.60
1902	Wellington	3.5	10	8.5	6.75	13.5	11.25	12	90.89
1903	Wellington	3.5	10	8.5	7	13	9	10.5	87.67
1904	Wellington	3	10	8	6.5	12	8.25	9	80.38
1905	Wellington	3	11.5	9.5	7.5	12	7.5	9	85.09
1906	Wellington	3.5	13	10.5	8.25	13.5	7.75	9.25	94.55
1907	Wellington	3.5	13	9	8.5	13.5	8.5	9.75	93.52
1908	Wellington	3.5	13.5	9	7.75	14	8.5	10.25	94.18
1909	Wellington	3.5	13	9.5	7	13	9.75	9.75	94.03
1910	Wellington	3.5	13	9.5	8.5	10.5	9.75	10.5	94.04
1911	Wellington	3.5	14.5	10	7.5	13	10.25	10.5	98.45
1912	Wellington	3.5	13.5	11	8.25	14	10.75	10.75	101.08
1913	Wellington	4	14.5	11	8.5	15	12.5	15	111.73

Table A-7. Meat prices (pence), 1885-1913

year	province	Beef (lb)	Mutton (lb)	Pork (lb)	Lamb (lb)	Veal (lb)	Meat Index (lb)
1885	Auckland	4.25	3.5	6	6	4.5	83.118218
1886	Auckland	4.25	3.25	5.5	5.5	4	79.5485722
1887	Auckland	3.75	2.25	3.5	4.5	3	63.7484143
1888	Auckland	3	2.63	4.5	4.25	3.63	60.0338574
1889	Auckland	3.5	3.13	4.5	4	4	66.3925184
1890	Auckland	4.25	3.5	4.5	5	4.5	78.3185928
1891	Auckland	5.25	4	4.5	4.5	5	87.5370377
1892	Auckland	6	4	4.5	6	6	99.5824891
1893	Auckland	5	3.5	5	4	3.75	81.0690601
1894	Auckland	6	4.5	5	5	6	99.1374701
1895	Auckland	5	3	5	5	4	82.4079161
1896	Auckland	5	3	5	5	4	82.4079161
1897	Auckland	3.5	2.5	5	5	4	66.9544955
1898	Auckland	4.25	3.38	5	5	4.5	78.4091275
1899	Auckland	4.25	4	5	4.5	4.5	79.4277694
1900	Auckland	3.5	3.25	4	4.5	3.5	67.5063202
1901	Auckland	4.75	4.75	5.25	6	5.5	92.9510359
1902	Auckland	6	5.25	6	6	5	106.814617
1903	Auckland	6.5	4.75	6	6.5	5	110.554337
1904	Auckland	5.5	5.25	6.75	6.75	5.5	106.284661
1905	Auckland	5	5	6	6.5	5	98.4777806
1906	Auckland	5.5	5	6	6.5	5.5	103.481437
1907	Auckland	4.5	5	6	6.75	5	94.3306311
1908	Auckland	5	5	6	6.5	5	98.4777806
1909	Auckland	4.25	4	6	5.75	5.25	85.1678735
1910	Auckland	4.5	4.75	6	6	5.5	91.542478
1911	Auckland	5.25	5.25	6.5	7	6	104.744718
1912	Auckland	5.75	5.5	7.5	6.75	5.5	110.519356
1913	Auckland	5.75	5.25	7	6.25	6	107.603749
1885	Canterbury	4.13	2.38	5.5	4	4.25	66.1068515
1886	Canterbury	4.5	2.25	5.25	4	4.25	67.9317015
1887	Canterbury	4.25	2.63	5.75	5	4.5	71.9585096
1888	Canterbury	4	2.5	5	3.5	4	63.4342908
1889	Canterbury	4.25	2.5	5	4	4	67.0749518
1890	Canterbury	5	3	4	5	4	77.2511112
1891	Canterbury	5	3	6	6	4	82.761487
1892	Canterbury	5	3	5	7	5	84.8710439
1893	Canterbury	4	3	6	4.5	4	70.1978372
1894	Canterbury	3	2.5	4.5	3	3	52.5177352
1895	Canterbury	4	2.75	5	6	4	72.0143868
1896	Canterbury	4	2	4.5	3	4.5	58.6054804
1897	Canterbury	4.5	3.5	5	4	3	72.8960082

year	province	Beef (lb)	Mutton (lb)	Pork (lb)	Lamb (lb)	Veal (lb)	Meat Index (lb)
1898	Canterbury	4.5	3.5	5	4.5	4.5	75.8538977
1899	Canterbury	3	2	4	4	2.5	52.3181383
1900	Canterbury	4	4	6	6	3.5	78.3392751
1901	Canterbury	5	4	6	6	5	88.4488994
1902	Canterbury	6	4.75	6.5	6	5.5	100.939891
1903	Canterbury	5.75	4.5	7	6	5.25	98.2338615
1904	Canterbury	6	5	7	7	4.5	104.953333
1905	Canterbury	6	4.5	7	6	5.25	100.261281
1906	Canterbury	5.5	5	6.25	6.5	5	98.6992033
1907	Canterbury	5	4.75	7.5	7	5	96.108393
1908	Canterbury	4.75	4.5	7.5	6.5	5.25	91.5762937
1909	Canterbury	4.5	4	7	6	4.5	84.7723615
1910	Canterbury	6	4.25	7	6.25	5	99.7393918
1911	Canterbury	7	5	6.5	6	5	109.394846
1912	Canterbury	6	5	7	6	5	102.196772
1913	Canterbury	6	5	7.5	6	5	102.762399
1885	Otago	5.5	4	6.5	4.25	5	85.2842148
1886	Otago	5	3.75	5.25	4.5	5	79.9721578
1887	Otago	4.25	3.25	5.75	4.25	4	70.9495889
1888	Otago	4	3.25	5.75	5	4	71.1915105
1889	Otago	4.25	3	6	4.5	4.13	70.9537592
1890	Otago	5	3.75	6	5.5	4.5	83.787244
1891	Otago	4.5	3.5	5	4.5	4	74.0305592
1892	Otago	4	3.25	5.5	4.25	3.25	68.1021017
1893	Otago	5	4	5.5	4.5	4.5	80.9711915
1894	Otago	4.5	4	6	5.5	4	80.3108003
1895	Otago	4.5	3.25	5.75	4.5	4	73.7615306
1896	Otago	4.5	3.25	5	5.25	5	75.8996637
1897	Otago	4.75	3.25	5	4.5	5	75.5303365
1898	Otago	5.5	4.25	6	5.5	4.5	89.932761
1899	Otago	4.5	3.5	5.5	4.5	4.5	74.9494664
1900	Otago	5.5	4.5	5.5	5.5	5	90.7172462
1901	Otago	5.5	5	6	5.75	5	94.1294394
1902	Otago	6	5	7.5	6.5	7.5	104.066161
1903	Otago	6.75	5.5	7	6	6.25	109.04972
1904	Otago	5.75	5	6.75	7	5.5	101.3505
1905	Otago	6.5	5.25	7	7	6.5	109.594099
1906	Otago	6	5	7	7.5	5	104.784829
1907	Otago	5.5	5	7	6.5	5	97.6630578
1908	Otago	5.25	4.75	6.75	6.5	5	94.2570563
1909	Otago	5.5	4.5	6.5	6	4.5	93.1582506
1910	Otago	5.75	4.5	7.25	6	5	96.4077773
1911	Otago	6.5	5	7	6.5	5.5	106.22099
1912	Otago	5	5	7	7.5	6	96.7071668

year	province	Beef (lb)	Mutton (lb)	Pork (lb)	Lamb (lb)	Veal (lb)	Meat Index (lb)
1913	Otago	6.25	5	8	7	5	106.52583
1885	Wellington	4.5	3.5	5.5	5	6	84.134231
1886	Wellington	4.5	3	5	5	5	80.3719873
1887	Wellington	3.5	2.75	4	5	3.75	67.9840916
1888	Wellington	3	3	4.5	5	4	65.0195415
1889	Wellington	3.5	2.75	4.5	7.5	4	74.617192
1890	Wellington	3	3.25	5	3.5	3.5	61.7101857
1891	Wellington	4	3.25	5	6.5	5	81.3378312
1892	Wellington	4.25	3.25	5.5	6	5	83.0404076
1893	Wellington	4.5	3.5	5	5.5	5	84.483637
1894	Wellington	4.25	3.5	6.5	5.25	5	83.1633687
1895	Wellington	3.75	3.5	5.5	4.25	5	74.0768091
1896	Wellington	3.38	3.25	4.5	4.5	4	68.4538749
1897	Wellington	3.88	3.25	5	4.5	4.5	74.1145956
1898	Wellington	3.5	2.75	5.25	3.75	3.75	65.5945107
1899	Wellington	3.25	2.5	5	5.5	3.5	66.6059341
1900	Wellington	5	4.5	5.5	5.5	5.5	94.5218501
1901	Wellington	5	4.5	6	6.25	4.5	96.8663102
1902	Wellington	5.75	5.25	7	7.5	5.75	113.278446
1903	Wellington	5.5	4.75	7	6	5.13	103.468156
1904	Wellington	6	4.75	6	6	5.25	106.6616
1905	Wellington	5.75	5	7	6.75	5.5	109.644214
1906	Wellington	4.5	4.25	5.5	6	5.5	90.398581
1907	Wellington	5.5	4.75	6.5	7	5.25	106.179313
1908	Wellington	5	4.75	7	7	5.5	102.224344
1909	Wellington	4.75	4	6.5	7	5	95.4342919
1910	Wellington	5	4.75	6	7.25	5	101.295668
1911	Wellington	5	4.25	6.75	6.75	5	98.5860106
1912	Wellington	4.75	4.75	7	6	5	96.3422082
1913	Wellington	5.5	4.5	7	7.75	5.25	107.834865

Table A-8. Housing prices (pence), 1885-1913

year	Main city	Weekly rents (pence)	Housing index
1885	Auckland	119.15	64.51
1886	Auckland	132.1	71.52
1887	Auckland	132.97	71.99
1888	Auckland	115.59	62.58
1889	Auckland	104.03	56.32
1890	Auckland	104.51	56.58
1891	Auckland	105.44	57.08
1892	Auckland	105.33	57.02
1893	Auckland	105.28	57
1894	Auckland	105.89	57.33
1895	Auckland	106.06	57.42
1896	Auckland	110.23	59.68
1897	Auckland	105.85	57.31
1898	Auckland	102.05	55.25
1899	Auckland	137.1	74.22
1900	Auckland	137.1	74.22
1901	Auckland	151.65	82.1
1902	Auckland	155.18	84.01
1903	Auckland	155.4	84.13
1904	Auckland	155.7	84.29
1905	Auckland	160.2	86.73
1906	Auckland	163.65	88.6
1907	Auckland	163.65	88.6
1908	Auckland	166.43	90.1
1909	Auckland	170.85	92.5
1910	Auckland	177	95.83
1911	Auckland	179.55	97.21
1912	Auckland	194.55	105.33
1913	Auckland	201.6	109.14
1885	Christchurch	196.06	107.86
1886	Christchurch	175.88	96.75
1887	Christchurch	178.9	98.42
1888	Christchurch	159.77	87.89
1889	Christchurch	156.2	85.93
1890	Christchurch	148.68	81.79
1891	Christchurch	144.75	79.63
1892	Christchurch	144.95	79.74
1893	Christchurch	142.28	78.27
1894	Christchurch	141.45	77.82
1895	Christchurch	138.33	76.1
1896	Christchurch	136.99	75.36
1897	Christchurch	138.62	76.26
1898	Christchurch	150.05	82.55

year	Main city	Weekly rents (pence)	Housing index
1899	Christchurch	158.1	86.97
1900	Christchurch	174.75	96.13
1901	Christchurch	176.25	96.96
1902	Christchurch	180.45	99.27
1903	Christchurch	177.23	97.49
1904	Christchurch	176.63	97.16
1905	Christchurch	186.6	102.65
1906	Christchurch	201.38	110.78
1907	Christchurch	191.4	105.29
1908	Christchurch	188.4	103.64
1909	Christchurch	180.63	99.36
1910	Christchurch	180.6	99.35
1911	Christchurch	182.25	100.26
1912	Christchurch	181.13	99.64
1913	Christchurch	184.3	101.39
1885	Dunedin	190.65	112.98
1886	Dunedin	195.86	116.07
1887	Dunedin	179.8	106.55
1888	Dunedin	175.83	104.2
1889	Dunedin	177.39	105.12
1890	Dunedin	176.15	104.38
1891	Dunedin	173.38	102.74
1892	Dunedin	171.87	101.85
1893	Dunedin	168.83	100.05
1894	Dunedin	165.52	98.09
1895	Dunedin	157.13	93.11
1896	Dunedin	154.76	91.71
1897	Dunedin	151.8	89.96
1898	Dunedin	152.92	90.62
1899	Dunedin	149.55	88.62
1900	Dunedin	152.55	90.4
1901	Dunedin	153	90.67
1902	Dunedin	155.4	92.09
1903	Dunedin	157.35	93.24
1904	Dunedin	160.5	95.11
1905	Dunedin	161.55	95.73
1906	Dunedin	163.5	96.89
1907	Dunedin	163.05	96.62
1908	Dunedin	166.5	98.67
1909	Dunedin	166.8	98.84
1910	Dunedin	167.48	99.24
1911	Dunedin	168.38	99.78
1912	Dunedin	169.5	100.44
1913	Dunedin	171.6	101.69

year	Main city	Weekly rents (pence)	Housing index
1885	Wellington	150.71	67.3
1886	Wellington	168.7	75.34
1887	Wellington	177.87	79.43
1888	Wellington	171.12	76.42
1889	Wellington	167.18	74.66
1890	Wellington	167.35	74.74
1891	Wellington	165.98	74.12
1892	Wellington	166.42	74.32
1893	Wellington	169.17	75.55
1894	Wellington	169.14	75.54
1895	Wellington	166.93	74.55
1896	Wellington	165.41	73.87
1897	Wellington	161.41	72.08
1898	Wellington	172.3	76.95
1899	Wellington	177.6	79.31
1900	Wellington	196.73	87.86
1901	Wellington	199.2	88.96
1902	Wellington	204.95	91.53
1903	Wellington	209.85	93.72
1904	Wellington	217.5	97.13
1905	Wellington	224.5	100.26
1906	Wellington	227.95	101.8
1907	Wellington	226.55	101.17
1908	Wellington	227	101.38
1909	Wellington	225.3	100.62
1910	Wellington	221.35	98.85
1911	Wellington	218.35	97.51
1912	Wellington	220.35	98.41
1913	Wellington	234.25	104.61

Table A-9. Fuel and light prices (pence), 1885-1913

Year	Province	Candles	Coals per ton	Firewood per cord	Fuel & Light index
1885	Auckland	11	300	420	120.43
1886	Auckland	10	330	450	120.84
1887	Auckland	7.5	315	426	103.68
1888	Auckland	7.25	390	387	111.88
1889	Auckland	8	330	360	108.08
1890	Auckland	8	360	390	112.85
1891	Auckland	8	420	294	119.26
1892	Auckland	6	300	144	86.9
1893	Auckland	8	324	276	105.78
1894	Auckland	5.5	300	384	87.76
1895	Auckland	8	300	420	104.35
1896	Auckland	8	360	420	113.27
1897	Auckland	8	300	420	104.35
1898	Auckland	6.5	252	348	87.05
1899	Auckland	7	270	300	92.15
1900	Auckland	7.5	270	204	93.24
1901	Auckland	7.25	462	384	120.69
1902	Auckland	7	486	300	120.05
1903	Auckland	6.5	456	270	112.24
1904	Auckland	7.5	396	315	113.21
1905	Auckland	6.75	390	333	107.53
1906	Auckland	6.75	411	222	107.88
1907	Auckland	7	345	240	101.75
1908	Auckland	7	342	324	102.89
1909	Auckland	7	318	252	98.33
1910	Auckland	7	357	264	103.83
1911	Auckland	7	342	210	100.68
1912	Auckland	6.5	342	300	99.13
1913	Auckland	7	294	390	97.01
1885	Canterbury	9	378	510	125.62
1886	Canterbury	7.5	390	480	106.45
1887	Canterbury	6.5	378	378	92.33
1888	Canterbury	5.75	438	390	83.43
1889	Canterbury	5.75	420	378	83.12
1890	Canterbury	5.5	432	390	80.1
1891	Canterbury	8	360	420	111.62
1892	Canterbury	7	372	330	97.95
1893	Canterbury	6	360	456	86.51
1894	Canterbury	8	360	216	107.97
1895	Canterbury	7.25	390	360	101.78
1896	Canterbury	7	420	480	100.41
1897	Canterbury	7	360	480	99.64
1898	Canterbury	6	390	450	86.8

Year	Province	Candles	Coals per ton	Firewood per cord	Fuel & Light index
1899	Canterbury	6	432	516	87.85
1900	Canterbury	8	600	300	112.6
1901	Canterbury	7	444	480	100.69
1902	Canterbury	6	528	408	87.7
1903	Canterbury	6	492	420	87.51
1904	Canterbury	6	462	420	87.24
1905	Canterbury	6.25	486	420	90.73
1906	Canterbury	6.25	543	390	90.9
1907	Canterbury	7	432	420	99.89
1908	Canterbury	6.75	444	420	96.8
1909	Canterbury	7	456	432	100.3
1910	Canterbury	7	462	426	100.29
1911	Canterbury	7	450	375	99.52
1912	Canterbury	6.5	480	348	93.06
1913	Canterbury	7.5	528	372	106.71
1885	Otago	11.5	372	279	128.2
1886	Otago	9	328.5	294	108.17
1887	Otago	9	333	300	109.02
1888	Otago	8	372	300	109.28
1889	Otago	9.75	336	258	112.67
1890	Otago	8.25	408	237	114.68
1891	Otago	8.5	330	300	105.77
1892	Otago	7	312	240	93.2
1893	Otago	6.25	270	270	82.87
1894	Otago	8.75	330	264	106.48
1895	Otago	7.375	300	288	94.41
1896	Otago	6.5	270	240	83.85
1897	Otago	7.5	276	288	91.25
1898	Otago	7	237	282	81.88
1899	Otago	7	246	270	83.24
1900	Otago	6.25	360	300	96.2
1901	Otago	7.5	366	300	105.29
1902	Otago	6.5	345	408	97.33
1903	Otago	8	360	345	108.25
1904	Otago	7	360	348	101.99
1905	Otago	7	360	318	101.53
1906	Otago	7.75	360	312	106.18
1907	Otago	7.25	354	336	102.56
1908	Otago	6.75	336	360	97.09
1909	Otago	7	342	360	99.57
1910	Otago	6.75	336	348	96.93
1911	Otago	6.75	327	348	95.62
1912	Otago	7.5	378	336	107.61
1913	Otago	6.75	360	336	100.15

Year	Province	Candles	Coals per ton	Firewood per cord	Fuel & Light index
1885	Wellington	11.5	450	354	118.23
1886	Wellington	10	480	330	114.26
1887	Wellington	9	420	372	102.54
1888	Wellington	7.5	510	270	102.44
1889	Wellington	7.5	504	321	102.72
1890	Wellington	8.5	516	258	108.77
1891	Wellington	8.5	546	336	113.37
1892	Wellington	8.5	504	336	108.92
1893	Wellington	8	516	360	107.62
1894	Wellington	7.5	504	300	102.38
1895	Wellington	7.5	420	330	93.9
1896	Wellington	7	468	312	95.82
1897	Wellington	7	378	318	86.2
1898	Wellington	6	492	270	91
1899	Wellington	7	396	300	87.97
1900	Wellington	7.5	468	300	98.65
1901	Wellington	7	504	264	98.61
1902	Wellington	7.5	528	324	105.19
1903	Wellington	7	504	318	99.54
1904	Wellington	7.5	516	348	104.36
1905	Wellington	7.25	486	348	99.75
1906	Wellington	7	570	300	105.54
1907	Wellington	7.25	486	372	100.08
1908	Wellington	7	450	372	94.79
1909	Wellington	7.5	462	378	99.16
1910	Wellington	7.25	492	426	101.38
1911	Wellington	7.5	510	342	103.66
1912	Wellington	7	450	438	95.57
1913	Wellington	7	486	489	99.87

Table A-10. Miscellaneous prices (pence), 1885-1913

Year	Province	Soap per cwt.	Medical (Payments per patient)	Library Income per person (for each education district)	Carpenters' wages in pence	Timber per feet in pence	Miscellaneous index
1885	Auckland	240	364.36	3.46	114	1.16	93.34
1886	Auckland	258	370.03	3.44	102	1.12	93.41
1887	Auckland	210	378.47	3.43	102	0.98	89.49
1888	Auckland	234	389.85	3.41	102	0.98	91.75
1889	Auckland	180	404.74	3.39	102	1	89.44
1890	Auckland	186	422.63	3.37	102	1.04	91.59
1891	Auckland	336	441.94	3.33	90	1.02	100.2
1892	Auckland	144	461.23	3.28	84	0.92	87.37
1893	Auckland	216	479.22	3.2	96	0.91	94.23
1894	Auckland	210	493.72	3.12	90	0.87	93.15
1895	Auckland	198	503.58	3.05	90	0.89	92.61
1896	Auckland	198	508.29	2.99	90	0.92	92.85
1897	Auckland	198	508.02	2.96	96	0.94	93.38
1898	Auckland	180	502.79	2.96	108	0.97	92.92
1899	Auckland	246	491.65	2.98	120	0.94	97.02
1900	Auckland	120	476.41	3.02	126	0.97	87.27
1901	Auckland	180	459.73	3.09	126	0.98	92.4
1902	Auckland	219	442.88	3.19	120	1.01	94.84
1903	Auckland	234	427.3	3.32	126	1.01	95.95
1904	Auckland	270	413.8	3.46	114	1.01	97.29
1905	Auckland	237	403.02	3.57	114	1.02	95.44
1906	Auckland	240	395.88	3.63	120	0.97	95.17
1907	Auckland	276	392.33	3.64	132	1.04	98.62
1908	Auckland	336	390.54	3.63	132	1.07	101.71
1909	Auckland	270	389.42	3.61	132	1.13	99.08
1910	Auckland	270	389.54	3.59	132	1.19	99.68
1911	Auckland	246	391.8	3.55	132	1.22	98.59
1912	Auckland	303	396.72	3.51	132	1.25	102.08
1913	Auckland	279	403.31	3.44	132	1.21	100.36
1885	Canterbury	240	145.57	3.5	114	1.16	84.81
1886	Canterbury	210	148.75	3.49	108	1.12	82.89
1887	Canterbury	222	148.8	3.48	108	0.98	81.99
1888	Canterbury	147	146.36	3.47	114	0.98	76.86
1889	Canterbury	138	142.54	3.47	120	1	75.83
1890	Canterbury	180	138.08	3.46	108	1.04	77.83
1891	Canterbury	216	132.93	3.45	102	1.02	78.38
1892	Canterbury	174	126.56	3.44	108	0.92	73.7
1893	Canterbury	192	119.07	3.44	108	0.91	73.07

Year	Province	Soap per cwt.	Medical (Payments per patient)	Library Income per person (for each education district)	Carpenters' wages in pence	Timber per feet in pence	Miscellaneous index
1894	Canterbury	168	111.71	3.45	90	0.87	68.76
1895	Canterbury	216	106.1	3.47	96	0.89	70.74
1896	Canterbury	216	103.6	3.48	108	0.92	71.15
1897	Canterbury	171	104.41	3.49	120	0.94	69.76
1898	Canterbury	180	108.51	3.5	108	0.97	71.09
1899	Canterbury	96	115.46	3.52	108	0.94	65.89
1900	Canterbury	204	124.67	3.55	132	0.97	77.46
1901	Canterbury	204	135.87	3.58	126	0.98	79.94
1902	Canterbury	180	148.96	3.61	132	1.01	81.81
1903	Canterbury	228	162.88	3.62	126	1.01	87.18
1904	Canterbury	186	175.84	3.6	132	1.01	87.05
1905	Canterbury	195	186.49	3.56	126	1.02	88.99
1906	Canterbury	222	194.62	3.52	132	0.97	91.43
1907	Canterbury	225	200.96	3.49	132	1.04	93.38
1908	Canterbury	240	206.32	3.48	132	1.07	95.47
1909	Canterbury	252	210.94	3.48	132	1.13	97.77
1910	Canterbury	264	214.41	3.46	132	1.19	99.69
1911	Canterbury	294	216.05	3.44	132	1.22	101.76
1912	Canterbury	306	215.46	3.42	138	1.25	102.75
1913	Canterbury	234	212.47	3.42	138	1.21	97.72
1885	Otago	264	190.6	2.24	144	1.16	82.19
1886	Otago	252	193.85	2.2	126	1.12	80.39
1887	Otago	207	196.67	2.16	120	0.98	76.32
1888	Otago	237	199.69	2.11	114	0.98	77.54
1889	Otago	219	203.79	2.07	138	1	77.94
1890	Otago	177	209.55	2.01	126	1.04	75.6
1891	Otago	246	216.14	1.95	114	1.02	78.85
1892	Otago	210	222.94	1.89	120	0.92	76.23
1893	Otago	180	229.53	1.83	102	0.91	73.62
1894	Otago	192	235.75	1.79	108	0.87	74.39
1895	Otago	198	241.77	1.75	120	0.89	75.71
1896	Otago	156	248.45	1.71	120	0.92	73.7
1897	Otago	195	256.08	1.69	114	0.94	76.74
1898	Otago	252	264.33	1.68	120	0.97	81.14
1899	Otago	210	273.36	1.67	126	0.94	79.68
1900	Otago	162	282.5	1.67	120	0.97	77.64
1901	Otago	225	291.02	1.67	132	0.98	83.19
1902	Otago	216	299.09	1.67	120	1.01	83.25
1903	Otago	228	308.03	1.68	132	1.01	85.41
1904	Otago	264	317.96	1.69	108	1.01	87.11

Year	Province	Soap per cwt.	Medical (Payments per patient)	Library Income per person (for each education district)	Carpenters' wages in pence	Timber per feet in pence	Miscellaneous index
1905	Otago	234	328	1.7	144	1.02	88.55
1906	Otago	246	338.06	1.71	132	0.97	89.15
1907	Otago	252	347.49	1.74	132	1.04	91.73
1908	Otago	228	354.96	1.79	126	1.07	91.76
1909	Otago	246	360.4	1.84	132	1.13	95.22
1910	Otago	228	365.06	1.89	132	1.19	96.06
1911	Otago	252	369.44	1.95	126	1.22	98.7
1912	Otago	240	373.78	2.01	144	1.25	100.49
1913	Otago	252	378.32	2.07	132	1.21	101.45
1885	Wellington	246	221.49	1.85	114	1.16	63.67
1886	Wellington	234	230.1	1.97	114	1.12	64.82
1887	Wellington	132	237.08	2.11	114	0.98	60.15
1888	Wellington	177	240.7	2.27	108	0.98	64.22
1889	Wellington	216	242.01	2.46	108	1	67.92
1890	Wellington	135	243.48	2.68	114	1.04	65.6
1891	Wellington	210	247.96	2.93	108	1.02	71.87
1892	Wellington	246	255.19	3.19	108	0.92	74.97
1893	Wellington	264	263.62	3.44	108	0.91	78.06
1894	Wellington	180	271.02	3.63	96	0.87	74.5
1895	Wellington	198	276.07	3.77	108	0.89	77.75
1896	Wellington	240	279.08	3.89	102	0.92	81.02
1897	Wellington	192	281.79	4	120	0.94	80.53
1898	Wellington	234	285.34	4.12	114	0.97	84.07
1899	Wellington	186	289.86	4.24	114	0.94	81.91
1900	Wellington	207	294.18	4.37	114	0.97	84.77
1901	Wellington	228	295.52	4.51	126	0.98	87.76
1902	Wellington	216	293.71	4.68	132	1.01	88.45
1903	Wellington	207	290.73	4.89	126	1.01	88.32
1904	Wellington	267	288.73	5.13	144	1.01	93.68
1905	Wellington	246	288.85	5.39	120	1.02	92.66
1906	Wellington	276	290.08	5.63	132	0.97	95.55
1907	Wellington	267	292.43	5.79	132	1.04	97.05
1908	Wellington	240	295.48	5.87	132	1.07	96.6
1909	Wellington	306	298.78	5.9	126	1.13	101.28
1910	Wellington	240	302.18	5.91	126	1.19	98.9
1911	Wellington	300	306.09	5.92	132	1.22	103.44
1912	Wellington	198	310.21	5.9	132	1.25	97.89
1913	Wellington	225	314.13	5.86	132	1.21	99.51

Table A-11. Clothing and Footwear price index (1909-13=100), 1885-1913

Year	Province	Clothes	Boots and shoes	Clothing and Footwear Index
1885	Auckland	43.43	95.64	52.91
1886	Auckland	44.78	97.54	54.4
1887	Auckland	46.26	98.65	55.9
1888	Auckland	47.98	98.9	57.49
1889	Auckland	50.02	98.34	59.23
1890	Auckland	52.36	97.14	61.11
1891	Auckland	55	95.4	63.12
1892	Auckland	57.87	93.1	65.18
1893	Auckland	60.81	90.23	67.11
1894	Auckland	63.76	86.95	68.9
1895	Auckland	66.62	83.58	70.5
1896	Auckland	69.17	80.5	71.84
1897	Auckland	71.22	78.21	72.91
1898	Auckland	72.65	77.17	73.76
1899	Auckland	73.39	77.6	74.42
1900	Auckland	73.45	79.34	74.88
1901	Auckland	73.14	82.02	75.27
1902	Auckland	72.99	85.19	75.87
1903	Auckland	73.55	88.5	77.03
1904	Auckland	75.13	91.74	78.97
1905	Auckland	77.65	94.64	81.59
1906	Auckland	80.9	96.96	84.64
1907	Auckland	84.59	98.63	87.9
1908	Auckland	88.35	99.71	91.06
1909	Auckland	92.09	100.32	94.08
1910	Auckland	95.95	100.54	97.08
1911	Auckland	100.05	100.4	100.13
1912	Auckland	104.17	99.84	103.07
1913	Auckland	107.75	98.89	105.47
1885	Canterbury	93.44	101.85	95.48
1886	Canterbury	89.42	100.32	92.02
1887	Canterbury	86	98.79	89.03
1888	Canterbury	83.27	97.19	86.55
1889	Canterbury	81.1	95.46	84.48
1890	Canterbury	79.25	93.6	82.62
1891	Canterbury	77.65	91.71	80.95
1892	Canterbury	76.6	90.04	79.76
1893	Canterbury	76.63	88.91	79.53
1894	Canterbury	77.8	88.42	80.33
1895	Canterbury	79.89	88.52	81.97
1896	Canterbury	82.55	89.13	84.15

Year	Province	Clothes	Boots and shoes	Clothing and Footwear Index
1897	Canterbury	85.34	90.16	86.52
1898	Canterbury	87.87	91.5	88.76
1899	Canterbury	89.89	93.03	90.66
1900	Canterbury	91.39	94.64	92.19
1901	Canterbury	92.5	96.18	93.41
1902	Canterbury	93.38	97.52	94.4
1903	Canterbury	94.17	98.6	95.26
1904	Canterbury	94.9	99.39	96.01
1905	Canterbury	95.57	99.91	96.64
1906	Canterbury	96.29	100.18	97.25
1907	Canterbury	97.13	100.28	97.91
1908	Canterbury	97.97	100.27	98.54
1909	Canterbury	98.69	100.22	99.07
1910	Canterbury	99.31	100.14	99.52
1911	Canterbury	99.93	100.04	99.95
1912	Canterbury	100.62	99.9	100.44
1913	Canterbury	101.46	99.71	101.02
1885	Otago	66.95	112.32	76.2
1886	Otago	64.26	111.79	73.8
1887	Otago	62.16	110.96	71.85
1888	Otago	60.76	109.78	70.44
1889	Otago	59.96	108.22	69.5
1890	Otago	59.64	106.38	68.92
1891	Otago	59.77	104.37	68.71
1892	Otago	60.57	102.4	69.06
1893	Otago	62.35	100.69	70.28
1894	Otago	65.1	99.39	72.36
1895	Otago	68.55	98.55	75.07
1896	Otago	72.24	98.14	77.99
1897	Otago	75.51	98.08	80.61
1898	Otago	77.78	98.25	82.46
1899	Otago	78.7	98.46	83.23
1900	Otago	78.33	98.49	82.95
1901	Otago	77.18	98.29	81.99
1902	Otago	75.97	97.97	80.95
1903	Otago	75.34	97.73	80.41
1904	Otago	75.74	97.72	80.72
1905	Otago	77.23	97.81	81.93
1906	Otago	79.76	97.84	83.94
1907	Otago	83.15	97.83	86.6
1908	Otago	86.97	97.93	89.59
1909	Otago	91.03	98.32	92.8
1910	Otago	95.34	99.05	96.25
1911	Otago	99.94	100.04	99.97

Year	Province	Clothes	Boots and shoes	Clothing and Footwear Index
1912	Otago	104.66	101.01	103.73
1913	Otago	109.04	101.57	107.12
1885	Wellington	59.88	132.07	72.98
1886	Wellington	60.83	139.31	74.83
1887	Wellington	61.67	143.96	76.23
1888	Wellington	62.66	146.11	77.44
1889	Wellington	63.96	146.34	78.66
1890	Wellington	65.48	145.22	79.91
1891	Wellington	67.11	142.81	81.05
1892	Wellington	68.72	138.36	81.86
1893	Wellington	70.24	131.17	82.11
1894	Wellington	71.75	121.53	81.85
1895	Wellington	73.31	110.45	81.22
1896	Wellington	74.92	99.49	80.42
1897	Wellington	76.51	90.34	79.75
1898	Wellington	78	84.05	79.47
1899	Wellington	79.27	80.77	79.64
1900	Wellington	80.23	80.61	80.33
1901	Wellington	81.01	82.73	81.44
1902	Wellington	81.85	86.04	82.88
1903	Wellington	82.99	89.77	84.64
1904	Wellington	84.57	93.41	86.7
1905	Wellington	86.58	96.63	88.99
1906	Wellington	88.91	99.2	91.38
1907	Wellington	91.35	101.01	93.68
1908	Wellington	93.65	102.05	95.68
1909	Wellington	95.72	102.33	97.33
1910	Wellington	97.74	101.83	98.75
1911	Wellington	99.91	100.58	100.08
1912	Wellington	102.23	98.7	101.34
1913	Wellington	104.4	96.56	102.38

Table A-12. CPI by province (1909-13=100), 1885-1913

Year	Auckland	Canterbury	Otago	Wellington
1885	88.74	85.52	93.28	84.99
1886	92.00	84.74	93.33	86.04
1887	79.90	79.83	85.60	80.17
1888	88.31	96.06	97.55	85.91
1889	81.36	80.88	85.35	82.36
1890	85.49	79.20	82.77	74.36
1891	84.65	81.13	80.91	82.30
1892	77.89	78.05	75.22	86.75
1893	77.36	78.15	82.56	85.60
1894	74.05	67.88	78.85	82.13
1895	81.47	76.96	87.89	81.01
1896	84.05	77.35	83.53	80.39
1897	80.81	79.35	88.31	79.65
1898	79.22	89.15	92.11	79.61
1899	78.69	75.95	82.10	77.18
1900	74.58	80.68	79.26	83.70
1901	87.94	87.23	88.70	86.79
1902	96.49	99.48	93.11	97.40
1903	88.84	88.80	90.69	87.35
1904	89.39	90.78	86.64	88.08
1905	91.90	96.72	90.82	95.59
1906	92.46	97.46	90.40	96.02
1907	99.02	106.97	102.46	105.10
1908	95.92	95.27	93.34	95.87
1909	92.40	92.08	95.42	95.00
1910	95.07	96.89	97.31	98.42
1911	102.11	104.30	101.06	101.97
1912	102.43	99.64	102.01	99.74
1913	105.58	104.85	101.94	103.72

Table A-13. Railway statistics, 1885-1913

Year ended 31st March.	Length open (Miles).	Train-mileage.	Passengers.	Goods and Live-stock, tonnage*
1885	1477		3232886	1749856
1886	1613		3362266	1823767
1887	1727		3426403	1747754
1888	1758		3451850	1735762
1889	1777	2796007	3132803	1954126
1890	1809	2868203	3376459	2112734
1891	1842	2894776	3433629	2134023
1892	1869	3010489	3555764	2122987
1893	1886	3002174	3759044	2258235
1894	1948	3113231	3972701	2128709
1895	1993	3221620	3905578	2123343
1896	2014	3307226	4162426	2175943
1897	2018	3409218	4439387	2461127
1898	2055	3666483	4672264	2628746
1899	2090	3968708	4955553	2744441
1900	2104	4187893	5468284	3251716
1901	2212	4620971	6243593	3461331
1902	2235	5066360	7356136	3667039
1903	2291	5443333	7575390	3918261
1904	2328	5685399	8306383	4259217
1905	2374	6107079	8514112	4185468
1906	2407	6413573	8826382	4415166
1907	2458	6755454	9600786	4824563
1908	2474	7051274	9756716	5070176
1909	2674	7458236	10457144	5135408
1910	2717	7889166	11141142	5490018
1911	2753	8141075	11200613	5863674
1912	2798	8371687	11891134	5887908
1913	2851	9016224	13123879	6246128

Source: New Zealand Official yearbook, 1893-1913

Appendix B

B1.Constructon of provincial real wages

Average wage rates were collected from *Statistics New Zealand Annual Reports*. As previously noted by Arnold, there are two sources from which the historical wages could be derived: Department of Labour Factories' Reports (New Zealand & Statistics, 1891-1924), and *Statistics New Zealand Annual Reports*, first published in 1873. The first source contains data on the wages of factory employees from 1891, and was not sufficient in terms of coverage (representing only about 14 % of the workforce in the 1900s). The second source provides data on wages that is more continuous, and covers a greater variety of occupations.

The reported range of wage rate values was averaged to produce a single nominal rate for each occupation. Weights were extracted from the Occupations of People Census (*New Zealand Census Statistics 1874-1911*), however, the 1891 *Occupations of People Census Statistics* did not report the number of people employed at the provincial level, and was thus omitted. The resulting series were grouped into eight different sectors (Arnold, 1982a): industry, farming, mining, building and construction, transport, trade, services, handicraft (occupations in each sector were weighted according to the occupation censuses of 1886, 1896, 1901, 1906, and 1911). Year 1891 was omitted since the number of people employed in each specific occupation was not available at the provincial level, and therefore figures from 1896 census were utilized instead. From 1896, the suborders of occupations were reported rather than the actual occupations. In the absence of any further information, there was little choice but to take the suborder with the occupation in it (Arnold, 1982a). Public Utilities subgroup was omitted from the wage series, since the shopkeepers and shopkeeper assistants' series were not available. Some of the series' violent yearly fluctuations could be artificial due to rounding, since Statistics New Zealand at some years reported the range of weekly, daily or yearly wages, at others – a single value. The weights for a particular occupations used 1886 weights, whereas the subseries weights (industry, farming etc. breakdown in the overall index) differed based on the weights in each census year (1885-1890 used 1886 weights; 1891-1900: 1896 weights; 1901-1905: 1901 weights; 1906-1910: 1906 weights, and

1911-1913: 1911 weights). There was a considerable decline in the share of people employed in the manufacturing sector based on 1896 census figures. This decline is not necessarily a true reflection of the labour force movements since there was a change in the way the various occupations, included in the census, were grouped together (before 1891 the number of people employed in each occupation were reported, after 1891 the individual occupations census figures were substituted by orders and suborders of occupations).

The final regional wage indices used occupation weights from each successive census (Tables: B-1 to B-6, below), and were each calculated as a Tornqvist index (the base period 1909-1913=100). The deflators used to derive provincial real wages for the periphery provinces used the main centres' CPI series (see Chapter 2 for construction of the regional CPIs): Taranaki used Auckland, Nelson and Marlborough – Canterbury, Hawke's Bay – Wellington, and Westland used the average of the Canterbury and Otago provincial districts (this was approximated based on the locations of the provincial districts). Chapter 4 and 5 use real wages only from the four largest provinces (Auckland, Canterbury, Otago and Wellington). Initially real wages series were only constructed for the 1885-1913, which for some chapters was expanded to 1873-1940 (Chapter 5 covered 1873-1919 period, and Chapters 6 used 1873-1900). Statistics New Zealand series (published for the four main centres) were used to connect a provincial real wage series from 1913 to 1940 (Table B-7).

Table B-1. Wage-series' occupations breakdown

Industry (without board)	Farming	Mining (no board)	Building (no board)	Transport (no board)	Trade (no board)	Services	Handicraft (no board)
	Farm-labourers with board	Miners	Carpenter		Storekeepers	Married couples with board	Bakers
Watchmakers	Farm-labourers without board		General Labourers	Engine-drivers	Storekeeper's Assistants	House servants with board	Needlewomen
Wheelwrights	Shepherds with board				Storemen	Housemaids without board	Shoemakers
Shipwrights	Stockkeepers with board					Nursemaids without board	Coopers
Milliners	Station-labourers with board						Smith
Masons	Shearers with board						
Plaster							
Bricklayer							
Plumbers							
Painters							
Dressmakers							
Machinists							
Tailors							
Tailoresses							
Butchers							
Draper's Assistants							
Saddlers							
Grocer's assistants							

Table B-2. Provincial weights in % (Census year -1886)

Subseries	Auckland	Canterbury	Otago	Wellington	Taranaki	Hawke's Bay	Malborough	Nelson	Westland
Industry (without board)	21.96	17.63	15.61	18.49	10.73	13.12	9.56	9.54	10.92
Farming	31.91	41.67	32.75	33.84	53.23	40.92	41.87	28.42	6.45
Mining (no board)	6.85	0.47	14.47	0.29	0.11	0.12	4.12	30.38	54.5
Building (no board)	13.98	14.42	15.5	22.21	19.24	25.16	25.56	14.84	12.31
Transport (no board)	1.08	1.11	1.54	2.06	1.08	1.22	0.66	0.87	1.06
Trade (no board)	1.63	0.73	1	1.19	0.56	0.87	1	0.86	1.11
Services	14.28	16.68	13.03	15.63	10.29	13.76	12.22	9.74	8.34
Handicraft (no board)	8.3	7.29	6.1	6.29	4.76	4.83	5.01	5.35	5.32
	100	100	100	100	100	100	100	100	100

Table B-3. Provincial weights in % (Census year -1896)

Subseries	Auckland	Canterbury	Otago	Wellington	Taranaki	Hawke's Bay	Malborough	Nelson	Westland
Industry (without board)	12.39	14.52	13.27	13.47	6.67	9.12	6.00	5.57	6.29
Farming	36.74	49.93	43.24	43.60	68.02	48.97	57.70	35.50	12.39
Mining (no board)	16.11	0.31	11.26	0.28	0.23	0.46	6.47	33.71	49.75
Building (no board)	8.82	6.91	7.17	11.45	8.04	10.51	6.20	6.16	6.58
Transport (no board)	8.66	7.16	7.28	8.87	3.60	8.27	4.97	5.71	7.85
Trade (no board)	0.49	0.30	0.50	0.79	0.50	0.50	0.93	0.31	0.42
Services	13.26	16.77	13.92	17.98	10.86	19.04	15.40	10.68	14.36
Handicraft (no board)	3.53	4.10	3.37	3.55	2.08	3.13	2.33	2.37	2.37
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table B-4. Provincial weights in % (Census year -1901)

Subseries	Auckland	Canterbury	Otago	Wellington	Taranaki	Hawke's Bay	Malborough	Nelson	Westland
Industry (without board)	12.53	15.63	13.54	12.80	7.38	9.09	6.81	6.05	7.66
Farming	34.52	47.99	41.66	41.73	66.40	49.25	60.91	36.11	10.86
Mining (no board)	15.20	0.43	9.49	0.22	0.30	0.13	3.86	29.60	45.49
Building (no board)	8.24	7.51	7.22	10.91	6.98	8.32	5.81	5.20	5.63
Transport (no board)	9.95	7.33	7.97	9.93	5.17	9.81	5.57	7.21	10.56
Trade (no board)	0.41	0.19	0.53	0.63	0.12	0.60	0.03	0.18	0.32
Services	15.16	16.53	15.03	19.43	11.46	19.69	14.74	12.94	15.94
Handicraft (no board)	3.98	4.39	4.57	4.35	2.19	3.11	2.28	2.71	3.54
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table B-5. Provincial weights in % (Census year -1906)

Subseries	Auckland	Canterbury	Otago	Wellington	Taranaki	Hawke's Bay	Malborough	Nelson	Westland
Industry (without board)	11.86	14.68	13.30	12.40	7.91	9.97	6.86	6.11	7.72
Farming	35.15	44.11	41.43	36.43	66.33	47.61	60.92	35.02	12.87
Mining (no board)	11.95	0.75	7.81	0.49	0.28	0.04	1.65	26.91	30.12
Building (no board)	9.47	10.84	8.28	13.68	5.48	10.74	7.15	6.43	7.17
Transport (no board)	10.86	8.38	9.11	12.59	5.46	9.07	5.84	8.61	16.63
Trade (no board)	0.35	0.03	0.27	0.48	0.10	0.49	0.10	0.09	0.34
Services	15.70	16.36	14.95	19.60	12.18	18.67	15.52	13.58	20.90
Handicraft (no board)	4.66	4.85	4.85	4.32	2.25	3.40	1.97	3.27	4.27
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table B-6. Provincial weights in % (Census year -1911)

Subseries	Auckland	Canterbury	Otago	Wellington	Taranaki	Hawke's Bay	Malborough	Nelson	Westland
Industry(without board)	11.39	15.14	15.90	12.36	8.02	9.94	6.67	4.95	8.14
Farming	36.82	44.23	36.04	35.26	64.61	47.24	58.10	32.56	16.79
Mining (no board)	8.52	0.46	6.65	0.35	0.30	0.29	1.13	29.42	24.23
Building (no board)	11.59	10.09	9.25	10.50	6.55	10.65	8.00	6.44	9.14
Transport (no board)	11.72	9.49	10.33	15.01	6.97	11.02	8.09	10.01	16.27
Trade (no board)	0.52	0.14	0.51	0.45	0.07	0.26	0.11	0.13	0.18
Services	15.14	15.38	15.47	21.76	11.31	17.08	15.76	13.53	20.75
Handicraft (no board)	4.31	5.08	5.85	4.30	2.18	3.53	2.14	2.96	4.50
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table B-7. CPI, nominal and real wage indices by province, base 1909-13=100

Year	Province	Nominal Wage Index	CPI	Real Wage Index
1873	Auckland	94.07	104.18	90.29
1874	Auckland	89.67	111.84	80.18
1875	Auckland	77.10	102.53	75.20
1876	Auckland	75.85	97.37	77.90
1877	Auckland	76.10	108.58	70.09
1878	Auckland	85.58	119.51	71.61
1879	Auckland	82.86	122.93	67.40
1880	Auckland	89.09	109.09	81.67
1881	Auckland	86.93	109.77	79.20
1882	Auckland	89.90	106.84	84.14
1883	Auckland	78.45	106.44	73.70
1884	Auckland	78.50	103.47	75.87
1885	Auckland	83.84	92.93	90.22
1886	Auckland	79.03	94.70	83.45
1887	Auckland	77.65	85.45	90.88
1888	Auckland	72.77	87.52	83.15
1889	Auckland	70.72	85.46	82.75
1890	Auckland	71.60	89.92	79.62
1891	Auckland	68.11	91.26	74.64
1892	Auckland	70.41	84.64	83.18
1893	Auckland	74.54	82.97	89.84
1894	Auckland	67.84	81.91	82.83
1895	Auckland	72.28	84.30	85.74
1896	Auckland	73.48	86.69	84.76
1897	Auckland	73.49	84.69	86.78
1898	Auckland	77.94	83.77	93.04
1899	Auckland	81.34	84.46	96.31
1900	Auckland	87.98	80.15	109.76
1901	Auckland	87.11	90.88	95.85
1902	Auckland	87.49	96.10	91.04
1903	Auckland	90.12	94.52	95.35
1904	Auckland	87.48	94.54	92.53
1905	Auckland	89.72	95.99	93.47
1906	Auckland	87.80	94.82	92.60
1907	Auckland	94.76	96.34	98.36
1908	Auckland	95.32	97.90	97.36
1909	Auckland	92.76	95.56	97.07
1910	Auckland	94.36	96.56	97.72
1911	Auckland	97.60	99.53	98.06
1912	Auckland	106.92	103.05	103.75
1913	Auckland	108.79	104.66	103.95

Year	Province	Nominal Wage Index	CPI	Real Wage Index
1914	Auckland	106.90	108.70	98.34
1915	Auckland	142.80	113.50	125.81
1916	Auckland	114.30	118.60	96.37
1917	Auckland	109.40	123.10	88.87
1918	Auckland	125.70	132.00	95.23
1919	Auckland	133.50	137.20	97.30
1920	Auckland	150.50	155.30	96.91
1921	Auckland	167.70	157.90	106.21
1922	Auckland	162.90	148.49	109.71
1923	Auckland	162.10	152.46	106.32
1924	Auckland	164.70	162.37	101.44
1925	Auckland	164.50	169.07	97.30
1926	Auckland	166.10	172.76	96.14
1927	Auckland	167.20	170.15	98.27
1928	Auckland	174.90	173.07	101.06
1929	Auckland	179.25	173.73	103.18
1930	Auckland	179.45	167.86	106.90
1931	Auckland	168.40	151.93	110.84
1932	Auckland	157.65	136.72	115.31
1933	Auckland	151.60	124.23	122.03
1934	Auckland	152.40	127.79	119.26
1935	Auckland	156.67	138.55	113.08
1936	Auckland	169.86	145.42	116.81
1937	Auckland	181.90	155.08	117.30
1938	Auckland	189.21	160.10	118.18
1939	Auckland	194.97	167.48	116.41
1940	Auckland	200.48	172.40	116.29
1873	Canterbury	80.26	102.15	78.57
1874	Canterbury	80.34	110.14	72.95
1875	Canterbury	78.24	100.09	78.17
1876	Canterbury	84.91	129.82	65.41
1877	Canterbury	85.05	123.06	69.12
1878	Canterbury	83.71	113.34	73.86
1879	Canterbury	81.71	118.84	68.76
1880	Canterbury	82.17	101.08	81.30
1881	Canterbury	84.77	106.83	79.35
1882	Canterbury	84.72	108.76	77.90
1883	Canterbury	83.39	105.07	79.36
1884	Canterbury	80.51	97.00	83.00
1885	Canterbury	86.06	92.09	93.45
1886	Canterbury	80.32	91.25	88.02
1887	Canterbury	77.94	87.55	89.02
1888	Canterbury	77.97	89.87	86.75
1889	Canterbury	83.12	85.00	97.79

Year	Province	Nominal Wage Index	CPI	Real Wage Index
1890	Canterbury	88.69	83.21	106.59
1891	Canterbury	103.04	86.61	118.97
1892	Canterbury	91.44	83.96	108.90
1893	Canterbury	88.72	82.55	107.47
1894	Canterbury	74.60	75.85	98.35
1895	Canterbury	74.43	81.26	91.60
1896	Canterbury	80.61	81.79	98.55
1897	Canterbury	85.80	84.29	101.78
1898	Canterbury	90.89	85.38	106.46
1899	Canterbury	91.08	81.28	112.05
1900	Canterbury	78.18	86.71	90.16
1901	Canterbury	76.48	88.56	86.36
1902	Canterbury	85.37	97.93	87.18
1903	Canterbury	84.75	92.60	91.53
1904	Canterbury	88.59	94.45	93.80
1905	Canterbury	86.55	98.59	87.79
1906	Canterbury	88.24	98.81	89.30
1907	Canterbury	94.09	99.34	94.72
1908	Canterbury	92.79	96.61	96.05
1909	Canterbury	94.71	97.15	97.48
1910	Canterbury	94.89	99.02	95.84
1911	Canterbury	95.54	101.10	94.50
1912	Canterbury	106.08	100.29	105.77
1913	Canterbury	105.40	101.80	103.53
1914	Canterbury	108.80	101.50	107.19
1915	Canterbury	113.00	110.10	102.63
1916	Canterbury	116.20	114.40	101.57
1917	Canterbury	123.10	121.00	101.74
1918	Canterbury	129.00	128.10	100.70
1919	Canterbury	139.90	136.40	102.57
1920	Canterbury	164.00	155.60	105.40
1921	Canterbury	174.50	157.10	111.08
1922	Canterbury	167.20	144.41	115.78
1923	Canterbury	163.90	148.13	110.64
1924	Canterbury	167.10	154.68	108.03
1925	Canterbury	169.20	159.02	106.40
1926	Canterbury	170.70	162.30	105.17
1927	Canterbury	171.90	161.96	106.14
1928	Canterbury	178.10	162.09	109.88
1929	Canterbury	180.85	159.97	113.05
1930	Canterbury	180.90	155.14	116.60
1931	Canterbury	169.35	144.44	117.25
1932	Canterbury	159.10	132.85	119.76
1933	Canterbury	153.20	125.52	122.05

Year	Province	Nominal Wage Index	CPI	Real Wage Index
1934	Canterbury	152.80	127.84	119.52
1935	Canterbury	157.93	132.18	119.48
1936	Canterbury	170.74	135.48	126.03
1937	Canterbury	182.22	144.32	126.26
1938	Canterbury	189.19	149.63	126.44
1939	Canterbury	194.69	156.43	124.46
1940	Canterbury	199.94	162.50	123.04
1873	Otago	94.28	103.89	90.75
1874	Otago	94.83	95.41	99.40
1875	Otago	94.65	114.06	82.98
1876	Otago	91.41	114.19	80.05
1877	Otago	96.53	123.60	78.10
1878	Otago	97.80	129.54	75.50
1879	Otago	92.14	125.15	73.62
1880	Otago	87.01	113.16	76.90
1881	Otago	95.38	133.15	71.63
1882	Otago	99.59	113.70	87.60
1883	Otago	91.55	118.06	77.55
1884	Otago	97.04	112.78	86.04
1885	Otago	89.36	101.77	87.80
1886	Otago	93.23	98.63	94.53
1887	Otago	86.28	92.69	93.09
1888	Otago	89.38	93.37	95.72
1889	Otago	92.10	91.03	101.17
1890	Otago	90.07	92.37	97.51
1891	Otago	91.55	89.14	102.71
1892	Otago	83.57	83.45	100.14
1893	Otago	87.16	86.24	101.07
1894	Otago	91.03	86.45	105.30
1895	Otago	86.08	86.42	99.61
1896	Otago	84.29	87.56	96.26
1897	Otago	85.38	89.11	95.81
1898	Otago	88.36	91.31	96.78
1899	Otago	98.24	85.20	115.29
1900	Otago	93.30	85.22	109.49
1901	Otago	89.53	92.51	96.77
1902	Otago	92.14	94.54	97.46
1903	Otago	93.80	94.97	98.77
1904	Otago	88.28	93.71	94.21
1905	Otago	93.86	96.79	96.97
1906	Otago	102.42	94.32	108.59
1907	Otago	102.15	97.71	104.54
1908	Otago	98.72	94.54	104.42
1909	Otago	98.87	96.28	102.70

Year	Province	Nominal Wage Index	CPI	Real Wage Index
1910	Otago	96.57	97.69	98.85
1911	Otago	97.87	99.90	97.97
1912	Otago	102.49	102.03	100.45
1913	Otago	104.35	102.69	101.62
1914	Otago	106.40	103.50	102.80
1915	Otago	126.90	111.40	113.91
1916	Otago	129.60	114.00	113.68
1917	Otago	132.40	119.40	110.89
1918	Otago	134.80	130.60	103.22
1919	Otago	145.00	136.00	106.62
1920	Otago	166.10	152.60	108.85
1921	Otago	176.10	151.80	116.01
1922	Otago	170.90	147.46	115.89
1923	Otago	165.40	150.95	109.57
1924	Otago	167.60	156.40	107.16
1925	Otago	172.70	161.71	106.79
1926	Otago	173.50	163.69	105.99
1927	Otago	176.00	162.76	108.14
1928	Otago	176.40	166.16	106.17
1929	Otago	172.85	168.04	102.86
1930	Otago	174.30	165.52	105.30
1931	Otago	160.90	152.17	105.73
1932	Otago	151.00	140.13	107.76
1933	Otago	147.05	129.78	113.31
1934	Otago	147.65	130.71	112.96
1935	Otago	150.38	137.71	109.20
1936	Otago	162.25	143.15	113.34
1937	Otago	173.33	155.87	111.20
1938	Otago	180.07	161.25	111.67
1939	Otago	185.37	167.93	110.39
1940	Otago	190.44	174.55	109.11
1873	Wellington	91.10	93.08	97.87
1874	Wellington	82.27	115.92	70.97
1875	Wellington	89.19	112.63	79.19
1876	Wellington	89.10	112.00	79.55
1877	Wellington	88.19	126.11	69.93
1878	Wellington	89.43	105.85	84.49
1879	Wellington	84.22	111.84	75.30
1880	Wellington	73.62	103.14	71.38
1881	Wellington	80.17	98.52	81.37
1882	Wellington	88.68	104.57	84.81
1883	Wellington	89.01	108.60	81.96
1884	Wellington	80.65	96.07	83.95
1885	Wellington	89.54	91.95	97.38

Year	Province	Nominal Wage Index	CPI	Real Wage Index
1886	Wellington	91.10	92.40	98.59
1887	Wellington	86.97	86.39	100.67
1888	Wellington	87.46	87.25	100.24
1889	Wellington	82.97	90.14	92.04
1890	Wellington	95.14	86.15	110.44
1891	Wellington	87.25	92.44	94.38
1892	Wellington	91.61	92.01	99.57
1893	Wellington	87.86	91.03	96.52
1894	Wellington	84.49	90.02	93.85
1895	Wellington	82.68	84.24	98.15
1896	Wellington	71.17	83.61	85.13
1897	Wellington	77.14	83.94	91.90
1898	Wellington	78.84	84.18	93.65
1899	Wellington	85.21	82.27	103.58
1900	Wellington	86.25	87.86	98.17
1901	Wellington	88.84	90.25	98.44
1902	Wellington	89.37	96.78	92.35
1903	Wellington	91.20	93.12	97.93
1904	Wellington	89.86	93.50	96.11
1905	Wellington	89.66	97.63	91.84
1906	Wellington	93.89	97.48	96.31
1907	Wellington	92.26	100.22	92.06
1908	Wellington	93.87	98.46	95.33
1909	Wellington	93.89	98.20	95.61
1910	Wellington	98.91	98.81	100.10
1911	Wellington	100.82	98.82	102.02
1912	Wellington	102.32	99.39	102.95
1913	Wellington	103.75	104.03	99.72
1914	Wellington	107.20	112.50	95.29
1915	Wellington	135.50	120.10	112.82
1916	Wellington	112.50	126.20	89.14
1917	Wellington	120.30	133.90	89.84
1918	Wellington	124.50	143.90	86.52
1919	Wellington	132.70	148.30	89.48
1920	Wellington	152.80	162.20	94.20
1921	Wellington	166.20	160.30	103.68
1922	Wellington	163.00	153.20	106.40
1923	Wellington	160.00	159.83	100.11
1924	Wellington	163.70	168.98	96.88
1925	Wellington	167.80	173.15	96.91
1926	Wellington	170.20	176.31	96.53
1927	Wellington	171.40	177.84	96.38
1928	Wellington	175.80	181.90	96.65
1929	Wellington	179.40	186.39	96.25

Year	Province	Nominal Wage Index	CPI	Real Wage Index
1930	Wellington	179.55	183.70	97.74
1931	Wellington	167.80	167.18	100.37
1932	Wellington	156.30	150.64	103.76
1933	Wellington	151.05	140.00	107.90
1934	Wellington	152.10	141.79	107.27
1935	Wellington	155.52	147.77	105.25
1936	Wellington	169.36	152.96	110.72
1937	Wellington	182.24	162.79	111.95
1938	Wellington	190.06	170.47	111.49
1939	Wellington	196.23	176.13	111.41
1940	Wellington	202.12	177.37	113.95
1885	Hawke's Bay	81.93		97.76
1886	Hawke's Bay	84.48		99.38
1887	Hawke's Bay	84.01		106.00
1888	Hawke's Bay	82.88		98.57
1889	Hawke's Bay	79.11		96.66
1890	Hawke's Bay	82.85		111.99
1891	Hawke's Bay	82.83		101.07
1892	Hawke's Bay	83.44		96.69
1893	Hawke's Bay	85.56		100.37
1894	Hawke's Bay	82.59		100.71
1895	Hawke's Bay	83.40		103.46
1896	Hawke's Bay	80.14		100.41
1897	Hawke's Bay	76.68		96.47
1898	Hawke's Bay	79.11		99.77
1899	Hawke's Bay	87.13		113.10
1900	Hawke's Bay	86.89		104.01
1901	Hawke's Bay	80.23		92.54
1902	Hawke's Bay	82.64		85.37
1903	Hawke's Bay	86.42		99.29
1904	Hawke's Bay	85.48		97.65
1905	Hawke's Bay	86.79		91.03
1906	Hawke's Bay	87.94		91.67
1907	Hawke's Bay	92.54		88.62
1908	Hawke's Bay	95.30		99.47
1909	Hawke's Bay	94.61		99.69
1910	Hawke's Bay	100.65		102.29
1911	Hawke's Bay	100.44		98.60
1912	Hawke's Bay	100.33		100.60
1913	Hawke's Bay	103.17		99.55
1885	Marlborough	84.51		100.15
1886	Marlborough	84.46		100.30
1887	Marlborough	72.90		91.99
1888	Marlborough	73.01		78.70

Year	Province	Nominal Wage Index	CPI	Real Wage Index
1889	Marlborough	81.09		100.78
1890	Marlborough	85.04		107.73
1891	Marlborough	77.49		95.70
1892	Marlborough	74.82		96.01
1893	Marlborough	73.90		94.74
1894	Marlborough	77.77		115.84
1895	Marlborough	72.90		95.16
1896	Marlborough	74.96		97.84
1897	Marlborough	75.30		95.52
1898	Marlborough	77.18		87.93
1899	Marlborough	73.46		98.32
1900	Marlborough	81.05		101.73
1901	Marlborough	83.62		96.27
1902	Marlborough	81.56		82.44
1903	Marlborough	86.76		98.13
1904	Marlborough	85.84		94.89
1905	Marlborough	84.35		87.33
1906	Marlborough	87.80		90.21
1907	Marlborough	94.21		88.83
1908	Marlborough	96.51		101.41
1909	Marlborough	95.54		104.18
1910	Marlborough	100.12		103.41
1911	Marlborough	100.12		96.14
1912	Marlborough	101.00		101.39
1913	Marlborough	102.36		97.72
1885	Nelson	85.92		101.82
1886	Nelson	82.28		97.71
1887	Nelson	80.48		101.57
1888	Nelson	79.64		85.85
1889	Nelson	76.79		95.44
1890	Nelson	75.14		95.19
1891	Nelson	78.55		97.00
1892	Nelson	77.57		99.54
1893	Nelson	74.73		95.81
1894	Nelson	79.21		117.98
1895	Nelson	79.85		104.24
1896	Nelson	73.62		96.10
1897	Nelson	73.89		93.73
1898	Nelson	78.69		89.65
1899	Nelson	72.99		97.69
1900	Nelson	82.67		103.76
1901	Nelson	71.36		82.15
1902	Nelson	83.24		84.13
1903	Nelson	91.06		103.01

Year	Province	Nominal Wage Index	CPI	Real Wage Index
1904	Nelson	87.92		97.19
1905	Nelson	87.54		90.63
1906	Nelson	93.77		96.35
1907	Nelson	94.60		89.20
1908	Nelson	93.71		98.47
1909	Nelson	100.55		109.64
1910	Nelson	93.52		96.59
1911	Nelson	93.59		89.87
1912	Nelson	104.57		104.97
1913	Nelson	105.97		101.16
1885	Taranaki	80.65		94.33
1886	Taranaki	73.31		82.79
1887	Taranaki	73.99		94.66
1888	Taranaki	63.61		75.25
1889	Taranaki	73.78		93.22
1890	Taranaki	74.80		89.99
1891	Taranaki	67.98		82.03
1892	Taranaki	71.19		92.56
1893	Taranaki	62.30		81.51
1894	Taranaki	76.23		105.10
1895	Taranaki	74.93		93.33
1896	Taranaki	64.28		77.65
1897	Taranaki	74.81		94.03
1898	Taranaki	72.92		92.97
1899	Taranaki	78.67		100.52
1900	Taranaki	71.34		95.97
1901	Taranaki	83.82		96.17
1902	Taranaki	82.58		86.38
1903	Taranaki	82.56		93.63
1904	Taranaki	93.28		105.08
1905	Taranaki	92.66		101.15
1906	Taranaki	86.58		93.80
1907	Taranaki	89.80		91.17
1908	Taranaki	97.68		101.95
1909	Taranaki	97.44		105.55
1910	Taranaki	94.53		99.49
1911	Taranaki	96.67		94.81
1912	Taranaki	100.18		97.86
1913	Taranaki	109.65		103.89
1885	Westland	97.36		110.10
1886	Westland	96.19		109.08
1887	Westland	94.52		115.28
1888	Westland	89.63		95.74
1889	Westland	89.97		109.08

Year	Province	Nominal Wage Index	CPI	Real Wage Index
1890	Westland	94.30		117.10
1891	Westland	89.74		111.30
1892	Westland	90.58		118.76
1893	Westland	92.58		115.64
1894	Westland	89.88		123.56
1895	Westland	89.15		109.07
1896	Westland	88.73		111.04
1897	Westland	84.14		101.06
1898	Westland	87.78		98.11
1899	Westland	85.89		109.60
1900	Westland	84.30		106.57
1901	Westland	86.11		98.18
1902	Westland	86.23		89.98
1903	Westland	87.68		98.18
1904	Westland	85.89		97.29
1905	Westland	85.21		91.11
1906	Westland	86.58		92.39
1907	Westland	89.17		85.97
1908	Westland	91.78		97.41
1909	Westland	101.96		108.99
1910	Westland	95.82		98.71
1911	Westland	98.04		95.57
1912	Westland	101.84		101.04
1913	Westland	102.07		98.81

Table B-8. Rural sector real wages in the four main provinces, 1873-1913

Year	Province	Farm labourers with board	Farm labourers without board	Shearers with board	Shepherds with board	Station-labourers with board	Composite (only occupations with board)
1873	Auckland	17.28	NA	21.60	14.00	12.00	17.06
1874	Auckland	17.88	NA	19.67	19.75	15.65	17.96
1875	Auckland	14.63	NA	24.38	19.51	14.63	15.38
1876	Auckland	15.41	NA	25.68	15.41	15.41	15.93
1877	Auckland	16.12	NA	20.72	18.42	13.81	16.35
1878	Auckland	14.64	NA	16.74	20.92	14.64	15.07
1879	Auckland	14.24	NA	16.27	14.24	12.20	14.24
1880	Auckland	13.75	NA	18.33	17.19	13.75	14.16
1881	Auckland	13.67	NA	18.22	18.22	13.67	14.13
1882	Auckland	18.72	NA	18.72	19.50	18.72	18.76
1883	Auckland	18.79	NA	18.79	19.57	18.79	18.83
1884	Auckland	19.33	NA	19.33	20.14	19.33	19.37
1885	Auckland	21.52	36.28	18.83	19.06	21.52	21.26
1886	Auckland	19.01	31.68	18.48	18.70	17.42	18.88
1887	Auckland	15.80	35.11	19.02	20.48	15.80	16.20
1888	Auckland	18.28	34.28	20.00	19.04	9.71	17.97
1889	Auckland	18.72	29.25	19.01	22.18	17.55	18.85
1890	Auckland	16.68	33.36	18.07	20.85	17.79	17.02
1891	Auckland	15.34	30.14	17.81	17.81	13.70	15.51
1892	Auckland	15.95	29.62	22.15	19.69	14.77	16.40
1893	Auckland	18.08	30.13	24.10	20.09	19.59	18.57
1894	Auckland	15.26	30.52	22.59	26.45	24.42	16.67
1895	Auckland	16.01	29.66	23.72	25.95	14.83	16.85
1896	Auckland	18.46	28.84	21.34	25.23	14.42	18.74
1897	Auckland	14.76	29.52	21.65	25.83	14.76	15.68
1898	Auckland	20.89	31.33	20.89	29.10	20.29	21.28
1899	Auckland	20.72	35.52	21.71	28.37	20.72	21.16
1900	Auckland	19.96	34.31	20.27	23.65	20.27	20.18
1901	Auckland	22.01	36.68	20.36	23.84	22.01	22.02
1902	Auckland	19.25	33.82	19.51	26.02	23.41	19.82
1903	Auckland	21.16	37.03	19.40	26.45	21.16	21.34
1904	Auckland	23.80	34.38	18.51	27.99	21.15	23.61
1905	Auckland	23.44	33.86	18.75	30.39	20.84	23.42
1906	Auckland	23.73	34.28	19.78	28.56	23.73	23.77
1907	Auckland	23.35	38.45	19.46	28.11	23.35	23.40
1908	Auckland	22.98	38.30	21.71	30.43	22.98	23.30
1909	Auckland	23.55	41.86	19.88	32.70	23.55	23.83
1910	Auckland	25.89	44.01	19.68	34.52	23.30	25.88
1911	Auckland	27.63	45.21	22.61	29.31	25.12	27.33

Year	Province	Farm labourers with board	Farm labourers without board	Shearers with board	Shepherds with board	Station-labourers with board	Composite (only occupations with board)
1912	Auckland	24.26	41.24	20.62	34.37	26.69	24.71
1913	Auckland	23.89	43.00	20.30	27.87	22.69	23.85
1873	Canterbury	19.58	NA	17.13	22.43	18.35	19.54
1874	Canterbury	20.43	NA	15.89	22.70	18.92	20.24
1875	Canterbury	24.98	NA	19.98	22.89	19.15	24.32
1876	Canterbury	15.41	NA	15.41	22.47	19.26	15.96
1877	Canterbury	17.47	NA	14.87	29.25	20.32	18.09
1878	Canterbury	17.65	NA	17.65	19.85	17.65	17.76
1879	Canterbury	17.67	NA	14.73	21.04	18.93	17.76
1880	Canterbury	17.31	NA	14.84	26.79	17.31	17.67
1881	Canterbury	18.72	NA	16.38	32.76	21.06	19.44
1882	Canterbury	18.85	NA	17.24	22.99	16.09	18.84
1883	Canterbury	19.03	NA	16.63	23.79	20.27	19.22
1884	Canterbury	20.62	NA	18.81	29.00	19.33	20.89
1885	Canterbury	20.09	33.98	17.64	32.80	19.00	20.56
1886	Canterbury	19.18	32.96	17.81	30.82	20.55	19.77
1887	Canterbury	19.99	34.35	19.13	30.94	19.99	20.50
1888	Canterbury	18.08	31.77	18.08	30.60	18.92	18.76
1889	Canterbury	20.59	33.82	19.41	31.13	20.59	21.07
1890	Canterbury	20.43	42.06	21.63	29.29	21.03	20.98
1891	Canterbury	23.09	40.41	23.09	37.28	25.98	23.96
1892	Canterbury	21.44	41.68	19.65	27.29	26.80	21.92
1893	Canterbury	24.23	42.40	24.23	40.38	24.23	25.05
1894	Canterbury	19.78	42.85	21.97	32.14	23.07	20.69
1895	Canterbury	18.46	30.76	20.51	29.99	21.53	19.31
1896	Canterbury	18.34	30.57	20.38	29.80	21.40	19.18
1897	Canterbury	20.76	29.66	19.77	33.86	20.76	21.38
1898	Canterbury	20.50	32.21	20.50	28.06	23.43	21.03
1899	Canterbury	19.99	33.83	19.48	29.47	24.35	20.67
1900	Canterbury	17.30	28.83	19.22	31.23	23.07	18.40
1901	Canterbury	19.76	28.23	17.50	29.17	19.76	20.13
1902	Canterbury	20.42	34.46	18.64	28.08	17.87	20.59
1903	Canterbury	18.90	29.70	17.55	27.45	18.90	19.27
1904	Canterbury	21.18	35.73	18.53	29.12	23.82	21.58
1905	Canterbury	20.29	30.43	16.99	29.59	20.29	20.59
1906	Canterbury	21.51	36.69	18.55	30.15	22.77	21.86
1907	Canterbury	22.65	37.75	18.46	30.41	22.65	22.83
1908	Canterbury	23.29	38.82	18.98	31.27	23.29	23.48
1909	Canterbury	25.73	38.60	19.56	31.09	23.16	25.56
1910	Canterbury	25.25	42.92	20.20	30.51	22.72	25.13
1911	Canterbury	23.49	44.51	19.78	31.94	25.96	23.86

Year	Province	Farm labourers with board	Farm labourers without board	Shearers with board	Shepherds with board	Station-labourers with board	Composite (only occupations with board)
1912	Canterbury	29.91	37.39	22.44	31.16	29.91	29.60
1913	Canterbury	28.24	44.20	22.10	29.67	24.56	27.81
1873	Otago	21.66	NA	17.33	24.06	20.05	21.48
1874	Otago	22.71	NA	20.96	26.20	22.71	22.80
1875	Otago	19.73	NA	17.53	24.11	17.53	19.73
1876	Otago	17.51	NA	16.03	23.72	17.51	17.76
1877	Otago	16.18	NA	18.81	22.75	16.18	16.65
1878	Otago	17.37	NA	12.24	19.30	19.30	17.30
1879	Otago	17.98	NA	12.78	15.98	13.98	17.41
1880	Otago	17.67	NA	15.47	26.51	15.47	17.90
1881	Otago	18.78	NA	15.02	20.65	16.90	18.58
1882	Otago	19.79	NA	21.99	28.59	18.03	20.26
1883	Otago	18.00	NA	15.88	27.53	18.21	18.39
1884	Otago	19.06	NA	15.52	24.38	19.06	19.15
1885	Otago	19.65	31.93	14.25	21.49	19.65	19.47
1886	Otago	17.49	34.22	16.22	23.23	16.48	17.67
1887	Otago	18.34	37.76	17.26	26.30	18.88	18.72
1888	Otago	18.74	38.82	17.85	25.66	19.28	19.90
1889	Otago	21.42	41.19	17.85	28.61	20.32	21.55
1890	Otago	18.95	33.96	17.59	25.94	18.95	19.23
1891	Otago	19.63	39.27	18.23	26.88	19.63	19.93
1892	Otago	20.97	32.95	20.97	29.21	20.97	21.39
1893	Otago	18.84	46.38	17.39	26.57	23.19	19.39
1894	Otago	20.24	36.29	17.35	26.99	20.24	20.44
1895	Otago	19.09	35.08	19.67	27.00	19.67	19.56
1896	Otago	17.13	32.82	18.56	26.17	18.56	17.74
1897	Otago	18.24	33.67	18.24	27.35	19.64	18.77
1898	Otago	17.80	30.12	16.88	23.96	21.90	18.28
1899	Otago	19.07	35.21	20.54	28.12	20.54	19.68
1900	Otago	20.54	38.14	18.78	29.83	22.00	21.00
1901	Otago	18.92	27.02	16.21	28.15	21.62	19.39
1902	Otago	18.51	37.02	19.39	26.88	18.51	18.98
1903	Otago	21.06	36.85	18.43	30.05	19.48	21.30
1904	Otago	22.68	34.68	18.67	29.35	18.67	22.61
1905	Otago	21.96	33.58	17.31	27.98	21.96	22.03
1906	Otago	23.86	34.46	18.55	30.92	23.86	23.95
1907	Otago	23.03	35.82	17.91	29.85	23.03	23.11
1908	Otago	23.80	42.31	19.39	30.85	23.80	23.93
1909	Otago	25.97	42.84	19.04	32.46	25.97	25.94
1910	Otago	25.59	35.83	19.45	27.72	25.59	25.39
1911	Otago	25.03	37.54	19.02	29.20	25.03	24.93

Year	Province	Farm labourers with board	Farm labourers without board	Shearers with board	Shepherds with board	Station-labourers with board	Composite (only occupations with board)
1912	Otago	26.95	41.65	22.05	28.18	24.50	26.64
1913	Otago	24.35	43.82	20.69	29.42	26.78	24.54
1873	Wellington	18.80	NA	24.17	25.07	25.07	19.72
1874	Wellington	19.41	NA	17.25	19.77	15.10	19.10
1875	Wellington	24.86	NA	17.76	24.42	18.50	24.15
1876	Wellington	22.32	NA	17.86	22.32	24.55	22.21
1877	Wellington	19.82	NA	15.86	26.43	19.82	19.96
1878	Wellington	18.90	NA	18.90	28.34	18.90	19.38
1879	Wellington	17.88	NA	16.76	17.88	17.88	17.83
1880	Wellington	15.51	NA	19.39	26.26	16.97	16.33
1881	Wellington	15.23	NA	22.84	22.84	16.24	16.06
1882	Wellington	23.91	NA	17.93	21.52	19.13	23.24
1883	Wellington	18.42	NA	16.11	18.42	18.42	18.30
1884	Wellington	19.78	NA	19.52	23.42	18.22	19.87
1885	Wellington	21.75	37.09	20.39	27.19	21.75	21.96
1886	Wellington	18.94	40.58	21.64	27.51	18.94	19.51
1887	Wellington	20.26	28.94	19.10	26.53	20.26	20.52
1888	Wellington	22.92	40.12	21.49	26.27	22.92	23.02
1889	Wellington	19.41	36.06	18.03	32.82	19.41	20.03
1890	Wellington	23.22	42.08	20.31	33.86	20.31	23.46
1891	Wellington	18.93	36.51	20.28	34.25	21.63	19.92
1892	Wellington	21.74	32.61	19.02	31.70	19.02	21.97
1893	Wellington	17.58	35.70	19.22	27.46	21.97	18.39
1894	Wellington	19.44	36.10	19.44	28.93	19.44	19.92
1895	Wellington	20.77	37.10	22.26	30.91	20.77	21.37
1896	Wellington	20.93	38.87	21.93	31.15	23.92	21.66
1897	Wellington	20.85	35.74	22.34	37.23	23.83	21.91
1898	Wellington	20.79	35.64	21.78	30.19	23.76	22.57
1899	Wellington	27.35	42.54	22.79	32.16	24.31	27.21
1900	Wellington	25.61	41.26	21.06	34.38	25.61	25.82
1901	Wellington	27.70	38.78	19.11	28.86	22.16	27.04
1902	Wellington	23.25	36.97	18.94	27.56	25.83	23.38
1903	Wellington	24.16	42.95	19.69	29.08	21.48	24.05
1904	Wellington	21.39	36.47	19.61	28.97	24.06	21.82
1905	Wellington	23.05	38.41	19.21	29.88	23.05	23.20
1906	Wellington	23.08	33.34	18.46	29.49	23.08	23.17
1907	Wellington	22.45	35.70	19.96	29.10	22.45	22.66
1908	Wellington	22.85	38.09	20.06	30.68	22.85	23.11
1909	Wellington	25.46	38.19	20.37	32.88	22.91	25.45
1910	Wellington	25.30	37.95	20.24	31.63	22.77	25.24
1911	Wellington	25.30	48.07	22.77	30.57	22.77	25.31

Year	Province	Farm labourers with board	Farm labourers without board	Shearers with board	Shepherds with board	Station-labourers with board	Composite (only occupations with board)
1912	Wellington	27.67	37.73	22.64	32.49	30.18	27.79
1913	Wellington	26.43	40.85	21.63	28.64	26.43	26.30

Table B-9. Building sector real wages (weekly in shillings) in the four main provinces, 1873-1913

Year	Province	Bricklayers	Carpenters	Masons	Painters	Plasterers	Plumbers	General labourers	Composite building
1873	Auckland	50.39	50.39	55.19	NA	50.39	43.19	33.60	47.19
1874	Auckland	46.94	44.71	55.88	NA	51.41	40.24	31.30	45.08
1875	Auckland	53.64	48.77	53.64	NA	48.77	43.89	29.26	46.33
1876	Auckland	61.62	51.35	66.76	NA	66.76	46.22	30.81	53.92
1877	Auckland	50.65	40.29	55.26	NA	50.65	41.44	27.63	44.32
1878	Auckland	48.11	46.02	58.57	NA	46.02	37.65	29.29	44.28
1879	Auckland	48.81	42.71	50.84	NA	48.81	38.64	28.47	43.05
1880	Auckland	55.00	45.83	55.00	NA	55.00	41.25	32.08	47.36
1881	Auckland	59.22	45.55	59.22	NA	59.22	45.55	31.89	50.11
1882	Auckland	56.16	46.80	56.16	NA	56.16	46.80	32.76	49.14
1883	Auckland	51.67	42.28	51.67	NA	51.67	46.98	32.88	46.19
1884	Auckland	53.16	43.49	53.16	NA	53.16	48.33	36.24	47.92
1885	Auckland	56.49	51.11	59.18	48.42	59.18	53.80	39.01	52.46
1886	Auckland	52.80	44.88	55.44	44.88	58.08	52.80	34.32	49.03
1887	Auckland	58.51	49.74	52.66	49.74	52.66	49.74	40.96	50.57
1888	Auckland	48.56	48.56	51.42	37.14	54.27	42.85	34.28	45.30
1889	Auckland	49.73	49.73	49.73	46.80	49.73	52.65	35.10	47.64
1890	Auckland	47.26	47.26	47.26	40.31	47.26	41.70	33.36	43.49
1891	Auckland	43.83	41.09	46.57	34.24	43.83	35.61	32.87	39.72
1892	Auckland	44.30	41.35	53.16	47.26	44.30	59.07	33.97	46.20
1893	Auckland	60.26	48.21	60.26	48.21	60.26	48.21	36.16	51.65
1894	Auckland	48.84	45.78	48.84	45.78	48.84	42.73	39.68	45.78
1895	Auckland	47.45	44.48	47.45	44.48	47.45	41.52	35.59	44.06
1896	Auckland	46.14	43.26	46.14	46.14	46.14	40.37	34.61	43.26
1897	Auckland	47.23	47.23	47.23	47.23	47.23	41.33	35.42	44.70
1898	Auckland	59.68	53.72	59.68	49.74	59.68	47.75	38.79	52.72
1899	Auckland	59.20	59.20	59.20	42.92	59.20	53.28	41.44	53.49
1900	Auckland	68.62	65.50	68.62	53.02	68.62	62.38	43.67	61.49
1901	Auckland	57.77	57.77	60.52	49.52	60.52	55.02	35.76	53.84
1902	Auckland	62.44	52.03	62.44	50.73	62.44	52.03	35.12	53.89
1903	Auckland	63.48	55.55	63.48	44.97	63.48	50.26	39.68	54.41
1904	Auckland	60.82	50.24	60.82	44.95	68.75	50.24	37.02	53.26
1905	Auckland	59.90	49.48	62.51	49.48	67.72	52.09	39.07	54.32
1906	Auckland	68.55	52.73	63.28	48.78	68.55	50.10	39.55	55.93
1907	Auckland	67.47	57.09	62.28	49.30	64.87	49.30	39.36	55.67
1908	Auckland	66.39	56.18	56.18	48.52	66.39	54.90	40.86	55.63
1909	Auckland	68.02	57.56	62.79	52.32	70.64	53.63	41.86	58.12
1910	Auckland	67.31	56.96	62.14	51.78	67.31	53.94	46.60	58.01
1911	Auckland	65.31	55.26	65.31	55.26	67.82	55.26	45.21	58.49
1912	Auckland	58.22	53.37	63.07	53.37	65.50	53.37	43.67	55.80

Year	Province	Bricklayers	Carpenters	Masons	Painters	Plasterers	Plumbers	General labourers	Composite building
1913	Auckland	62.11	52.55	62.11	50.16	66.89	52.55	43.00	55.62
1873	Canterbury	53.84	48.95	58.74	NA	53.84	48.95	36.71	50.17
1874	Canterbury	45.40	45.40	49.94	NA	49.94	45.40	29.51	44.26
1875	Canterbury	44.96	47.45	44.96	NA	44.96	49.95	29.97	43.71
1876	Canterbury	46.22	40.44	42.37	NA	44.29	38.52	30.81	40.44
1877	Canterbury	47.95	46.73	44.70	NA	47.95	40.63	28.44	42.73
1878	Canterbury	48.53	48.53	52.94	NA	52.94	44.12	30.88	46.32
1879	Canterbury	42.07	46.28	50.49	NA	46.28	42.07	29.45	42.77
1880	Canterbury	54.41	51.94	56.89	NA	54.41	49.47	37.10	50.70
1881	Canterbury	56.17	46.80	56.17	NA	51.49	46.80	35.10	48.75
1882	Canterbury	50.57	48.27	52.87	NA	50.57	50.57	34.48	47.89
1883	Canterbury	57.10	47.59	54.72	NA	54.72	54.72	33.31	50.36
1884	Canterbury	52.84	50.26	56.70	NA	55.41	54.12	36.08	50.90
1885	Canterbury	59.72	51.58	59.72	54.29	62.44	59.72	35.29	54.68
1886	Canterbury	57.53	49.31	60.27	49.31	60.27	54.79	32.88	52.05
1887	Canterbury	65.68	51.40	62.82	48.55	62.82	54.26	37.12	54.67
1888	Canterbury	58.42	52.85	58.42	50.07	52.85	54.24	36.16	51.86
1889	Canterbury	61.76	58.82	61.76	52.94	55.88	55.88	44.12	55.88
1890	Canterbury	60.09	54.08	60.09	54.08	48.07	60.09	42.06	54.08
1891	Canterbury	57.73	49.07	57.73	46.18	57.73	49.07	37.52	50.72
1892	Canterbury	59.55	53.59	59.55	53.59	59.55	53.59	41.68	54.45
1893	Canterbury	60.57	54.51	60.57	54.51	54.51	60.57	42.40	55.38
1894	Canterbury	56.03	49.44	56.03	49.44	56.03	56.03	36.26	51.32
1895	Canterbury	49.22	49.22	55.38	49.22	55.38	55.38	30.76	49.22
1896	Canterbury	64.19	55.02	64.19	45.85	55.02	55.02	33.62	53.27
1897	Canterbury	53.39	59.32	53.39	44.49	53.39	53.39	35.59	50.42
1898	Canterbury	64.42	52.71	58.56	49.78	55.64	52.71	36.60	52.92
1899	Canterbury	67.66	55.36	61.51	52.29	58.44	55.36	38.45	55.58
1900	Canterbury	63.43	63.43	57.66	51.90	57.66	57.66	34.60	55.19
1901	Canterbury	70.58	59.28	62.11	56.46	56.46	56.46	31.05	56.06
1902	Canterbury	61.27	56.16	56.16	47.23	56.16	49.78	34.46	51.60
1903	Canterbury	64.80	56.70	56.70	48.60	62.10	54.00	37.80	54.38
1904	Canterbury	58.23	58.23	58.23	50.29	63.53	50.29	34.41	53.32
1905	Canterbury	65.93	53.25	65.93	55.79	63.40	58.33	35.50	56.88
1906	Canterbury	60.72	55.66	60.72	48.07	58.19	55.66	37.95	53.86
1907	Canterbury	62.91	55.37	57.88	52.85	60.40	50.33	41.52	54.47
1908	Canterbury	62.11	56.93	62.11	51.76	62.11	51.76	43.99	55.82
1909	Canterbury	61.76	56.61	61.76	51.47	61.76	50.61	41.17	55.02
1910	Canterbury	60.60	55.55	65.65	50.50	65.65	49.66	42.92	55.79
1911	Canterbury	64.29	54.40	64.29	51.93	64.29	54.40	42.04	56.52
1912	Canterbury	64.81	57.34	64.81	54.84	64.81	49.86	44.87	57.34
1913	Canterbury	63.85	56.48	63.85	56.48	66.30	51.57	44.20	57.53

Year	Province	Bricklayers	Carpenters	Masons	Painters	Plasterers	Plumbers	General labourers	Composite building
1873	Otago	57.75	57.75	57.75	NA	48.13	38.50	38.50	49.73
1874	Otago	75.99	68.13	73.37	NA	62.89	41.93	41.93	60.71
1875	Otago	48.22	52.60	61.37	NA	52.60	35.07	32.88	47.12
1876	Otago	61.30	52.54	61.30	NA	70.06	35.03	35.03	52.54
1877	Otago	60.68	60.68	60.68	NA	46.52	32.36	32.36	48.88
1878	Otago	54.04	45.35	54.04	NA	61.76	30.88	32.81	46.48
1879	Otago	53.93	51.94	55.93	NA	57.93	31.96	35.96	47.94
1880	Otago	57.44	48.60	55.23	NA	57.44	35.35	35.35	48.24
1881	Otago	50.70	45.06	45.06	NA	52.57	41.31	26.29	43.50
1882	Otago	58.27	54.31	53.32	NA	67.06	52.77	35.62	53.56
1883	Otago	55.06	51.88	55.06	NA	57.18	46.59	32.82	49.76
1884	Otago	57.63	55.42	57.63	NA	62.07	48.77	36.57	53.01
1885	Otago	58.96	58.96	58.96	49.13	61.41	51.59	36.85	53.69
1886	Otago	58.30	53.23	60.83	53.23	60.83	54.50	35.49	53.77
1887	Otago	59.34	53.94	56.64	45.85	64.73	56.64	33.71	52.98
1888	Otago	58.90	50.87	58.90	45.52	61.58	53.55	32.13	51.64
1889	Otago	65.91	63.16	65.91	52.18	68.66	54.93	34.33	57.87
1890	Otago	59.54	56.84	59.54	54.13	59.54	54.13	37.89	54.52
1891	Otago	64.51	53.29	58.90	50.48	61.70	61.70	36.46	55.29
1892	Otago	71.90	59.91	53.92	53.92	65.90	53.92	35.95	56.49
1893	Otago	55.08	49.28	55.08	49.28	57.98	55.08	37.69	51.35
1894	Otago	52.05	52.05	57.84	46.27	52.05	52.05	46.27	51.23
1895	Otago	66.54	57.86	63.64	54.96	66.54	60.75	37.61	58.27
1896	Otago	62.81	57.10	65.67	51.39	62.81	62.81	39.97	57.51
1897	Otago	53.31	53.31	61.72	46.29	61.72	53.31	42.08	53.10
1898	Otago	54.76	54.76	57.50	49.28	57.50	54.76	41.07	52.81
1899	Otago	61.62	61.62	61.62	55.75	64.55	58.68	42.54	58.05
1900	Otago	67.47	58.67	67.47	64.54	67.47	64.54	41.07	61.61
1901	Otago	59.45	59.45	67.56	48.64	59.45	54.05	35.13	54.82
1902	Otago	68.75	52.88	58.17	50.24	63.46	55.53	37.02	55.15
1903	Otago	60.55	57.91	63.18	56.60	65.81	57.91	36.85	56.97
1904	Otago	64.03	48.02	64.03	53.36	64.03	53.36	42.69	55.64
1905	Otago	61.99	61.99	67.16	49.08	64.57	56.82	38.74	57.19
1906	Otago	68.92	58.31	68.92	54.34	68.92	55.66	42.41	59.64
1907	Otago	66.52	56.29	69.08	53.73	66.52	53.73	46.05	58.85
1908	Otago	68.75	55.53	68.75	52.89	68.75	55.53	47.60	59.69
1909	Otago	67.51	57.13	67.51	51.93	70.11	49.34	46.74	58.61
1910	Otago	66.54	56.30	63.98	51.18	66.54	53.74	46.06	57.76
1911	Otago	62.56	52.55	62.56	50.05	67.57	52.55	42.54	55.77
1912	Otago	63.71	58.81	63.71	53.91	66.16	53.91	41.65	57.41
1913	Otago	63.30	53.56	63.30	53.56	63.30	50.31	43.82	55.88
1873	Wellington	59.09	59.09	59.09	NA	59.09	48.35	42.98	54.61

Year	Province	Bricklayers	Carpenters	Masons	Painters	Plasterers	Plumbers	General labourers	Composite building
1874	Wellington	56.07	49.60	56.07	NA	56.07	38.82	25.88	47.09
1875	Wellington	57.71	48.83	71.03	NA	48.83	39.96	35.52	50.31
1876	Wellington	58.03	49.11	58.03	NA	53.57	40.18	35.71	49.11
1877	Wellington	45.60	39.65	NA	NA	41.63	35.68	27.75	31.72
1878	Wellington	75.58	54.32	61.41	NA	63.77	42.51	35.43	55.50
1879	Wellington	49.18	44.71	44.71	NA	46.94	51.41	32.41	44.89
1880	Wellington	53.32	36.36	53.32	NA	53.32	43.63	29.09	44.84
1881	Wellington	55.83	48.21	55.83	NA	55.83	48.21	38.06	50.33
1882	Wellington	52.60	43.04	57.38	NA	54.99	47.82	38.25	49.01
1883	Wellington	51.80	46.04	55.25	NA	50.64	46.04	34.53	47.38
1884	Wellington	57.25	49.44	62.45	NA	61.15	50.74	41.64	53.78
1885	Wellington	54.38	51.66	59.82	46.22	54.38	51.66	38.07	50.88
1886	Wellington	59.52	51.41	59.52	46.00	59.52	48.70	37.88	51.79
1887	Wellington	63.66	54.98	63.66	52.09	63.66	52.09	43.41	56.22
1888	Wellington	63.04	51.58	63.04	48.71	63.04	48.71	40.12	54.03
1889	Wellington	58.24	49.92	58.24	47.15	66.57	55.47	38.83	53.49
1890	Wellington	63.84	55.14	72.55	49.33	66.74	63.84	40.63	58.87
1891	Wellington	56.79	48.68	56.79	45.97	56.79	48.68	37.86	50.22
1892	Wellington	57.06	48.91	57.06	48.91	57.06	54.34	38.04	51.62
1893	Wellington	54.93	49.44	71.41	43.94	60.42	52.18	38.45	52.97
1894	Wellington	55.54	44.43	58.32	44.43	52.76	49.99	36.10	48.80
1895	Wellington	62.32	53.42	68.26	48.47	65.29	53.42	38.58	55.68
1896	Wellington	56.81	50.83	56.81	49.34	59.80	55.32	41.86	52.97
1897	Wellington	71.48	59.57	71.48	53.61	71.48	56.59	41.70	60.84
1898	Wellington	62.37	56.43	71.27	56.43	62.37	62.37	44.55	59.40
1899	Wellington	63.82	57.74	66.86	54.70	66.86	57.74	45.58	59.04
1900	Wellington	68.29	54.06	62.60	50.27	59.75	66.39	42.68	57.72
1901	Wellington	58.17	58.17	66.48	52.63	63.71	60.94	40.17	57.18
1902	Wellington	62.00	56.83	56.83	49.08	62.00	49.08	41.33	53.88
1903	Wellington	64.43	56.38	64.43	48.32	72.48	56.38	42.95	57.91
1904	Wellington	69.52	64.17	64.17	52.14	69.52	56.15	40.11	59.40
1905	Wellington	64.02	51.21	66.58	52.92	66.58	55.06	40.97	56.76
1906	Wellington	69.24	56.42	69.24	46.16	66.68	56.42	41.03	57.89
1907	Wellington	62.36	54.88	59.87	48.23	64.86	54.88	39.91	55.00
1908	Wellington	63.48	55.86	66.01	49.09	63.48	55.86	43.16	56.70
1909	Wellington	63.64	53.46	63.64	48.37	63.64	57.28	40.73	55.82
1910	Wellington	65.78	53.13	65.78	50.60	65.78	55.66	43.01	57.11
1911	Wellington	63.25	55.66	65.78	53.13	65.78	55.66	43.01	57.46
1912	Wellington	67.91	55.34	67.91	50.31	67.91	55.34	45.28	58.57
1913	Wellington	64.88	52.87	64.88	48.06	64.88	50.46	43.26	55.61

Table B-10. Public work expenditure (shillings per capita) and number of assisted per 100 employed workers

Year	Province	Public works expenditure p.c.	Number of Assisted per 100 employed workers
1873	Auckland	3.44	NA
1874	Auckland	4.22	NA
1875	Auckland	5.37	NA
1876	Auckland	4.82	NA
1877	Auckland	70.85	NA
1878	Auckland	55.51	NA
1879	Auckland	94.19	NA
1880	Auckland	21.58	NA
1881	Auckland	115.52	NA
1882	Auckland	49.76	NA
1883	Auckland	76.96	NA
1884	Auckland	70.97	NA
1885	Auckland	64.97	NA
1886	Auckland	58.98	NA
1887	Auckland	52.99	NA
1888	Auckland	47.00	NA
1889	Auckland	41.01	NA
1890	Auckland	35.02	NA
1891	Auckland	29.03	NA
1892	Auckland	23.04	NA
1893	Auckland	17.05	0.88
1894	Auckland	11.05	0.98
1895	Auckland	10.55	1.10
1896	Auckland	11.37	0.98
1897	Auckland	12.36	0.65
1898	Auckland	10.90	0.84
1899	Auckland	10.23	1.11
1900	Auckland	17.44	1.10
1901	Auckland	33.34	2.36
1902	Auckland	29.56	0.64
1903	Auckland	15.54	2.34
1904	Auckland	18.20	2.26
1905	Auckland	21.51	2.57
1906	Auckland	46.62	3.91
1907	Auckland	35.83	3.99
1908	Auckland	39.77	3.86
1909	Auckland	45.96	5.13
1910	Auckland	44.80	3.50
1911	Auckland	46.75	2.80
1912	Auckland	80.62	2.52
1913	Auckland	81.10	1.75

Year	Province	Public works expenditure p.c.	Number of Assisted per 100 employed workers
1873	Canterbury	56.66	NA
1874	Canterbury	86.46	NA
1875	Canterbury	96.65	NA
1876	Canterbury	77.67	NA
1877	Canterbury	23.78	NA
1878	Canterbury	31.60	NA
1879	Canterbury	38.24	NA
1880	Canterbury	14.37	NA
1881	Canterbury	24.94	NA
1882	Canterbury	41.46	NA
1883	Canterbury	17.62	NA
1884	Canterbury	16.28	NA
1885	Canterbury	14.95	NA
1886	Canterbury	13.62	NA
1887	Canterbury	12.29	NA
1888	Canterbury	10.95	NA
1889	Canterbury	9.62	NA
1890	Canterbury	8.29	NA
1891	Canterbury	6.96	NA
1892	Canterbury	5.62	NA
1893	Canterbury	4.29	1.56
1894	Canterbury	2.96	1.17
1895	Canterbury	10.99	0.95
1896	Canterbury	3.16	0.98
1897	Canterbury	3.85	0.80
1898	Canterbury	4.51	0.78
1899	Canterbury	3.54	0.62
1900	Canterbury	7.37	0.48
1901	Canterbury	10.67	0.94
1902	Canterbury	13.82	0.88
1903	Canterbury	20.90	1.46
1904	Canterbury	11.15	1.01
1905	Canterbury	12.69	1.12
1906	Canterbury	18.27	1.92
1907	Canterbury	14.10	1.99
1908	Canterbury	31.24	0.81
1909	Canterbury	36.52	4.17
1910	Canterbury	26.77	2.47
1911	Canterbury	21.94	1.47
1912	Canterbury	31.54	1.83
1913	Canterbury	32.49	2.33
1873	Otago	34.01	NA
1874	Otago	70.38	NA
1875	Otago	62.99	NA

Year	Province	Public works expenditure p.c.	Number of Assisted per 100 employed workers
1876	Otago	52.40	NA
1877	Otago	99.63	NA
1878	Otago	112.76	NA
1879	Otago	80.69	NA
1880	Otago	71.39	NA
1881	Otago	85.29	NA
1882	Otago	62.81	NA
1883	Otago	78.57	NA
1884	Otago	71.71	NA
1885	Otago	64.86	NA
1886	Otago	58.01	NA
1887	Otago	51.16	NA
1888	Otago	44.31	NA
1889	Otago	37.46	NA
1890	Otago	30.61	NA
1891	Otago	23.76	NA
1892	Otago	16.91	NA
1893	Otago	10.05	1.69
1894	Otago	3.20	1.68
1895	Otago	3.73	1.84
1896	Otago	3.14	1.43
1897	Otago	5.85	0.70
1898	Otago	5.13	0.75
1899	Otago	4.47	0.87
1900	Otago	23.66	1.41
1901	Otago	6.58	1.53
1902	Otago	30.42	0.97
1903	Otago	49.56	1.24
1904	Otago	43.32	0.52
1905	Otago	49.06	0.68
1906	Otago	44.84	2.43
1907	Otago	44.89	2.86
1908	Otago	45.52	2.19
1909	Otago	24.27	2.90
1910	Otago	23.64	4.24
1911	Otago	35.01	4.66
1912	Otago	76.25	3.95
1913	Otago	78.24	2.96
1873	Wellington	28.29	NA
1874	Wellington	23.50	NA
1875	Wellington	15.79	NA
1876	Wellington	13.55	NA
1877	Wellington	133.74	NA
1878	Wellington	95.26	NA

Year	Province	Public works expenditure p.c.	Number of Assisted per 100 employed workers
1879	Wellington	59.29	NA
1880	Wellington	126.59	NA
1881	Wellington	86.30	NA
1882	Wellington	74.39	NA
1883	Wellington	45.68	NA
1884	Wellington	43.39	NA
1885	Wellington	41.10	NA
1886	Wellington	38.81	NA
1887	Wellington	36.51	NA
1888	Wellington	34.22	NA
1889	Wellington	31.93	NA
1890	Wellington	29.64	NA
1891	Wellington	27.34	NA
1892	Wellington	25.05	NA
1893	Wellington	22.76	6.56
1894	Wellington	20.47	4.80
1895	Wellington	30.50	4.16
1896	Wellington	43.11	4.12
1897	Wellington	28.29	2.67
1898	Wellington	19.94	3.30
1899	Wellington	11.93	2.88
1900	Wellington	29.25	2.60
1901	Wellington	45.90	2.41
1902	Wellington	43.30	2.00
1903	Wellington	110.48	2.92
1904	Wellington	94.49	2.65
1905	Wellington	51.75	2.04
1906	Wellington	56.65	4.27
1907	Wellington	126.97	5.67
1908	Wellington	40.42	5.48
1909	Wellington	37.99	6.90
1910	Wellington	38.25	6.10
1911	Wellington	52.32	4.76
1912	Wellington	94.98	4.55
1913	Wellington	94.29	4.55
1873	Taranaki	8.83	NA
1874	Taranaki	7.49	NA
1875	Taranaki	19.68	NA
1876	Taranaki	45.66	NA
1877	Taranaki	20.45	NA
1878	Taranaki	16.31	NA
1879	Taranaki	14.33	NA
1880	Taranaki	6.91	NA
1881	Taranaki	8.69	NA

Year	Province	Public works expenditure p.c.	Number of Assisted per 100 employed workers
1882	Taranaki	8.11	NA
1883	Taranaki	8.29	NA
1884	Taranaki	8.34	NA
1885	Taranaki	8.38	NA
1886	Taranaki	8.42	NA
1887	Taranaki	8.47	NA
1888	Taranaki	8.51	NA
1889	Taranaki	8.56	NA
1890	Taranaki	8.60	NA
1891	Taranaki	8.64	NA
1892	Taranaki	8.69	NA
1893	Taranaki	8.73	NA
1894	Taranaki	8.78	NA
1895	Taranaki	10.60	NA
1896	Taranaki	11.76	NA
1897	Taranaki	15.02	NA
1898	Taranaki	13.32	NA
1899	Taranaki	15.42	NA
1900	Taranaki	18.58	NA
1901	Taranaki	26.71	NA
1902	Taranaki	49.79	NA
1903	Taranaki	108.92	NA
1904	Taranaki	131.39	NA
1905	Taranaki	102.78	NA
1906	Taranaki	40.22	NA
1907	Taranaki	65.11	NA
1908	Taranaki	43.89	NA
1909	Taranaki	36.35	NA
1910	Taranaki	31.26	NA
1911	Taranaki	28.34	NA
1912	Taranaki	98.56	NA
1913	Taranaki	89.48	NA

B2. Unemployed Assistance

According to the early *Department of Labour reports*, the dominating proportion of unemployed who were assisted were labourers, bushmen and carpenters. Assistance for the "unemployed" was undertaken by the *Bureau of Industries*.

The New Zealand. Parliament. House of (1892) reported that:

> "…These agents forward a schedule on the last day of every month stating particulars as to the number of unemployed in their district, and produce a report on the various works, both public and private, in their locality needing more workmen. In this manner the minus or plus quantities of available labour can be generally equalised".

The agencies did not provide unemployment benefit, per se, but rather redistributed the unemployed from areas with surplus labour in a particular occupation, to those in deficit. Some of those assigned jobs were seasonal farm jobs and unemployed workers were occasionally provided with food and transport vouchers. The Government assisted many people throughout the recession period in New Zealand for example, the Bureau of Industries found 768 jobs for married and 1223 – for single workers in the Wellington Provincial District in 1894, most of which were labourers and bushmen, with a few being farm-labourers. The State Farm located in Wellington, well known as a bush farm at Levin, employed many workers (mostly elderly men) who were not able to find employment. In its early years, Levin Farm acted as '...a reservoir or storage-place where labour can be temporarily placed till other channels are opened', basically assisting men and their families while they were looking for an alternative employment (New Zealand Department of Statistics, 1873-1935).

Appendix C

Table C-1. Data description, continued

Variable	Unit of measurement	Time-period & Coverage	Data Source
Real Wage Index	Index series 1873-1913 (nominal wages by occupation were collected and deflated), from 1913 – used Statistics New Zealand wages	1873-1940 - four main provinces[1] 1885-1913 – all nine provinces included[2]	Nominal Wages-rates reports (Annual reports, Various years) Occupation weights (Census of occupations Reports) (New Zealand & Statistics, 1891-1924)
CPI	Index series	1873-1940 - four main provinces	Prices of various food and other items ; Rent figures from Boroughs' statistics; Education series constructed from timber prices and carpenters' wages (See Arnold (1982b))
Butter, beef, mutton, pork, milk, grain, flour	Prices in shillings	1847-1940– four main provinces 1850s/1860s -1924 – other provinces	Prices of various food and other items (Annual reports, Various years)
Public Works	Expenditure per capita in shillings (e.g. waterworks, sewerage, railways etc.) in real values (deflated)	1862-1935 - four main provinces	Boroughs receipts and expenditure (Annual reports, Various years); Population figures (New Zealand Department of Statistics, 1873-1935)
Female/male enrolment ratio	Enrolment ratio of the number of women attending primary schools to the number of males attending the same schools	1873-1919: province specific (common schools) - four main provinces 1920 -1939 Rankin (1992) aggregate series	Primary enrolment statistics (Annual reports, Various years) Population figures (New Zealand Department of Statistics, 1873-1935); Primary and Secondary education figures from 1919 were derived from Long–Term Data series Statistics New Zealand database
Dwelling density	Number of persons divided by the number of dwellings in each of the four boroughs in given year (Auckland, Christchurch, Dunedin, Wellington)	1874-1919 - four main provinces	Boroughs statistics (Annual reports, Various years)

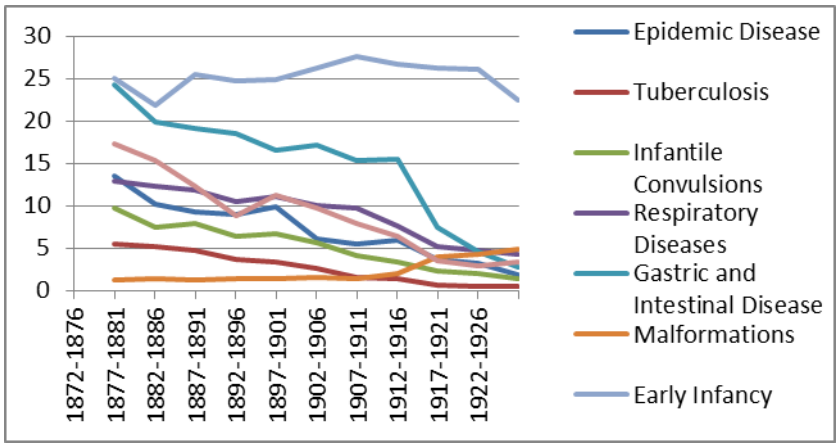
[1] The four main Provinces: Auckland, Canterbury, Otago, Wellington

[2] Data from the following nine provinces was included: Auckland, Canterbury, Otago, Wellington, Taranki, Hawkes' Bay, Marlborough, Nelson, Westland

Table C-1. Data description

Variable	Unit of measurement	Time-period & Coverage	Data Source
Urban Proportion	Urban population (in boroughs) as a proportion of the total population in the province	1861-1940 - four main provinces	Boroughs statistics (Annual reports, Various years) and Population Census
General Fertility Rate	Number of infant births over the number of women of child-bearing age, 16-44.	1871-1919 - four main provinces	Number of births (Annual reports, Various years) Number of women of child-bearing age (New Zealand Department of Statistics, 1873-1935)
Infant Mortality	Number of infant deaths per 1,000 live births	1861-1940 – all provinces	Number of births and number of deaths of infants under one year reported yearly (Annual reports, Various years)
Nuptiality rate (ages 16-24)	Proportion of married women ages 16-24, age standardized	1874-1940 - four main provinces	New Zealand Census Statistics, 1873 -
Disease-specific & age-specific	Number of deaths in each disease group	1872-1909 /40 Respiratory & constitutional: 1872-1884 & 1908-1919; Constitutional: 1911-1940 Digestive: 1872-1904 (total population only) Diarrhoeal: 1872-1911/16	Number of births under one year Number of deaths from death-specific diseases reported yearly in (Annual reports, Various years)
Urban/ rural infant mortality	Number of infant deaths in the main boroughs[1] per 1,000 live births in each respective borough	1887-1919	Annual Reports/Statistics New Zealand Census Reports; Tiong
Annual average temperature	Degrees Celsius	1860s-approx. 1940	NIWA Database

Figure C-1. Infant mortality per 1,000 live births from Principal Causes of Death, 1872-1926



Source: Fraser (1928)

[1] The main boroughs: Auckland, Christchurch, Dunedin, Wellington.

Table C-2. Descriptive statistics, cause-specific infant deaths per 1,000 live births (1872-1899)

Variable	Mean	Mean standard error	Standard deviation	Min	Max	Coefficient of Variation
			Auckland			
Epidemic	6.03	0.77	3.85	0.70	15.43	0.64
Diarrhoeal	19.31	1.22	6.11	11.13	33.26	0.32
Digestive	0.20	0.05	0.23	0.00	0.94	1.16
Septic	0.35	0.07	0.22	0.00	0.64	0.61
Respiratory	0.59	0.12	0.41	0.00	1.43	0.70
Other	0.16	0.06	0.19	0.00	0.47	1.19
			Canterbury			
Epidemic	4.95	0.68	3.40	0.26	12.32	0.69
Diarrhoeal	17.79	1.56	7.81	6.51	33.20	0.44
Digestive	0.04	0.02	0.10	0.00	0.41	2.86
Septic	0.75	0.13	0.43	0.00	1.41	0.58
Respiratory	0.28	0.11	0.37	0.00	1.10	1.33
Other	0.04	0.03	0.09	0.00	0.22	2.23
			Otago			
Epidemic	5.41	0.96	4.79	0.23	15.87	0.89
Diarrhoeal	8.16	0.88	4.39	2.05	16.71	0.54
Digestive	0.04	0.02	0.09	0.00	0.28	2.36
Septic	0.83	0.14	0.48	0.20	1.75	0.57
Respiratory	0.59	0.11	0.36	0.20	1.19	0.62
Other	0.15	0.06	0.19	0.00	0.63	1.27
			Wellington			
Epidemic	5.29	0.55	2.77	0.85	11.64	0.52
Diarrhoeal	18.15	1.79	8.97	6.10	41.52	0.49
Digestive	0.07	0.03	0.17	0.00	0.64	2.45
Septic	0.65	0.16	0.52	0.00	1.79	0.81
Respiratory	0.36	0.10	0.32	0.00	0.77	0.87
Other	0.03	0.03	0.11	0.00	0.38	3.32

Source: Annual reports (Various years)

Table C-3. Descriptive statistics, cause-specific infant deaths per 1,000 live births (1900-1920)

Variable	Mean	Mean standard error	Standard deviation	Min	Max	Coefficient of Variation
			Auckland			
Epidemic	3.42	0.85	3.80	0.85	14.66	1.11
Diarrhoeal	3.99	1.44	6.45	0.00	24.64	1.62
Digestive	0.00	0.00	0.00	0.00	0.00	.
Septic	0.09	0.03	0.11	0.00	0.37	1.27
Respiratory	0.03	0.02	0.06	0.00	0.16	2.11
Other	N/A					
			Canterbury			
Epidemic	3.09	0.68	3.03	0.67	12.30	0.98
Diarrhoeal	3.09	1.15	5.16	0.00	16.63	1.67
Digestive	0.00	0.00	0.00	0.00	0.00	.
Septic	0.23	0.06	0.20	0.00	0.70	0.85
Respiratory	0.07	0.05	0.15	0.00	0.45	2.24
Other	N/A					
			Otago			
Epidemic	3.42	0.62	2.79	0.21	9.56	0.82
Diarrhoeal	1.61	0.54	2.40	0.00	8.25	1.49
Digestive	0.00	0.00	0.00	0.00	0.00	.
Septic	0.17	0.05	0.19	0.00	0.43	1.09
Respiratory	0.09	0.04	0.13	0.00	0.32	1.33
Other	N/A					
			Wellington			
Epidemic	2.76	0.69	3.09	0.36	12.29	1.12
Diarrhoeal	2.30	0.73	3.25	0.00	8.75	1.41
Digestive	0.00	0.00	0.00	0.00	0.00	.
Septic	0.18	0.06	0.19	0.00	0.55	1.05
Respiratory	0.07	0.04	0.12	0.00	0.36	1.77
Other	N/A					

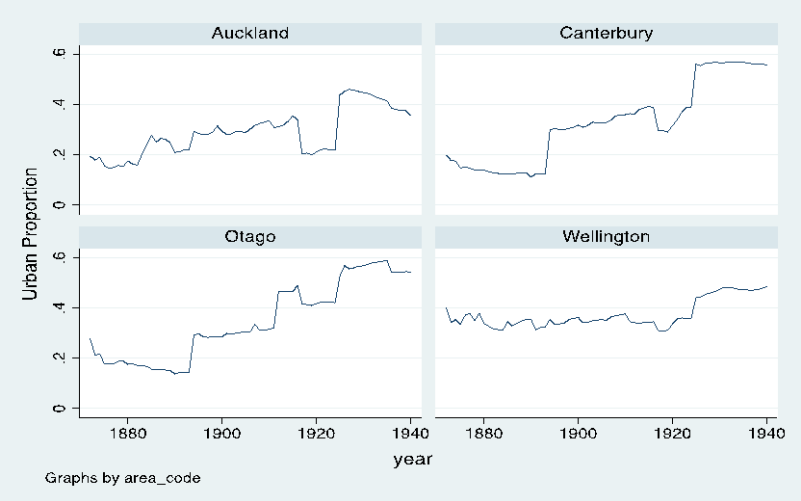
Source: Annual reports (Various years)

Table C-4. Descriptive statistics: average yearly temperature and infant diarrhoeal disease rates, 1873-1916.

Variable	Mean	Standard deviation	Min	Max
	Auckland			
Temperature	15.02	0.49	14.09	15.88
Infant diarrhoeal diseases	13.52	9.54	0.00	33.26
	Canterbury			
Temperature	11.59	0.47	10.25	12.74
Infant diarrhoeal diseases	12.13	9.72	0.00	33.20
	Otago			
Temperature	10.33	0.54	9.19	11.64
Infant diarrhoeal diseases	5.73	4.84	0.00	16.71
	Wellington			
Temperature	12.94	0.47	11.09	13.96
Infant diarrhoeal diseases	12.06	10.44	0.00	41.52

Source: Disease data from Annual reports (Various years)
Temperature data from (National Institute of & Atmospheric)

Figure C-2. Urban proportion, 1862-1940



Source: Statistics New Zealand Annual Publications, 1862-1940
New Zealand Census, 1862-1940

Table C-5. Panel unit root tests

Panel variable	Levin Lin Cheuing (LLC) Adjusted t-stat* Cross-sectional means removed	Im, Pesaran and Shin W-statistics (IPS)
Infant mortality rates	-7.5034** (trend)	-8.523** (trend)
Persons per dwelling	-3.29** (no trend)	-3.13035** (no trend)
Public works expenditure per capita	-13.5401** (no trend)	-2.86** (no trend)
Public works (accumulated expenditure)	2.74 (trend)	2.708 (trend)
Real wages	-3.7731** (trend)	-3.395** (trend)
Female/male enrolment ratio	-5.52** (no trend)	-2.49** (no trend)
Fertility/GFR (general fertility rate)	-2.27* (no trend)	1.108 (trend)
Summer temperature	-17.792** (trend)	-19.1283** (trend)

Note: For the LLC test - Ho: a common unit root, H1: panels are stationary; For the IPS - Ho: individual unit root process, H1: some panels are stationary **, * indicates rejection of the null at the 1 % and 5% levels of significance, respectively

Figure C-3. Normality Histogram of standardized residuals (specification 1)

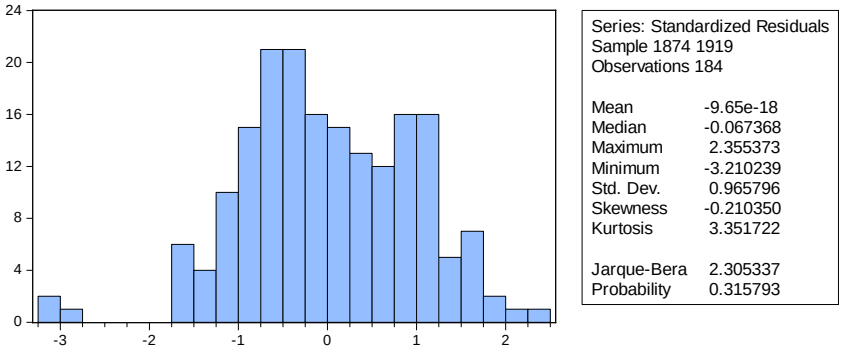


Figure C-4. Normality Histogram of standardized residuals (specification 2)

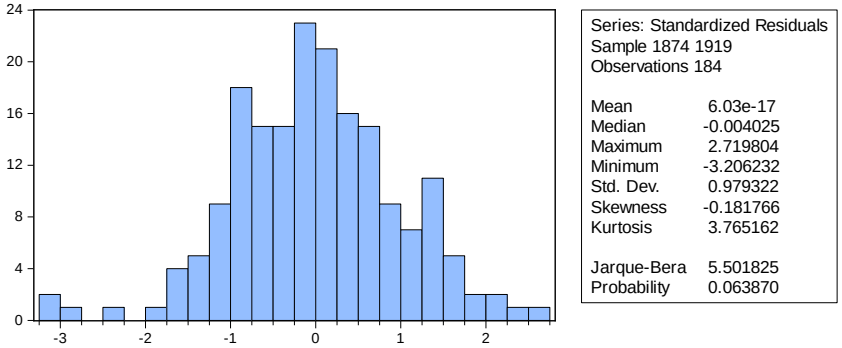


Table C-6. Partial covariance-correlation

	Infant mortality per 1,000 live births	Fertility (child per woman ratio)	Differenced summer temp	Female/male education ratio	Persons per dwelling	Public works, accumulated expenditure	Real wage index (1909-13=100)
Infant mortality per 1,000 live births	1.00						
Fertility (child per woman ratio)	0.64	1.00					
p-value	0.00						
Differenced summer temp	0.19	0.10	1.00				
p-value	0.01	0.17					
Female/male education ratio	-0.45	-0.64	-0.04	1.00			
p-value	0.00	0.00	0.64				
Persons per dwelling	0.37	0.34	0.13	-0.17	1.00		
p-value	0.00	0.00	0.09	0.02			
Public works, accumulated expenditure	-0.19	0.03	0.12	0.33	-0.04	1.00	
p-value	0.01	0.72	0.10	0.00	0.63		
Real wage index (1909-13=100)	-0.52	-0.73	-0.05	0.46	-0.26	-0.04	1.00
p-value	0.00	0.00	0.52	0.00	0.00	0.55	

Table C-7. Demographic and Economic variables in the four main provinces (various years)

Year	Province	Infant mortality per 1,000 live births	Fertility (child per woman ratio)	Female/male education ratio	Persons per dwelling	Public works, accumulated expenditure	Real wage index (1909-13=100)	Urban Proportion	Nuptiality rate (16-24)	Average Summer Temperature	Average Winter Temperature	Female literacy rate
1861	Auckland	84.014	NA	NA	NA	NA	NA	0.311343	NA	21.53333	13	0.711663
1862	Auckland	115.1079	NA	NA	NA	6.878889	NA	0.327461	NA	21.16667	13.63333	0.728773
1863	Auckland	130.9122	NA	NA	NA	18.88603	NA	0.29414	NA	20.8	11.06667	0.745883
1864	Auckland	214.2322	NA	NA	NA	53.39371	NA	0.283656	NA	21.4	12.03333	0.762993
1865	Auckland	140.6337	NA	NA	NA	80.58607	NA	0.231637	NA	20.2	10.76667	0.758562
1866	Auckland	132.7014	NA	NA	NA	116.6399	NA	0.220149	NA	19.86667	11.33333	0.754132
1867	Auckland	97.98129	NA	NA	NA	135.0671	NA	0.218725	NA	20.23333	11.4	0.749702
1868	Auckland	101.6239	NA	NA	NA	138.7819	NA	0.225247	NA	18.03333	11.06667	0.753521
1869	Auckland	143.6019	NA	NA	NA	131.7926	NA	0.213706	NA	18.73333	10.93333	0.75734
1870	Auckland	108.1517	NA	NA	NA	131.3758	NA	0.211476	NA	18.5	11.6	0.76116
1871	Auckland	94.52332	199.401	NA	NA	123.639	NA	0.189774	NA	18.26667	11.4	0.764979
1872	Auckland	108.9265	200.652	NA	NA	127.4707	NA	0.19483	NA	20.83333	11.36667	0.783161
1873	Auckland	130.9063	198.84	0.818599	NA	116.4715	90.2932	0.178324	NA	19.2	11.5	0.801344
1874	Auckland	110.4952	203.505	0.736046	4.539801	124.0282	80.181	0.189397	0.296438	19.66667	11.33333	0.819526
1875	Auckland	147.1725	202.137	0.712013	4.67022	110.0566	75.1975	0.156749	0.285732	19.63333	11.73333	0.822732
1876	Auckland	110.6124	209.723	0.780037	4.146207	109.0497	77.8968	0.145282	0.221748	19.16667	11.6	0.825937
1877	Auckland	77.24094	200.9	0.729838	4.602877	761.7217	70.0852	0.149527	0.165332	18.66667	10.7	0.829142
1878	Auckland	77.22123	203.928	0.811753	4.577	762.5441	71.6134	0.158302	0.166956	18.46667	10.9	0.832348
1879	Auckland	103.0546	184.532	0.871476	5.078432	829.4003	67.3998	0.152343	0.123707	18.7	11.06667	0.842278
1880	Auckland	58.25527	182.873	0.895757	5.29352	701.5025	81.6687	0.175824	0.114602	19.46667	11.33333	0.852208
1881	Auckland	89.01569	177.056	0.901038	5.29352	793.4949	79.1957	0.163283	0.151086	18.5	11.93333	0.862138
1882	Auckland	96.42175	172.441	0.916755	6.805188	832.8248	84.1417	0.158699	0.177023	18.6	11.6	0.865008
1883	Auckland	98.26739	170.617	0.923066	4.326258	689.8365	73.7008	0.201989	0.173605	19.5	11.26667	0.867877

Year	Province	Infant mortality per 1,000 live births	Fertility (child per woman ratio)	Female/male education ratio	Persons per dwelling	Public works, accumulated expenditure	Real wage index (1909-13=100)	Urban Proportion	Nuptiality rate (16-24)	Average Summer Temperature	Average Winter Temperature	Female literacy rate
1884	Auckland	95.93573	175.607	0.908264	4.186925	689.1582	75.8726	0.240827	0.138473	16.9	11.43333	0.870746
1885	Auckland	107.1826	176.121	0.914494	5.364121	685.1164	90.2175	0.277749	0.145351	18.16667	11.53333	0.873616
1886	Auckland	114.9156	158.113	0.920724	4.942284	678.3912	83.4504	0.251354	0.177497	19.33333	10.66667	0.876485
1887	Auckland	101.4932	157.413	0.91791	4.898529	669.4906	90.8753	0.265176	0.127711	19.86667	11.16667	0.880821
1888	Auckland	67.7682	151.923	0.898612	4.791386	658.8021	83.1494	0.261258	0.145626	17.13333	11.4	0.885157
1889	Auckland	83.58135	145.311	0.90753	5.551365	646.6264	82.7521	0.24771	0.163541	19.23333	11.6	0.889493
1890	Auckland	80.2389	137.5	0.916448	5.11884	633.2003	79.6184	0.209715	0.188153	18.8	12.4	0.893829
1891	Auckland	91.91271	137.793	0.932547	4.424645	618.7128	74.6354	0.212382	0.219462	19.33333	11.06667	0.898166
1892	Auckland	96.98388	130.533	0.994985	4.191455	603.3167	83.1813	0.220912	0.313598	18.6	12.03333	0.901541
1893	Auckland	94.65958	128.862	0.938918	5.12806	587.1369	89.8373	0.219454	0.263619	19.06667	12.36667	0.904916
1894	Auckland	93.76546	126.878	0.933389	4.318489	570.2761	82.8269	0.292984	0.229747	19.93333	11.73333	0.908291
1895	Auckland	97.51773	119.44	0.922086	5.159935	573.4363	85.7419	0.285409	0.227943	19.53333	10.4	0.911666
1896	Auckland	105.037	122.303	0.934876	4.904074	574.3735	84.7601	0.279774	0.147061	19.36667	11.7	0.915041
1897	Auckland	85.35448	120.525	0.912952	4.907243	572.2628	86.7751	0.279865	0.146774	19	11.4	0.919235
1898	Auckland	100.3972	122.804	0.912952	4.980392	549.524	93.039	0.28999	0.124386	18.23333	11.56667	0.923428
1899	Auckland	100.6914	121.054	0.88901	5.485714	504.8291	96.3106	0.314676	0.087629	18.73333	10.96667	0.927622
1900	Auckland	81.75278	115.958	0.90109	4.9895	543.1548	109.765	0.294362	0.154659	18.13333	12.06667	0.931815
1901	Auckland	65.22571	127.874	0.904014	4.700147	565.3003	95.8516	0.279667	0.131299	17.46667	11.83333	0.936009
1902	Auckland	100.1603	117.129	0.881569	5.156268	566.4838	91.0414	0.28402	0.129207	17.66667	10.6	0.937632
1903	Auckland	101.8715	116.851	0.881673	5.14455	545.6084	95.3526	0.292798	0.130865	18.1	11	0.939255
1904	Auckland	64.12353	119.437	0.870147	5.104003	546.5355	92.5302	0.290981	0.131667	17.66667	11.26667	0.940879
1905	Auckland	75.05795	117.276	0.878252	5.454756	550.333	93.474	0.28972	0.139919	17.26667	10.9	0.942502
1906	Auckland	67.87485	118.011	0.885055	5.551572	528.7302	92.6024	0.302659	0.159478	17.26667	11.06667	0.944125
1907	Auckland	83.90098	115.802	0.879614	5.558612	522.0298	98.363	0.316992	0.179036	19.46667	11.1	0.945731
1908	Auckland	79.42973	117.355	0.881562	5.540895	524.8584	97.3599	0.324732	0.184701	18.73333	10.7	0.947337

Year	Province	Infant mortality per 1,000 live births	Fertility (child per woman ratio)	Female/male education ratio	Persons per dwelling	Public works, accumulated expenditure	Real wage index (1909-13=100)	Urban Proportion	Nuptiality rate (16-24)	Average Summer Temperature	Average Winter Temperature	Female literacy rate
1909	Auckland	65.02107	116.963	0.88943	5.518098	541.8273	97.0689	0.329421	0.176474	18.75	12.33333	0.948943
1910	Auckland	74.90244	112.499	0.894562	5.287764	556.2787	97.7237	0.335872	0.29483	19.73333	11.76667	0.950549
1911	Auckland	59.41017	113.886	0.895058	5.147103	573.5353	98.0631	0.309606	0.33536	17.73333	11.26667	0.952155
1912	Auckland	53.9934	117.942	0.89426	5.281056	620.9453	103.749	0.310276	0.238142	17.6	10.53333	0.954975
1913	Auckland	63.41402	118.705	0.914468	5.380729	646.6065	103.947	0.318372	0.200282	17.63333	11	0.957796
1914	Auckland	51.64941	119.656	0.907347	5.077326	673.0106	98.3441	0.332749	0.143407	18.16667	10.4	0.960616
1915	Auckland	48.00099	112.539	0.907765	4.918525	688.1547	125.815	0.355604	0.13113	18.26667	11.8	0.963436
1916	Auckland	49.50495	111.011	0.904549	4.395114	755.0361	96.3744	0.33734	0.120247	19.36667	12.5	0.966257
1917	Auckland	44.57269	105.654	0.906183	5.009308	1304.929	88.8708	0.20238	0.107487	18.6	12.06667	NA
1918	Auckland	49.41113	92.8503	0.907498	5.081666	1325.478	95.2273	0.206805	0.129512	18.36667	10.96667	NA
1919	Auckland	42.96276	87.3897	0.906823	5.154023	1760.519	97.3032	0.199515	0.16215	17.73333	10.86667	NA
1920	Auckland	44.21962	104.092	0.864527	NA	1836.754	96.9092	0.21066	0.172028	18.1	11.13333	NA
1921	Auckland	49.86906	100.968	0.88936	NA	NA	106.206	0.221071	0.167392	18.16667	11.66667	NA
1922	Auckland	40.92043	99.5596	0.868928	NA	NA	109.707	0.223	0.160816	19.06667	11.13333	NA
1923	Auckland	39.65498	98.9334	0.870876	NA	NA	106.32	0.219889	0.169205	18.56667	10.73333	NA
1924	Auckland	44.37278	97.8938	0.86883	NA	NA	101.436	0.218081	0.154649	19	11.23333	NA
1925	Auckland	41.84055	97.4145	0.873153	NA	NA	97.2986	0.437168	0.140094	18.43333	11.03333	NA
1926	Auckland	38.87991	97.6351	0.865799	NA	NA	96.1445	0.452678	0.146096	17.83333	11.3	NA
1927	Auckland	36.17913	94.044	0.855757	NA	NA	98.269	0.460695	0.172655	18.66667	10.86667	NA
1928	Auckland	36.98208	89.6684	0.841942	NA	NA	101.056	0.45791	0.290527	19.2	11.7	NA
1929	Auckland	33.85233	85.6302	0.847055	NA	NA	103.179	0.452193	0.289403	18.86667	11.5	NA
1930	Auckland	32.46675	83.2122	0.829805	NA	NA	106.902	0.447935	0.257899	18.86667	11.2	NA
1931	Auckland	33.09471	83.8578	0.820768	NA	NA	110.843	0.444117	0.168973	18	11.26667	NA
1932	Auckland	32.24977	75.6254	0.79391	NA	NA	115.309	0.435949	0.190481	18.56667	10.26667	NA
1933	Auckland	31.13742	74.5745	0.798998	NA	NA	122.03	0.428133	0.134634	19.53333	10.8	NA

Year	Province	Infant mortality per 1,000 live births	Fertility (child per woman ratio)	Female/male education ratio	Persons per dwelling	Public works, accumulated expenditure	Real wage index (1909-13=100)	Urban Proportion	Nuptiality rate (16-24)	Average Summer Temperature	Average Winter Temperature	Female literacy rate
1934	Auckland	31.09532	74.6679	0.802885	NA	NA	119.261	0.420971	0.117302	19.06667	11.06667	NA
1935	Auckland	34.78261	73.205	0.803221	NA	NA	113.08	0.414885	0.14552	20.53333	11.43333	NA
1936	Auckland	32.11625	75.7357	0.830966	NA	NA	116.807	0.385054	0.11749	18.63333	11.06667	NA
1937	Auckland	30.04243	79.1197	0.852879	NA	NA	117.298	0.379819	0.111361	18.5	10.63333	NA
1938	Auckland	38.12095	82.4394	0.855894	NA	NA	118.183	0.377053	0.150617	20.03333	11.26667	NA
1939	Auckland	27.4486	86.2841	0.866824	NA	NA	116.415	0.376305	0.181209	17.7	11.3	NA
1940	Auckland	29.03509	97.8341	NA	NA	NA	116.289	0.356	0.187924	18.96667	11.03333	NA
1861	Canterbury	71.97943	NA	NA	NA	NA	NA	0.199813	NA	20	6.296296	0.760729
1862	Canterbury	78.54631	NA	NA	NA	105.3156	NA	0.209606	NA	0	0	0.763341
1863	Canterbury	90.74244	NA	NA	NA	236.1496	NA	0.198245	NA	0	0	0.765954
1864	Canterbury	106.9482	NA	NA	NA	310.661	NA	0.199467	NA	0	0	0.768567
1865	Canterbury	120.7815	NA	NA	NA	229.541	NA	0.133853	NA	0	0	0.777712
1866	Canterbury	108.2145	NA	NA	NA	226.2674	NA	0.111951	NA	0	0	0.786857
1867	Canterbury	113.8726	NA	NA	NA	276.4344	NA	0.123399	NA	0	0	0.796003
1868	Canterbury	117.1443	NA	NA	NA	403.7112	NA	0.186434	NA	0	0	0.789627
1869	Canterbury	74.20495	NA	NA	NA	371.658	NA	0.179432	NA	0	0	0.783251
1870	Canterbury	100.6006	NA	NA	NA	357.6573	NA	0.179835	NA	0	0	0.776876
1871	Canterbury	66.32415	222.165	NA	NA	362.8244	NA	0.186556	NA	0	0	0.7705
1872	Canterbury	133.1213	214.697	NA	NA	380.2339	NA	0.197688	NA	0	0	0.790208
1873	Canterbury	116.2186	212.215	0.808153	NA	367.2789	78.5715	0.176813	NA	0	0	0.809916
1874	Canterbury	135.2879	246.581	0.845484	5.230691	414.567	72.9503	0.175142	0.293762	0	0	0.829624
1875	Canterbury	137.5187	253.179	0.841999	4.8	386.8677	78.1654	0.146789	0.269105	0	0	0.833243
1876	Canterbury	117.5172	242.589	0.848479	4.928846	424.398	65.4077	0.152447	0.207644	0	0	0.836862
1877	Canterbury	105.5474	244.332	0.88021	5.256461	2738.209	69.1161	0.146973	0.165738	0	0	0.84048
1878	Canterbury	101.8913	229.829	0.886819	5.5	2701.278	73.8624	0.139692	0.167362	0	0	0.844099

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1879	Canterbury	129.9134	226.293	0.871109	5.586436	2503.804	68.7567	0.140594	0.109155	0	0	0.849714
1880	Canterbury	104.1285	229.842	0.89473	5.68923	2424.779	81.2979	0.138721	0.124602	0	0	0.855328
1881	Canterbury	107.9582	204.789	0.883008	5.68923	2444.731	79.3485	0.132604	0.15757	16.23333	7	0.860942
1882	Canterbury	93.22034	196.119	0.877827	5.562259	2477.902	77.897	0.128002	0.176169	15.73333	6.6	0.864208
1883	Canterbury	121.8365	185.703	0.893656	5.440256	2416.969	79.3598	0.126264	0.17275	16.1	6.7	0.867475
1884	Canterbury	77.46018	186.133	0.893536	4.655388	2109.867	83.005	0.124523	0.127048	14.46667	6.733333	0.870741
1885	Canterbury	96.812	169.282	0.898166	5.552928	1873.782	93.4453	0.122482	0.160215	15.16667	6.95	0.874007
1886	Canterbury	100.9	163.777	0.902796	5.150739	1686.482	88.0183	0.123841	0.165051	16.16667	5.333333	0.877273
1887	Canterbury	99.92759	158.237	0.896395	5.367557	1534.138	89.0232	0.125816	0.13219	18.1	6.666667	0.883449
1888	Canterbury	82.28485	149.481	0.915845	5.51996	1407.696	86.7516	0.128354	0.150105	15.26667	7	0.889624
1889	Canterbury	94.0902	142.949	0.92213	5.20718	1300.982	97.7855	0.128811	0.168019	16.73333	5.633333	0.895799
1890	Canterbury	88.99177	141.94	0.928415	5.407667	1209.638	106.593	0.11139	0.19598	16.16667	6.9	0.901974
1891	Canterbury	111.6279	131.498	0.91287	4.38934	1130.502	118.966	0.124887	0.22729	16.63333	5.8	0.90815
1892	Canterbury	102.4673	120.583	0.918624	4.390013	1061.224	108.9	0.124473	0.301103	16.13333	7.866667	0.912127
1893	Canterbury	99.68848	120.33	0.924913	5.410003	1000.021	107.473	0.124576	0.252479	15.66667	7.866667	0.916104
1894	Canterbury	77.64505	116.738	0.934686	4.889911	945.5156	98.3519	0.299062	0.229296	17.1	7.033333	0.920082
1895	Canterbury	96.22697	110.671	0.911706	5.299594	941.2859	91.5961	0.305682	0.207723	17.3	6.4	0.924059
1896	Canterbury	77.21556	107.964	0.920239	4.468915	972.5155	98.5549	0.299049	0.12684	17.3	6.733333	0.928037
1897	Canterbury	77.35962	103.092	0.922863	4.480828	953.4686	101.783	0.30041	0.153418	16.2	6.433333	0.930626
1898	Canterbury	75.40884	99.208	0.921133	5	926.9599	106.456	0.304812	0.106548	16.4	6.3	0.933216
1899	Canterbury	105.8268	93.132	0.919361	4.647074	905.8711	112.051	0.308284	0.104386	15.93333	5.45	0.935806
1900	Canterbury	82.90156	99.5438	0.931038	4.905734	870.6348	90.1586	0.317581	0.148819	14.65	6.566667	0.938395
1901	Canterbury	84.01236	99.6723	0.924432	4.346541	911.1944	86.3594	0.310195	0.125459	15.06667	6.3	0.940985
1902	Canterbury	84.50309	97.495	0.937517	4.970029	884.8136	87.1778	0.315875	0.130456	15.5	6.333333	0.9428
1903	Canterbury	86.41304	98.4921	0.907658	4.898191	841.3656	91.5286	0.329626	0.130444	15.23333	5.833333	0.944614

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1904	Canterbury	74.71561	101.279	0.916062	4.851955	831.1792	93.8011	0.32812	0.13373	16	6.3	0.946429
1905	Canterbury	71.51604	104.639	0.916943	4.714191	825.7371	87.7902	0.325418	0.144809	15.5	6.866667	0.948244
1906	Canterbury	61.94048	103.719	0.90768	4.804206	830.8043	89.3002	0.328087	0.164367	15.33333	7.333333	0.950059
1907	Canterbury	103.8724	108.198	0.896403	4.686227	800.2111	94.7168	0.338263	0.183926	17.73333	6.533333	0.951028
1908	Canterbury	64.3797	103.053	0.899396	4.756089	764.0218	96.0493	0.355012	0.182644	16.06667	6.666667	0.951996
1909	Canterbury	57.14931	105.343	0.893711	4.732722	769.4431	97.4845	0.358608	0.174417	16.46667	7.966667	0.952965
1910	Canterbury	60.86142	99.9289	0.894955	4.32013	774.4294	95.8353	0.359767	0.304963	17.23333	7.333333	0.953933
1911	Canterbury	52.55715	97.5941	0.908743	4.35329	794.0379	94.4971	0.363668	0.306109	15.36667	7.366667	0.954902
1912	Canterbury	55.36646	100.533	0.912728	4.306887	802.5519	105.774	0.36286	0.228677	15.3	6.9	0.956462
1913	Canterbury	55.28846	103.537	0.904862	4.324304	775.6607	103.531	0.37925	0.186063	15.86667	6.9	0.958022
1914	Canterbury	52.84371	100.231	0.906925	4.312648	781.832	107.192	0.386626	0.129188	16.83333	6.766667	0.959583
1915	Canterbury	48.39419	101.208	0.909211	4.323484	800.3148	102.634	0.39248	0.131778	16.6	7.066667	0.961143
1916	Canterbury	56.23902	100.534	0.918458	4.022161	868.5858	101.573	0.388692	0.114159	17.1	7.5	0.962703
1917	Canterbury	47.73589	97.7711	0.927509	4.344039	1171.681	101.736	0.296408	0.112993	15.2	7.266667	NA
1918	Canterbury	42.81118	87.0417	0.9324	4.30703	1207.65	100.703	0.295971	0.137671	15.2	6.2	NA
1919	Canterbury	47.1549	80.766	0.932424	4.270021	1278.771	102.566	0.290683	0.170309	15.1	7.433333	NA
1920	Canterbury	53.91448	101.757	0.888934	NA	1242.433	105.398	0.314802	0.172602	15.15	7.2	NA
1921	Canterbury	45.17869	92.4026	0.914468	NA	NA	111.076	0.338088	0.164501	15.15	7.533333	NA
1922	Canterbury	43.41317	96.9039	0.893459	NA	NA	115.783	0.369401	0.162913	15.3	5.966667	NA
1923	Canterbury	54.2319	91.129	0.895462	NA	NA	110.643	0.387606	0.165566	17	5.9	NA
1924	Canterbury	42.71186	91.3011	0.893358	NA	NA	108.028	0.389026	0.151011	14.5	7.333333	NA
1925	Canterbury	41.9406	90.8136	0.897803	NA	NA	106.399	0.560737	0.136455	16.13333	6.466667	NA
1926	Canterbury	44.77953	89.9174	0.890241	NA	NA	105.175	0.553593	0.152736	15.8	6.833333	NA
1927	Canterbury	48.48776	84.9673	0.879916	NA	NA	106.14	0.563951	0.179295	17.45	5.4	NA
1928	Canterbury	36.94056	85.5149	0.86571	NA	NA	109.876	0.564884	0.290246	16.13333	7.233333	NA

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1929	Canterbury	35.06173	81.4303	0.870968	NA	NA	113.051	0.568844	0.286312	15.9	6.733333	NA
1930	Canterbury	35.52924	80.9169	0.853231	NA	NA	116.604	0.566428	0.235667	15.16667	5.533333	NA
1931	Canterbury	29.21748	78.0318	0.843939	NA	NA	117.248	0.566911	0.17435	15.6	5.766667	NA
1932	Canterbury	35.51762	71.5051	0.816323	NA	NA	119.759	0.569198	0.195857	15.56667	5.2	NA
1933	Canterbury	37.932	69.5848	0.821554	NA	NA	122.054	0.569341	0.114226	16.5	5.833333	NA
1934	Canterbury	35	69.9045	0.825551	NA	NA	119.523	0.568613	0.129044	16.53333	6.3	NA
1935	Canterbury	29.58407	65.842	0.825897	NA	NA	119.48	0.568328	0.138512	18.2	6.166667	NA
1936	Canterbury	28.15346	69.4008	0.854425	NA	NA	126.032	0.564418	0.115958	15.13333	7.033333	NA
1937	Canterbury	35.22818	71.4694	0.876957	NA	NA	126.263	0.562064	0.109829	14.83333	6.133333	NA
1938	Canterbury	34.32677	71.3743	0.880057	NA	NA	126.443	0.561088	0.164214	16.76667	5.933333	NA
1939	Canterbury	34.02187	77.8236	0.891295	NA	NA	124.459	0.56175	0.182908	16.3	6.033333	NA
1940	Canterbury	30.72263	87.0433	NA	NA	NA	123.039	0.557414	0.18954	16.46667	6.666667	NA
1861	Otago	77.39938	NA	NA	NA	NA	NA	0.215366	NA	0	13.83333	0.81924
1862	Otago	94.89051	NA	NA	NA	54.50487	NA	0.242564	NA	0	0	0.818616
1863	Otago	118.4211	NA	NA	NA	56.56861	NA	0.241264	NA	0	0	0.817992
1864	Otago	111.5343	NA	NA	NA	166.9469	NA	0.438075	NA	14.11111	6.425926	0.817368
1865	Otago	100.1994	NA	NA	NA	219.1542	NA	0.398013	NA	14.27778	6.962963	0.822285
1866	Otago	85.78313	NA	NA	NA	240.7157	NA	0.312763	NA	13.7963	7.148148	0.827201
1867	Otago	88.62495	NA	NA	NA	280.4277	NA	0.261297	NA	14.93333	7.033333	0.832117
1868	Otago	84.272	NA	NA	NA	330.4178	NA	0.278371	NA	12.96667	5.866667	0.824627
1869	Otago	77.55775	NA	NA	NA	283.6205	NA	0.224838	NA	14.36667	6.533333	0.817137
1870	Otago	83.78378	NA	NA	NA	299.7235	NA	0.223774	NA	13.4	6.166667	0.809647
1871	Otago	100.8458	266.401	NA	NA	357.4654	NA	0.263672	NA	13.83333	6.6	0.802157
1872	Otago	86.05042	233.346	NA	NA	375.5507	NA	0.277332	NA	15.36667	5.766667	0.814023
1873	Otago	99.74587	225.507	0.823968	NA	301.4195	90.7476	0.212467	NA	13.73333	6.766667	0.82589

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1874	Otago	88.19425	236.19	0.811894	5.10599	350.82	99.3975	0.217346	0.291085	14.13333	5.466667	0.837757
1875	Otago	104.8286	238.46	0.839053	5.106191	322.9096	82.983	0.178022	0.252478	14.4	6.133333	0.83793
1876	Otago	92.93514	244.477	0.840163	5.192222	347.7692	80.0526	0.177317	0.19354	14.73333	6.033333	0.838103
1877	Otago	80.98052	229.077	0.846189	5.517202	1949.256	78.0953	0.178448	0.166144	14.33333	6.333333	0.838277
1878	Otago	41.88703	219.483	0.914703	5.078341	1952.368	75.4957	0.187763	0.15281	12.7	5.566667	0.83845
1879	Otago	92.24319	207.503	0.893042	4.495065	1823.639	73.623	0.189395	0.094603	13.33333	5.633333	0.847298
1880	Otago	85.43993	208.811	0.922257	5.4642	1927.738	76.8952	0.176329	0.134602	14.26667	7.233333	0.856147
1881	Otago	95.22834	188.613	0.91613	5.4642	1995.974	71.6337	0.178308	0.164055	14.13333	7.466667	0.864995
1882	Otago	73.67583	187.672	0.923879	4.9495	2046.226	87.5964	0.172324	0.175314	13.8	6.633333	0.867858
1883	Otago	93.857	179.697	0.916901	4.995298	2047.396	77.5467	0.169857	0.161325	14.23333	7.2	0.87072
1884	Otago	73.26812	175.753	0.91073	5.026119	1939.398	86.0408	0.168206	0.115622	12.6	6.633333	0.873582
1885	Otago	70.53772	166.527	0.906512	5.329865	1842.657	87.803	0.156933	0.175079	13.66667	7.066667	0.876444
1886	Otago	83.8194	153.07	0.902295	5.265371	1754.879	94.5283	0.153754	0.152604	14.4	5.833333	0.879306
1887	Otago	69.28251	145.512	0.91158	5.160256	1674.351	93.0898	0.156631	0.136669	16.76667	6.366667	0.884682
1888	Otago	56.96058	141.308	0.901763	4.839203	1599.773	95.7244	0.153764	0.154583	13.96667	6.166667	0.890059
1889	Otago	67.85963	136.737	0.911224	4.282272	1530.136	101.174	0.150365	0.172498	15.93333	4.866667	0.895436
1890	Otago	68.52608	130.464	0.920684	5.11205	1464.649	97.5072	0.137846	0.203807	14.93333	5.9	0.900812
1891	Otago	76.52215	130.73	0.911506	4.1525	1402.679	102.706	0.144688	0.235117	14.2	5.633333	0.906189
1892	Otago	42.86058	124.894	0.90403	4.842181	1343.718	100.143	0.145184	0.288609	13.83333	7.066667	0.909945
1893	Otago	84.87269	117.078	0.911093	4.459729	1287.35	101.068	0.143968	0.241338	13.53333	6.5	0.913701
1894	Otago	75.35885	118.815	0.89009	5.167295	1233.232	105.302	0.292126	0.228845	15.33333	6.333333	0.917458
1895	Otago	61.43597	112.132	0.921214	5.09708	1214.267	99.6056	0.298004	0.187502	15.23333	5.3	0.921214
1896	Otago	54.86411	106.093	0.912249	4.834244	1276.726	96.2581	0.284545	0.133485	14.3	5.8	0.92497
1897	Otago	55.61147	104.655	0.932707	4.169648	1261.705	95.811	0.283604	0.160062	14.5	6	0.928121
1898	Otago	63.59705	101.221	0.928437	4.759209	1238.535	96.7781	0.285092	0.088709	13.53333	5.733333	0.931273

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1899	Otago	86.69772	97.3319	0.839005	4.844689	1228.163	115.295	0.284209	0.121144	13.66667	5.466667	0.934424
1900	Otago	67.25794	100.068	0.936324	4.865116	1225.363	109.487	0.284778	0.142979	13.13333	6.1	0.937575
1901	Otago	67.1693	105.658	0.940493	4.317788	1178.815	96.7736	0.299494	0.126708	12.7	5.366667	0.940727
1902	Otago	67.60564	101.571	0.938099	5.187735	1185.437	97.4594	0.29683	0.131706	12.83333	5.933333	0.942546
1903	Otago	67.24021	104.037	0.923437	4.88239	1181.192	98.7705	0.299912	0.130024	13	4.866667	0.944365
1904	Otago	76.63428	105.373	0.928714	5.008507	1171.836	94.2096	0.303454	0.135793	13.83333	6.2	0.946184
1905	Otago	59.96473	104.309	0.928982	4.659605	1174.182	96.9734	0.305696	0.149699	13	5.766667	0.948003
1906	Otago	57.47863	106.361	0.928015	4.852444	1274.54	108.588	0.306049	0.169257	12.8	6.4	0.949823
1907	Otago	74.04273	113.09	0.929677	4.899962	1263.419	104.541	0.335727	0.188815	15.56667	5.866667	0.951278
1908	Otago	55.6266	118.496	0.924306	4.899962	1265.044	104.42	0.310844	0.180587	13.86667	5.8	0.952734
1909	Otago	53.36091	129.3	0.913624	4.843804	1252.957	102.696	0.312484	0.17236	14.7	6.45	0.95419
1910	Otago	68.22939	135.772	0.91193	4.439705	1241.025	98.8494	0.314856	0.315095	14.66667	6.6	0.955645
1911	Otago	50.97389	146.291	0.908504	4.566943	1288.186	97.9688	0.322015	0.276858	13.06667	6.5	0.957101
1912	Otago	46.08767	148.212	0.900173	4.568498	1322.533	100.448	0.465949	0.219212	12.83333	6.233333	0.95948
1913	Otago	39.20361	148.133	0.899743	4.542384	1356.015	101.617	0.466698	0.171845	13.8	7.066667	0.96186
1914	Otago	49.32027	96.3166	0.905753	4.471514	1389.696	102.802	0.466381	0.129835	14.2	7	0.964239
1915	Otago	64.89071	89.2961	0.906549	5.195399	1445.744	113.914	0.466525	0.132425	13.76667	7.366667	0.966619
1916	Otago	42.73504	92.9139	0.91271	4.273142	1543.979	113.684	0.488511	0.10807	15.3	7.5	0.968998
1917	Otago	45.53008	91.8846	0.916509	4.539972	1862.55	110.888	0.416742	0.1185	14.76667	7.633333	NA
1918	Otago	43.19818	80.5674	0.916314	4.41176	1936.461	103.216	0.413399	0.145831	14.4	6.166667	NA
1919	Otago	43.47826	75.8177	0.921709	4.283549	2040.091	106.618	0.410108	0.170882	13.36667	7.433333	NA
1920	Otago	54.58731	92.7972	0.878718	NA	2147.579	108.847	0.417245	0.173175	14.2	7.133333	NA
1921	Otago	52.02514	87.3757	0.903959	NA	NA	116.008	0.424269	0.16161	13.66667	5.7	NA
1922	Otago	39.31204	86.0814	0.883191	NA	NA	115.894	0.423655	0.16501	14.46667	6.566667	NA
1923	Otago	42.7256	81.2505	0.885171	NA	NA	109.57	0.425013	0.161927	14.33333	6.5	NA

Year	Province	Infant mortality per 1,000 live births	Fertility (child per woman ratio)	Female/male education ratio	Persons per dwelling	Public works, accumulated expenditure	Real wage index (1909-13=100)	Urban Proportion	Nuptiality rate (16-24)	Average Summer Temperature	Average Winter Temperature	Female literacy rate
1924	Otago	32.77467	79.5938	0.883091	NA	NA	107.163	0.421243	0.147372	15.5	7.7	NA
1925	Otago	38.0117	80.3468	0.887486	NA	NA	106.794	0.527098	0.132816	13.9	6.4	NA
1926	Otago	40.63539	78.7583	0.88001	NA	NA	105.99	0.569167	0.159376	13.8	7.366667	NA
1927	Otago	40	78.7668	0.869804	NA	NA	108.135	0.555511	0.185935	14.53333	6.166667	NA
1928	Otago	37.28415	74.5339	0.855762	NA	NA	106.166	0.560322	0.289965	14.9	7.233333	NA
1929	Otago	32.14426	74.8243	0.860959	NA	NA	102.86	0.566489	0.283221	13.93333	7	NA
1930	Otago	65.21739	43.2934	0.843426	NA	NA	105.305	0.568115	0.213436	13.83333	6.033333	NA
1931	Otago	35.58858	75.4099	0.83424	NA	NA	105.735	0.574659	0.179727	13.6	5.833333	NA
1932	Otago	24.13209	69.8498	0.806942	NA	NA	107.756	0.579925	0.17545	13.33333	6.033333	NA
1933	Otago	23.97559	68.0252	0.812113	NA	NA	113.309	0.582526	0.093819	14.86667	6.433333	NA
1934	Otago	37.57472	69.6398	0.816064	NA	NA	112.96	0.58585	0.140785	14.9	6.633333	NA
1935	Otago	34.78644	67.715	0.816406	NA	NA	109.197	0.589233	0.131505	16.36667	6.733333	NA
1936	Otago	33.21678	68.4108	0.844606	NA	NA	113.338	0.541971	0.114425	14	7.2	NA
1937	Otago	30.64651	71.5303	0.866879	NA	NA	111.203	0.541676	0.123425	13.36667	6.6	NA
1938	Otago	32.5857	71.2689	0.869943	NA	NA	111.671	0.543579	0.17781	15.43333	6.5	NA
1939	Otago	31.22498	75.6702	0.881053	NA	NA	110.386	0.54495	0.184607	14.53333	6	NA
1940	Otago	33.82353	82.7572	NA	NA	NA	109.106	0.543685	0.191157	14.9	7.4	NA
1861	Wellington	47.25898	NA	NA	NA	NA	NA	0.332325	NA	0	0	0.686612
1862	Wellington	55.55556	NA	NA	NA	47.76076	NA	0.317745	NA	16.5	9.266666	0.697857
1863	Wellington	51.09489	NA	NA	NA	93.4087	NA	0.295386	NA	16.36667	10.03333	0.709101
1864	Wellington	62.25681	NA	NA	NA	141.0236	NA	0.310469	NA	16.7	8.7	0.720345
1865	Wellington	100	NA	NA	NA	158.4689	NA	0.288842	NA	17.06667	9.266666	0.728454
1866	Wellington	67.81751	NA	NA	NA	179.4992	NA	0.282149	NA	NA	NA	0.736563
1867	Wellington	84.6731	NA	NA	NA	213.4334	NA	0.33262	NA	17.53333	9.433333	0.744671
1868	Wellington	79.16666	NA	NA	NA	232.5897	NA	0.353746	NA	16.1	9.1	0.746947

Year	Province	Infant mortality per 1,000 live births	Fertility (child per woman ratio)	Female/male education ratio	Persons per dwelling	Public works, accumulated expenditure	Real wage index (1909-13=100)	Urban Proportion	Nuptiality rate (16-24)	Average Summer Temperature	Average Winter Temperature	Female literacy rate
1869	Wellington	98.15951	NA	NA	NA	219.2052	NA	0.345065	NA	17.1	0	0.749222
1870	Wellington	78.81269	NA	NA	NA	214.381	NA	0.351396	NA	16.63333	9.7	0.751498
1871	Wellington	62.43903	221.191	NA	NA	227.8612	NA	0.381478	NA	16.23333	9.266666	0.753774
1872	Wellington	90.40591	214.852	NA	NA	249.139	NA	0.400799	NA	17.63333	8.966666	0.781641
1873	Wellington	101.8998	212.217	0.700151	NA	225.2317	97.8721	0.341644	NA	16.23333	9.666667	0.809509
1874	Wellington	130.7012	250.341	0.731548	5.493229	241.9464	70.9699	0.354045	0.288408	16.76667	8.7	0.837377
1875	Wellington	122.063	249.821	0.68038	5.072727	193.7278	79.1903	0.335138	0.235852	17.43333	9.133333	0.839904
1876	Wellington	112.4592	264.503	0.756342	5.537247	188.5697	79.5524	0.371805	0.179436	17.3	8.7	0.842431
1877	Wellington	111.0614	242.217	0.774381	5.248684	573.353	69.9305	0.377651	0.16655	17.16667	9.1	0.844958
1878	Wellington	94.83454	239.745	0.752727	6.062276	606.8603	84.4922	0.350016	0.138258	16.06667	8.8	0.847485
1879	Wellington	122.6852	233.121	0.792345	5.3955	570.2458	75.3013	0.379795	0.104603	15.96667	8.566667	0.856253
1880	Wellington	75.86705	232.579	0.827223	5.434196	711.3717	71.3798	0.337286	0.144602	17.16667	9.333333	0.865022
1881	Wellington	85.0234	202.144	0.836535	5.434196	780.413	81.3724	0.327885	0.170539	16.46667	9.7	0.873791
1882	Wellington	105.0781	191.459	0.827068	5.389427	839.928	84.8073	0.316656	0.17446	16.36667	9.366667	0.872316
1883	Wellington	68.96552	187.722	0.856845	5.512346	841.9668	81.9599	0.314189	0.149899	16.96667	9.266666	0.870841
1884	Wellington	84.01792	181.621	0.868378	5.44881	818.6582	83.9511	0.312364	0.130486	14.8	9.333333	0.869366
1885	Wellington	81.14035	177.294	0.880774	5.712241	797.7271	97.3789	0.346496	0.189944	15.9	9.066667	0.867891
1886	Wellington	109.2645	175.445	0.893169	5.580952	778.7498	98.5926	0.329432	0.140158	16.5	8.033334	0.866416
1887	Wellington	107.6597	166.307	0.894508	5.3912	761.3973	100.669	0.338776	0.141147	17.63333	8.7	0.874492
1888	Wellington	78.75394	159.159	0.909405	5.195536	745.4109	100.242	0.348139	0.159062	15.23333	9.733334	0.882568
1889	Wellington	78.26396	148.995	0.913445	5.220987	730.5838	92.044	0.356113	0.180325	17.1	8.766666	0.890644
1890	Wellington	80.60709	149.882	0.917484	5.503105	716.7491	110.436	0.354008	0.211635	16.46667	9.633333	0.89872
1891	Wellington	96.2963	150.014	0.890325	5.665936	703.7703	94.3833	0.313034	0.242945	16.4	8.066667	0.906796
1892	Wellington	92.75362	139.987	0.919116	5.501207	691.5349	99.5681	0.323862	0.276114	16.5	9.633333	0.909544
1893	Wellington	85.89705	138.739	0.912384	5.555555	679.9495	96.5177	0.325499	0.230197	16.5	10.4	0.912293

Year	Province	Infant mortality per 1,000 live births	Fertility (child per woman ratio)	Female/male education ratio	Persons per dwelling	Public works, accumulated expenditure	Real wage index (1909-13=100)	Urban Proportion	Nuptiality rate (16-24)	Average Summer Temperature	Average Winter Temperature	Female literacy rate
1894	Wellington	75.73047	133.382	0.923077	5.625	668.9353	93.8545	0.355331	0.228394	17.83333	9.8	0.915041
1895	Wellington	95.70586	133.805	0.908293	5.549281	684.2033	98.1469	0.3361	0.167281	17.9	8.4	0.91779
1896	Wellington	80.767	122.443	0.911957	5.776173	674.0932	85.1267	0.336948	0.140129	17.1	9.566667	0.920538
1897	Wellington	75.96724	120.45	0.926716	5.466159	678.3067	91.8982	0.338423	0.142224	16.73333	9.4	0.9239
1898	Wellington	86.66666	117.32	0.896953	5.410028	649.03	93.6531	0.354545	0.070871	16.43333	9.333333	0.927262
1899	Wellington	96.05775	112.659	0.905682	5.968329	637.5856	103.58	0.358971	0.137902	16.1	8.266666	0.930624
1900	Wellington	67.72069	114.102	0.905401	5.326904	641.0767	98.1686	0.362399	0.137139	15.56667	9.566667	0.933985
1901	Wellington	69.78489	115.726	0.893773	4.712527	674.1688	98.4396	0.341743	0.127958	15.9	9.1	0.937347
1902	Wellington	88.81084	109.4	0.892868	5.510008	687.3696	92.3459	0.343501	0.131285	15.9	9.066667	0.928404
1903	Wellington	72.73549	115.517	0.89448	5.102996	740.9912	97.9322	0.349772	0.129604	16.33333	8.066667	0.91946
1904	Wellington	73.80952	114.892	0.888733	4.859796	790.7938	96.1079	0.350938	0.137856	16	8.866667	0.910516
1905	Wellington	71.88626	118.623	0.887965	5.32149	794.9759	91.8398	0.356404	0.154588	15.36667	8.933333	0.901573
1906	Wellington	57.95678	115.713	0.882754	5.196605	766.898	96.3093	0.349086	0.174146	15.1	9.3	0.892629
1907	Wellington	99.23664	119.252	0.875603	5.20565	813.768	92.0557	0.366677	0.186758	17.46667	8.6	0.904213
1908	Wellington	70.11716	124.082	0.873799	5.652567	811.4355	95.33	0.369346	0.178531	16.03333	8.533334	0.915797
1909	Wellington	68.82811	117.115	0.885103	5.770403	812.4076	95.6063	0.374197	0.170303	16.2	10.43333	0.927382
1910	Wellington	68.76844	112.548	0.885563	4.603261	819.125	100.101	0.377354	0.325228	17.06667	9.433333	0.938966
1911	Wellington	58.4685	107.668	0.894606	4.956183	944.8107	102.023	0.34615	0.247607	15.5	9.7	0.95055
1912	Wellington	55.28803	110.224	0.897388	4.980331	1006.704	102.952	0.341633	0.209747	15.5	9.3	0.953329
1913	Wellington	58.80191	103.669	0.895192	5.052836	1061.565	99.7243	0.339343	0.157626	16.36667	9.666667	0.956108
1914	Wellington	61.32577	104.252	0.893303	4.196491	1133.946	95.2889	0.342871	0.130483	16.66667	9.1	0.958888
1915	Wellington	36.15498	145.379	0.897257	4.907299	1216.14	112.823	0.341216	0.126336	16.7	9.7	0.961667
1916	Wellington	57.12343	102.529	0.894994	5.090625	1197.613	89.1442	0.345748	0.101981	17.26667	10.2	0.964446
1917	Wellington	50.65001	101.979	0.898116	4.747426	1398.387	89.8432	0.311338	0.124006	17.4	10.26667	NA
1918	Wellington	53.56496	93.9921	0.89085	4.941595	1493.444	86.5184	0.306987	0.15399	16.9	9.066667	NA

Year	Province	Infant mortality per 1,000 live births	Fertility (child per woman ratio)	Female/male education ratio	Persons per dwelling	Public works, accumulated expenditure	Real wage index (1909-13=100)	Urban Proportion	Nuptiality rate (16-24)	Average Summer Temperature	Average Winter Temperature	Female literacy rate
1919	Wellington	50.25996	87.2717	0.902066	5.135765	1639.434	89.4808	0.311804	0.171455	15.8	9.366667	NA
1920	Wellington	59.379	103.761	0.859992	NA	1686.506	94.2047	0.334909	0.170283	16.2	8.733334	NA
1921	Wellington	48.49924	96.788	0.884695	NA	NA	103.681	0.357394	0.158719	16.3	9.6	NA
1922	Wellington	43.27005	95.3883	0.86437	NA	NA	106.397	0.360923	0.167107	16.93333	9.266666	NA
1923	Wellington	47.33621	90.0974	0.866307	NA	NA	100.109	0.357932	0.158288	17.26667	8.6	NA
1924	Wellington	33.51035	88.029	0.864272	NA	NA	96.8772	0.357863	0.143733	17.26667	9.633333	NA
1925	Wellington	52.58286	86.5459	0.868572	NA	NA	96.9077	0.441205	0.139456	16.7	9	NA
1926	Wellington	39.31685	89.5406	0.861256	NA	NA	96.5346	0.443598	0.166015	16.1	9.3	NA
1927	Wellington	38.05798	88.5069	0.851268	NA	NA	96.3806	0.454688	0.192574	16.9	8.866667	NA
1928	Wellington	35.86878	86.2997	0.837525	NA	NA	96.6469	0.459713	0.289684	15.9	7.466667	NA
1929	Wellington	37.21014	85.5275	0.842611	NA	NA	96.2489	0.465529	0.28013	15.5	7.366667	NA
1930	Wellington	82.73951	38.3895	0.825452	NA	NA	97.7407	0.474923	0.191204	14.83333	6.933333	NA
1931	Wellington	28.42143	82.999	0.816462	NA	NA	100.373	0.483231	0.185104	15.33333	7.133333	NA
1932	Wellington	31.08607	76.4662	0.789745	NA	NA	103.757	0.482177	0.155042	15.36667	6.266667	NA
1933	Wellington	34.48276	72.8551	0.794806	NA	NA	107.895	0.478979	0.10556	17.1	7.2	NA
1934	Wellington	31.79191	70.3841	0.798673	NA	NA	107.273	0.475221	0.152527	16.73333	7.366667	NA
1935	Wellington	32.86482	69.5333	0.799007	NA	NA	105.246	0.472847	0.124497	18.26667	6.733333	NA
1936	Wellington	33.98746	70.279	0.826607	NA	NA	110.724	0.47178	0.112893	15.2	7.033333	NA
1937	Wellington	26.9341	73.5022	0.848404	NA	NA	111.947	0.471409	0.137021	15.46667	6.633333	NA
1938	Wellington	32.11338	77.2979	0.851404	NA	NA	111.492	0.473118	0.179509	17.06667	7.066667	NA
1939	Wellington	32.20367	81.2477	0.862276	NA	NA	111.411	0.477576	0.186307	15.76667	7.266667	NA
1940	Wellington	30.43605	92.4922	NA	NA	NA	113.952	0.486086	0.192773	16.73333	7.133333	NA

Appendix D

Figure D-1. Provincial (Statistical) Boundaries as of 1870-76

Source: McKinnon (2012)

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