

Stayers and Leavers, Diggers and Canucks: The 1914-1918 War in Comparative Perspective

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Abstract

We use World War I Attestation Papers to explore differences in stature of British and native born enlistees in the Australian Imperial Forces (AIF) and Canadian Expeditionary Forces (CEF). Results suggest important differences with respect to the growth path these two former colonies followed. Australia followed a biological standard of living growth path best characterized as non-changing in the later half of the 19th century, while the biological standard of living amongst Canadian born CEF enlistees fell during the same period. In contrast the biological standard of living for British born troops in the AIF and CEF suggest a varied and somewhat idiosyncratic growth path. Important socio-economic status effects captured through occupation, as well as religious affiliation, suggest a differential effect of social status in shaping stature of AIF and CEF enlistees, as well as a complex milieu between country of birth, and occupation and religion. Lastly, we note the stature advantage held by the Irish born persist in the context of enlistment in colonial forces.

Keywords: Stature, biological standard of living, Canada, Australia, British Empire

JEL Codes: N32, N34, J1, I31

Introduction

A familiar theme in the literature of comparative growth and development is the comparison of former British colonies with other developing regions (Ferguson 2004 et al). Of course there was considerable diversity within the British Empire (Schedvin 1990). A comparison of Australia and Canada is particularly interesting because they were settled at roughly the same time by large numbers of British emigrants. We begin with a broad-brush review of differences and similarities in the institutional and geographic environment of Australia and Canada. The stylized facts of institutional and geographic differentiation provide a context for in which to consider the empirical contribution of this paper: a direct comparison of anthropometric characteristics of soldiers who served in the 1914-1918 war. Military medical examinations permit a comparison of cohorts born before 1900 in the two countries.

The institutional and demographic roots of Australia and Canada have much in common. European settlement in both countries largely supplanted indigenous population, economy and institutions (notwithstanding ongoing campaigns for indigenous rights). European immigrants during the late eighteenth and nineteenth centuries came largely from the same host population in the British Isles. Indeed, Canada and Australia were the most attractive overseas destinations outside of the United States for several generations of British emigrants. Canada and Australia became the largest of the British overseas dominions or self-governing colonies within the British Empire.

The early legal and institutional fabric of both countries derived almost entirely from England and Scotland. Australia and Canada inherited the same colonial institutions, indeed some of the same colonial administrators. Admittedly, Canada's francophone population and the civil law tradition in Quebec constitute an important exception. Still, it is worth noting both countries developed federal systems in a modified Westminster model, and that even the Quebec legislature has continued to operate in this tradition. In the twentieth century both countries expanded public sector employment and state-sponsored social welfare systems only to encounter a painful readjustment late in the century to balance social entitlements with fiscal resources.

A large territorial expanse has made the transportation sector especially important for both Australia and Canada. A majority of the population of both countries now lives in cities that populate relatively thin corridors on the Canada-U.S. border and along the Australian coast. And yet geography also accounts for important differences. Resource development and settlement patterns in the two countries reflect geographical and climatic differences. Much of Canada but little of Australia sees snow and temperatures low enough to halt plant growth. Much of Australia but none of Canada has a tropical or sub-tropical climate. The extreme aridity found in large sections of Australia is largest absent from Canada; indeed large stretches of the Canadian landscape have abundant groundwater.

Soil and climate differences undoubtedly contributed to a different mix of economic activities and particular settlement patterns, but arguably more important are differences in the geographical context. Australia's location deep in the south Pacific (and the late development of Java/Indonesia) effectively isolated Australia for some time. By contrast transportation and communication between Canada and Britain was much easier from an early date, and

exchange with the United States was even easier. Canada's close early economic relationship with Britain was supplanted early in the twentieth century by north-south trade with the United States. Today Canadian international trade is overwhelmingly with the U.S. Economic relationships with Japan and China have grown in importance for Australia although neither reaches the importance to Canada of the U.S.

Another consequence of locational proximity is the high proportion of Canadians living within a short drive of the U.S. border and the long history of easy cross-border migration. The net flow was northbound in the 1830s and 1840s (arguably) and in the 1890s and 1900s (with greater certainty) but on balance there has been more migration southward. The lure of larger employment pools and higher real wages in the United States continues to influence the Canadian labour market. In contrast Australian workers lack easy access to a higher wage market. Indeed, Australia has offered the most attractive working opportunities in the South Pacific region throughout most of the 19th and 20th centuries.

Our admittedly casual overview suggests that substantial institutional and demographic commonality characterize the initial conditions for economic growth in Australia and Canada. Institutional differences emerged over time, of course, but from a global perspective it is easier to see the similarities and shared inheritance. The geographic and locational differences, on the other hand, from the outset were quite striking.

If we accept the stylized fact of common institutions and different geography, an advocate of geographic growth determinants would see no reason for the two economies to follow a similar trajectory. An enthusiast for institutional influences, on the other hand, might expect Canada and Australia to follow substantially similar growth paths. What do we see?

The answer turns out to depend a bit on how we try to answer the question. The evidence of GDP per capita is straightforward. Greasley and Oxley (1998) review a variety of differences and similarities in GDP per capita and related indicators. Their GDP data are taken from Butlin (1962) and Urquhart (1986) with a 1985 PPP adjustment. The salient economic outcome identified by these data is an enormous difference in per capita in 1870 followed by a powerful convergence in subsequent decades.

A parsimonious interpretation might be that geography created diverse starting conditions. In 1870 gold and wool production were still thriving activities in Australia, and the premium needed to induce migrants to make the longer voyage remained relatively high. Canada in 1870, by contrast, was not yet expanding westward, and both agriculture and manufacturing in the eastern provinces were being eclipsed by booming post-bellum US economic growth. In the decades after 1870, however, considerable convergence in GDP per capita was achieved. Much of the convergence can be traced to the way in which Australia and Canada emerged from the severe slump of the early 1990s. Canada recovered quickly and entered its biggest economic boom to that point date; Australia resumed growth but the pace was slow enough to give rise to notions of an Australian climacteric in the early 1890s (Greasley and Oxley 1998). Within the larger growth literature it is tempting to interpret the contrast as convergence reflecting the combined effect of common institutions and conventional convergence dynamics that brought the two economies to a common growth path.

A simple summary of the GDP per capita evidence in Table 1 confirms the appeal of a convergence narrative. Allen and Maddison, who rely on independent estimates of nominal GDP and price change, present the same trajectory of real Canadian per capita GDP relative to Australia: a sizeable gap c1870 diminished considerably although not entirely by 1913. Clarity diminishes, however, if we turn to a comparison of other indicators. Williamson shows first convergence and then a strong divergence of real wages as Canada overtook Australia during the 1880s. Allen suggests a longer period of convergence and only modest differences in 1913 (except for bricklayers).

Table 1: Canada/Australia on Various Indicators 1870-1913

	1870	1880	1890	1900	1913
Maddison (1995) real GDP per capita	0.43	0.37	0.47	0.64	0.77
Allen (1994) real GDP per capita		0.36	0.45	0.64	0.80
Williamson (1995) real wages	0.78	0.88	1.20	1.12	1.71
Allen (1994) bricklayer real wage/hr				1.05	1.37
Allen (1994) labourer real wage/hr				0.99	1.05
Allen (1994) real manufacturing earnings/yr		0.65	0.71	0.93	1.06
Maddison (1995) working hours	1.01				1.01
Huberman (2004) annual working hours	1.02	1.11	1.21	1.30	1.30
Crafts (1997) life expectancy at birth	0.89				0.89
Crafts (1997) literacy rate (%)	1.23				0.98
Crafts (1997) school enrollment (%)	1.24				1.04

There is no reason to expect these indicators of relative position to follow a similar trajectory. Allen's trade-specific wages describe work in particular cities (Toronto and Sydney) which may not be fully representative of the national economy. If individual trades and cities can differ, as they appear to, it is entirely plausible that manufacturing may have fallen behind a society-wide real wage (eg as e implied by accepting Williamson real wages and Allen's manufacturing earnings). Still, the difference between GDP per capita and real wage comparisons, and the diversity of real wage patterns, is unsettling.

Even more dissonant are the remaining indicators. Neither Maddison's data nor the improved evidence from Huberman show any convergence in the realization of leisure. Canadians either worked the same hours relative to Australia (Maddison) or increasingly more than Australians (Huberman). Acceptance of Huberman's estimate of working hours and any of the real wage series makes it a bit surprising that per capita GDP was lower in Canada by such a large margin. Alternately, Canadians and Australians adjusted their labour-leisure choice very differently as incomes rose.

The GDP evidence is consistent with life expectancy at birth to the extent that Australians apparently lived longer in both 1870 and 1913. Nevertheless, the lack of convergence is perhaps surprising. The differential in literacy and schooling in 1870 did change but in the opposite direction as income. Australia began with weaker indicators of human capital consistent with MacKinnon's (1989) critique. Both countries improved during the 1870-1913

period, impressively so in Australia. By the outbreak of war in 1914 there was effectively no difference in literacy and schooling.

Our review of recently published data suggests a complex and slightly indistinct impression of relative standard of living and growth. Real wages and incomes (GDP) in Canada relative to Australia improved steadily from 1870 to 1913, although the precise dimensions of the change are uncertain and probably varied by sector and region. In contrast, the indicators of leisure, life expectancy, literacy and schooling show a completely different pattern: Australia was either pulling ahead of Canada (leisure), catching up (literacy and schooling) or remaining in a lead (life expectancy).

Admittedly, some of the imprecision may arise from source and measurement difficulties. Our interest in the trajectory over time implies that we rely crucially on the 1870 benchmark. And yet, without engaging in a detailed review of underlying sources, it seems clear some of the early data is less reliable, perhaps significantly so. If the 1870 benchmarks are uncertain, then so are the trajectories. Further, regional differences were substantial within each economy, and the Australian and especially the Canadian population redistributed as it grew. Regional compositional effects and/or regional selectivity in sources might easily account for some of the imprecision.

Our contribution to the Australia-Canada comparison is to add one more indicator, stature, which we take to be a useful indicator of ‘net nutrition’ (Steckel 1995). The complex pattern of indicators reported in Table 1 makes it slightly complicated to interpret the Australia-Canada comparison. Additional evidence may be useful. We obtain anthropometric evidence from enlistment records completed by men who attempted to join the Australian Imperial Force (AIF) and the Canadian Expeditionary Force (CEF) in World War One (WWI).

Data & Sources

The 1914-1918 war was an unprecedented challenge for both Australia and Canada. As Dominions within the British Empire they quickly joined the war and contributed financial, human and physical resources on an unprecedented scale. Very large numbers of men (and small number of women as nurses) enlisted. Service was entirely voluntary in Australia and largely so in Canada (conscription was introduced late in the war).

Systematic analysis of the social origins of WWI armies is just now getting underway as military personnel databases become available. In both countries the urge to enlist permeated all regions and social classes although of course younger and unmarried men participated more enthusiastically. The francophone population in Quebec did not participate as fully but recent research suggests the degree of under-representation was modest. In Australia republican sentiment especially among Irish-descendants likely was strong enough to moderate enlistment from that group; unfortunately no quantitative evidence is available. In both countries the advent of severe recession in the second half of 1913 reduced the opportunity costs of military service especially for lower-skilled and recent entrants to the labour market. And in both countries participation by the middle and upper middle classes was emboldened by a widely-felt patriotism. On balance, WWI enlistment in both Australia and Canada was

remarkably broad; it reached into all corners of society and provides the closest we will ever have to a representative sample with medical information for cohorts born before 1900.

Anthropometric detail is available from several documents in the WWI personnel files. The attestation or enlistment paper for both Australia and Canada invited a notation for height, weight and other easily observable characteristics (see images in the Appendix). About 80 per cent of the Canadian forms neglected to record weight but all other fields were completed in both countries. A separate medical record document repeats and adds some additional information in both countries (including weight for the Canadians). Many although not all of the personnel files contain other documents such as transcripts of medical board proceedings, blood pressure for the injured and physical condition including weight on discharge.

The personnel files of the entire AIF and the CEF have been transferred to the National Archives of Australia (series B2455) and Library and Archives Canada (series RG 150, Accession 1992-93/166). We have constructed a sample from each of the armies consisting of all soldiers whose surnames begin with the letter B. This sampling strategy is cost-effective, reasonably representative of naming practice in all regions of the British Isles and of Quebec, and will permit easy identification of family members at a later stage of our analysis.

Demographic Comparison

The AIF and CEF records reflect a enlistees from a broad range of countries of birth. As our focus is on British and native born (i.e. Australian/Canadian) enlistees in the respective forces, we exclude all individuals from all other countries. The impact of such decision is expected to minimal, as the frequency with which other countries of birth are represented in the data is low. Table 2 shows a breakdown of the AIF and CEF samples across key socio-economic dimensions. The AIF sample ($n=27304$) is smaller than the CEF sample ($n=45333$); as well the AIF has a smaller proportion of British born enlistees (approximately 20%) compared to 44 per cent of British born CEF enlistees. English born enlistees accounted for about 16 per cent of the AIF sample, while those of Irish, Scottish and Welsh birth accounted for two per cent of the AIF sample or less. In contrast, the CEF records reflect a significantly larger proportion of English born CEF enlistees (34%), followed by Scottish (seven per cent), Irish and Welsh born. It is noteworthy that in both forces, the proportion made of up Irish born was low (two per cent or less), a reflection of the level of support for the British Empire amongst some Irish birth.

The birth cohorts for both AIF and CEF records follow a similar pattern. However, one important difference being a higher proportion of CEF enlistees born in the 1880s, but a lower proportion born in the 1890s. Such difference reflect patterns of growth and net migration to these countries, but also underscore the point that CEF forces were marginally older.

Differences in enlistee occupation are substantial, with AIF records reflecting a less skilled sample (i.e. labourer), but fewer farmers. In contrast, the CEF records reflect a greater proportion of enlistees declaring skilled and unskilled occupations, followed by farmers, with labourers accounting for only 12 per cent of the CEF records. Religious affiliation was

similar across to the two samples, with proportionately more Catholics, Methodists and Presbyterians in the CEF sample, but proportionately more Anglican affiliation in the AIF sample. Lastly, the breakdown by major age group (18, 19, 20 and 21+ years of age) was very similar across the two sample, but with slightly more 21 years or older enlistees in the CEF sample. The latter reflects differences in the distribution of samples across birth cohorts.

Table 2. Comparison of sample across key socio-economic dimensions

	AIF	CEF
Sample size		
British born	5351	19894
Native born	21953	25439
Region of Birth		
Native borne	80%	56%
England	16%	34%
Ireland	1%	3%
Scotland	2%	7%
Wales	0.3%	0.3%
Birth Cohort		
1860	0.3%	0.5%
1870	9%	11%
1880	26%	29%
1890	65%	60%
Occupation		
Farmer	10%	21%
White collar	15%	19%
Skill	15%	23%
Unskilled	16%	23%
Labourer	25%	12%
Other occ.	19%	3%
Religion		
Baptist	2%	5%
Catholic	18%	23%
C. England	54%	36%
Methodist	10%	12%
Other	5%	6%
Presbyterian	12%	17%
Age		
18 years old	10%	8%
19 years old	8%	6%
20 years old	6%	7%
21 years +	76%	79%

Comparison of Stature

Table 3 shows the unconditional mean height (in centimetres) and standard deviation for enlistees from the AIF and CEF records. Two results stand out. First, enlistees in the AIF were about 0.8 centimetres taller than enlistees in the CEF. Second, the distribution of AIF heights is less diffuse than that for the CEF; specifically, the standard deviation of height for the AIF was smaller than the standard deviation for the CEF.

Table 3. Unconditional mean height and standard deviation of height: AIF and CEF

	AIF	CEF
Mean	168.00	167.12
Std dev	6.12	6.38

Hidden within these mean heights are important differences and similarities across various socio-economic dimensions. Table 4 shows the break down of stature based on region of birth. The mean height of Australian born enlistees in the AIF is a full centimetre taller than the corresponding measure for Canadian born enlistees in the CEF. In contrast, the height differential across British born enlistees in the AIF and CEF are not markedly different. In fact, the largest absolute difference is with respect to English born enlistees, who as a group were taller in the AIF than in the CEF. The other marked difference relates to stature of Irish born enlistees relative to other British born enlistees; depending on which British-born cohort to which they are compared, the Irish born troops were at least one centimetre taller, regardless of whether the AIF or CEF is considered. Lastly, the Irish born troops also had mean heights exceeding the native born troops from the respective force, a difference that is particularly strong in the CEF.

Table 4. Stature of AIF and CEF enlistees by birth region

	AIF	CEF
Native born	168.21	167.21
England	167.05	166.85
Ireland	168.39	168.35
Scotland	167.09	167.15
Wales	166.59	166.59

Birth cohort effects (see Table 5) show a declining trend in stature through the middle to late 1800s. Bear in mind, however, that there are only a limited number of observations for those born in the 1860s or earlier, and so the mean heights for this birth cohort are not reliable. Ignoring the 1860s and earlier birth cohort, the trend in heights of the AIF troops is negligible, while the downward trend in the CEF heights persists and has been confirmed elsewhere (see Cranfield and Inwood 2007).

Table 5. Stature of AIF and CEF enlistees by birth cohort

	AIF	CEF
1860	168.97	168.31
1870	168.06	167.38
1880	168.02	167.58
1890	167.99	166.84

Between and within occupation effects are also noted (see Table 6). Amongst AIF enlistees, mean stature was largest for those with a ‘farmer’ occupation, followed by ‘white collar’, ‘other occupation’, ‘skilled’, ‘unskilled’ and then ‘labourer’. Amongst CEF enlistees, mean stature was largest for ‘white collar’, ‘other occupation’, then ‘farmer’, ‘unskilled’ and ‘labourer’. While the Australian forces are taller than the Canadian forces across all occupations, those with ‘farmer’ and ‘labourer’ occupation are almost two full centimetres taller than those in the CEF. Within force differences in stature across occupation are not surprising. However, between force differences in stature for the same occupation are somewhat surprising, as they suggest that not only were farmers in Australia better off than their brethren in Canada, but so too were labourers. Whether the latter difference reflects social, environmental or institutional differences (tied in particular to the treatment of labourers in the former penal colony) is unclear and an area in need of further investigation.

Table 6. Stature of AIF and CEF enlistees by occupation

	AIF	CEF
Farmer	169.40	167.48
White collar	168.49	168.24
Skill	167.45	166.86
Unskilled	167.52	166.72
Labourer	167.55	165.72
Other occ.	168.35	168.13

Except for those with Catholic affiliation, stature differences across religious affiliation are not remarkable, and do not reflect systematic effects (see Table 7). Nonetheless, the 2.8 cm difference between AIF and CEF troops listing ‘Catholic’ as their religious affiliation is striking. Why Catholics in Australia were so much taller than Catholics in Canada is not entirely clear. However, the marked height difference between Catholics and non-Catholics within the CEF records suggests that the underlying cause of stature differences of Catholics was unique to Canada, and one that led to insults to the net nutrition outcome of Catholic Canadians.

Table 7. Stature of AIF and CEF enlistees by religion

	AIF	CEF
Baptist	167.32	167.50
Catholic	168.06	165.22
C. of England	167.93	167.58
Methodist	167.88	167.56
Other	168.12	167.39
Presbyterian	168.39	168.14

Regression Analysis

While the decomposition of stature along key socio-economic dimensions is somewhat revealing, it does not provide the means to control for all of these factors simultaneously. In this respect, regression analysis is advantageous, as it allows for variation in factors thought to be associated with stature simultaneously. However, both the AIF and CEF has minimum height requirements. This means use of traditional ordinary least squares can lead to biased estimates of the conditional mean. To overcome this, anthropometricians have relied on truncated regression, as we do here.

AIF Results

Whitwell, de Souza and Nicholas (1997) note that the AIF had a minimum height requirement that varied over World War I, ranging from 165 centimetres in 1914 to 150 centimetres in 1917. Our preliminary analysis suggest truncation at 152.4 centimetres, although analysis with OLS yields very similar results and hence, the truncation effect does not appear to causing significant bias. Nonetheless, to err on the side of caution, we report, in Table 8, truncated regression results for the AIF records using a 152.4 cm truncation point.

When records of the AIF enlistees who were born in Britain and Australia were pooled together (see the columns under ‘All’ in Table 8), we find that compared to those born prior to 1875, enlistees in the 1875-1880 and 1890-1894 cohorts are significantly taller, but only by less than 0.5 cm. Somewhat different results obtain when we parse the sample into a model for those born in Britain (see the columns labelled ‘Britain only’) and Australia (see the columns labelled ‘Australia only’). Amongst those AIF troops born in Britain, those born between 1885 and 1894 were significantly taller than those born prior to 1875, and by up to one centimetre. In contrast, amongst Australian born troops, only those born in 1875-1979 were significantly taller than those born prior to 1875, while there is no significant difference with respect to other birth cohorts. This result provides evidence in further support of stature stagnation amongst Australian men in the latter part of the 19th century (see, e.g. Shlomowitz’s (2007) comment in response to, inter alia, Whitwell and Nicholas (1997)).

Table 8. Truncated regression results for AIF stature

Variable	All		British only		Australia only	
	Estimate	z-stat	Estimate	z-stat	Estimate	z-stat
Intercept	169.71	1000.16	168.09	348.46	169.85	581.68
Born pre-1875	Omitted					
Born 1875-1879	0.40	1.99	0.41	1.15	0.51	2.08
Born 1880-1884	-0.15	-0.92	0.02	0.07	-0.18	-0.95
Born 1885-1889	0.08	0.62	0.66	2.43	-0.09	-0.62
Born 1890-1894	0.29	2.53	1.04	4.10	0.11	0.88
Born after 1894	-0.05	-0.32	-0.39	-0.75	-0.09	-0.51
Farmer	Omitted					
White collar	-0.94	-6.04	-0.60	-1.51	-0.96	-5.67
Skilled	-1.99	-12.86	-2.28	-6.13	-1.89	-11.10
Unskilled	-1.91	-12.43	-2.46	-6.68	-1.75	-10.35
Labour	-1.89	-13.19	-2.55	-7.30	-1.72	-10.96
Other occ.	-1.06	-7.10	-1.24	-3.38	-1.00	-6.09
Australia	Omitted					
England	-1.23	-11.23	Omitted			
Scotland	-1.50	-5.50	-0.22	-0.57		
Ireland	0.07	0.22	1.58	4.11		
Wales	-1.83	-2.71	-0.54	-0.79		
West Au.					Omitted	
NSW					-0.08	-0.33
Queensland					0.22	0.83
South Au.					-0.02	-0.07
Tasmania					0.23	0.78
Victoria					-0.39	-1.59
Catholic	Omitted					
Baptist	-0.72	-2.50	-0.16	-0.21	-0.78	-2.52
C. England	-0.01	-0.10	0.39	1.14	-0.05	-0.48
Methodist	-0.25	-1.64	-0.56	-1.12	-0.18	-1.09
Presbyterian	0.31	2.07	0.60	1.27	0.38	2.39
Other relig.	0.08	0.44	0.61	1.24	0.01	0.07
18 years old	-1.66	-8.34	-1.21	-1.84	-1.70	-8.15
19 years old	-0.35	-1.72	-0.28	-0.43	-0.34	-1.57
20 years old	-0.11	-0.54	0.76	1.37	-0.20	-0.99
21 and older	Omitted					
σ	6.13	213.41	6.18	91.70	6.11	192.75
n	27236		5325		21911	

Occupation effects were also significant amongst the AIF enlistees. Compared to those with a ‘farmer’ occupation, those with some all occupations were significantly shorter, an effect that was pronounced for skilled and unskilled labour, but less so for white collar

occupations. Differences in stature between ‘farmer’ and all other occupations were robust to whether we modelled British born alone or Australian born alone, but was stronger for the Australian born. The exception to these results concerned ‘white collar’ occupations in the British only sub-sample, where there was no statistical difference in heights between those with a ‘farmer’ and ‘white collar’ occupation.

Region of birth effects were also significant in the pooled model. In particular, those of English, Scottish and Welsh birth had statistically significant and shorter stature compared to those of Australian birth. Interestingly, the difference in mean stature between Irish born and Australian born was not significantly different. The importance of this result relates to the height advantage of Irish born (relative to other British born) reported previously in the literature (Floud et al. 2006). When we model only the British born, only the Irish had significantly different stature from English born. So, even in this colonial example, the stature advantage the Irish had in the British Isle context appears to hold. When we modelled only those of Australian birth, there were no statistically significant height differences relative to those born in West Australia.

Relative to this who self-declare a Catholic religious affiliation, significant differences in stature are noted for those listing a Baptist and Presbyterian religious affiliation; Baptists were shorter, while Presbyterians were taller than Catholics. However, this effect appears to be driven only by those who were born in Australia. When the British only sub-sample was modelled, no statistically significant differences were measured, while amongst Australian born, Baptists were shorter and Presbyterians were tall. We also note that age dichotomous variables reflect a growth profile one expect (i.e. stature increases through late teens years).

CEF Results

As noted in Cranfield and Inwood (2007), the minimum height requirement in the CEF was 157.5 centimetres, the truncation point used in the regression for the CEF records.

Table 9 shows truncated regression results (with the truncation at the minimum height requirement) for the CEF enlistees. Amongst British and Canadian born CEF troops, we note that only those born after 1895 had statistically significant (shorter) stature compared to those born prior to 1875. However, the pooling of the two sub-population based on birth region mute an intra-birth region differential. In particular, amongst those CEF enlistees born in Britain, those born between 1885 and 1889 were taller than those born prior to 1875 (a similar result was found for British born in the AIF analysis), while those born after 1895 were shorter.

The birth cohort profile for the Canadian born enlistees in the CEF suggests a stature decline throughout the latter 15 years of the 19th century, a result we have reported and discussed elsewhere (e.g. Cranfield and Inwood 2007). An interesting conclusion to draw is that Australians tended to be taller than Canadians (compare the intercepts of the models for native born troops), but that Canadian born experienced a stature decline in the late 19th century, while Australian born troops did not. As mentioned previously, such a result further suggest a dissimilar growth path for these to colonies, at least in the domain of the

biological standard of living.

Table 9. Truncated regression results for CEF stature

CEF	All		British only		Canadian only	
Variable	Estimate	z-stat	Estimate	z-stat	Estimate	z-stat
Intercept	166.04	807.40	165.56	459.22	169.61	438.38
Born pre-1875	Omitted					
Born 1875-1879	-0.01	-0.04	0.18	0.66	-0.33	-0.94
Born 1880-1884	0.13	0.66	0.40	1.59	-0.34	-1.10
Born 1885-1889	0.07	0.40	0.60	2.47	-0.80	-2.81
Born 1890-1894	-0.24	-1.37	0.37	1.56	-1.06	-3.90
Born after 1894	-1.53	-7.75	-1.41	-4.20	-1.94	-6.94
Farmer	Omitted					
White collar	0.23	1.95	1.01	5.15	-0.17	-1.19
Skilled	-1.32	-11.27	-1.09	-5.82	-1.26	-8.39
Unskilled	-1.18	-10.15	-1.02	-5.36	-1.22	-8.35
Labour	-2.03	-14.30	-2.01	-8.95	-1.83	-10.06
Other occ.	0.60	2.70	0.96	2.00	0.37	1.52
Canada	Omitted					
England	-1.75	-17.75	Omitted			
Scotland	-1.49	-8.87	0.52	2.32		
Ireland	0.48	2.23	1.86	7.94		
Wales	-2.34	-3.24	-0.62	-0.84		
AB/SK	Omitted					
MB/BC					-0.99	-3.24
Ont					-2.26	-8.40
Que					-4.14	-14.38
Mari					-1.46	-5.16
Catholic	Omitted					
Baptist	2.94	16.24	0.56	1.34	2.03	9.71
C. England	3.47	28.92	1.49	5.82	2.87	18.92
Methodist	2.77	20.41	0.37	1.13	2.22	13.74
Presbyterian	3.50	26.88	1.10	3.70	2.93	18.86
Other relig.	2.69	15.17	1.04	3.02	1.73	7.91
18 years old	-1.00	-5.78	-1.42	-3.88	-1.01	-5.18
19 years old	0.41	2.29	-0.05	-0.14	0.45	2.19
20 years old	0.74	4.57	1.04	3.19	0.50	2.76
21 and older	Omitted					
σ	6.57	197.43	6.68	127.59	6.38	152.46
n	42832		18743		24089	

We find subtly different occupation effects for the CEF sample compare to the AIF sample. While most occupation dichotomous variables in the CEF analysis have statistically

significant coefficients, the direction of difference is somewhat different from the AIF records. Amongst the entire sample, those with a ‘white collar’ or ‘other occupation’ were taller than those with a farmer occupation, while those with all other occupations were shorter. A similar pattern is observed when we model CEF records for those of British birth. However, amongst those of Canadian birth, there was no difference in mean stature between those with a ‘farmer’ occupation and those with a ‘white collar’ occupation. Compared to the results for the AIF records, these results suggest important differences in stature across socio-economic status and country of birth. Farmers in Australia, regardless of country of origin, enjoyed a stature advantage, while the stature advantage of farmers in Canada appears to vary with country of birth; farmers born in Canada were no taller than those with a white collar occupation, while farmers of British birth were had a height *dis*advantage compare to their ‘white collar’ brethren in the CEF.

As with the AIF analysis, region of birth effects were significant in the pooled model. In particular, those of English, Scottish and Welsh birth had statistically significant and shorter stature compared to those of Canadian birth, while those of Irish birth were significantly taller than those of Canadian birth. When the British born were considered in isolation, those of Scottish and Irish birth had a significant height advantage compare to CEF enlistees of English birth. The latter result reinforces the stature advantage the Irish had in the British Isle context, and points to a height advantage of the Irish within the colonies. When we modelled only those of Canadian birth, a similar pattern reported previous in Cranfield and Inwood (2007) occurs; relative to those born in Alberta or Saskatchewan (low population density provinces with a significant agricultural base) those born elsewhere in Canada were significantly short, an effect that is most pronounced for those born in Quebec.

Unlike the AIF sample, religious affiliation effects in the CEF sample do not appear to be isolated to native born troops. Compared to those with a Catholic affiliation, those of all other religious affiliations are taller when the sample is pooled and the differences are large, ranging from 2.7 to 3.5 cm. When focus is shifted to British born only, those with a Church of England, Presbyterian and other religion affiliation are taller than Catholics, while amongst the Canadian born, those of all religions are taller than Catholics. Lastly, as with the AIF records, we note that age dichotomous variables reflect a growth profile one expect (i.e. stature increases through late teens years).

Conclusion

During the second half of the 19th century hundreds of thousands of individuals left Europe every year to live in one of the overseas ‘neo-Europes’, as we are reminded by the large number of British emigrants in the Australian Imperial Force and the Canadian Expeditionary Force 1914-1918. Personnel records from these overseas armies of the British Empire allow us to compare those who moved to Canada and Australia and the native-born descendants of earlier migrants. This anthropometric record suggests a number of similarities and also important differences that may reflect the differential working of geography, institutions and other growth influences.

The native born in both countries were taller than the British-born emigrants (Tables

8 and 9 intercepts) again consistent with the reputation of both colonies for a healthier environment and less costly food than in Britain. An alternate explanation of the British-overseas, selectivity to favour shorter migrants after 1870, has some plausibility but is unlikely to account fully for the differentials visible here. The Irish-born in the AIF and CEF were taller than native-born - significantly so in Canada although not in Australia (Table 8, Irish birth z-statistic). This conforms to other studies (Mokyr and Ó Gráda 1996; Ó Gráda 1994, pp 83-84, 105-106) although again, in principle, the potential selectivity of emigration would need to be considered in a full comparative analysis.

Those born in Australia were slightly taller than those born in Canada. This is consistent with Australia's greater isolation from large metropolitan areas and busy transportation corridors. If the convict origins of many Australian families created any disposition to shortness, the relatively healthy Australian environment quickly reversed it (Gandevia 1977).

In spite of rising incomes and real wages stature failed to increase in either Australia or Canada. Using five-year cohorts adult stature of the Australian-born peaked in the late 1870s and then stagnated at a slightly lower level for cohorts born in the 1880s and 1890s (Table 8). Stature of the Canadian-born declined continuously from the early 1870s to the late 1890s (Table 9). In a general way this would seem to follow the experience of other growing economies at the time (Steckel and Haurin 1994; Haines 2004; Inwood et al 2010). The greater decline for Canada and hence divergence between the two countries again is consistent with the hazardous growth hypothesis to the extent that economic and population growth decelerated in Australia and accelerated in Canada during the 1890s and 1900s.

Comparison at a more detailed level, however, reveals a number of important differences. Canada shows greater stature inequality whether we examine the overall standard deviation (Table 3) or differentials by cohort, region and occupation among the native-born (Tables 8 and 9). We have suggested that differing macroeconomic records and the hazardous growth hypothesis may explain the different cohort trajectories. More striking is pronounced regional differentiation in Canada against small and largely insignificant regional differences in Australia. Quebec may be something of a special case in Canada (Cranfield et al 2010) and yet gaps between the other birth provinces were almost as large. The internal spatial integration of the Canadian economy would appear to have been much weaker perhaps reflecting the strength of north-south links to the U.S. and tenuous character of east-west links within Canada. The Australian colonies, in contrast, were either better integrated with each other by overland transit and coastal shipping, or the country's greater isolation ensured that individual colonies were not easily drawn into distinct trajectories originating externally.

The patterns of occupational differentials show some similarities and some differences. In both countries farmers were tallest and craftsmen and labourers were the shortest. There was little difference between skilled and unskilled workers in either country. However greater relative stature was achieved by white collar occupations in Canada and by skilled craftsmen in Australia. Explaining these differences will be complicated in part because the occupations recorded at enlistment do not necessarily reflect the occupational environment for child growth, and there may well have reflected some selectivity by stature into adult occupations. We nevertheless speculate that stature differences by occupation are likely to arise from fac-

tors that might be characterized, broadly, as institutional rather than geographic influences.

The Australia-Canada comparison is interesting for a number of reasons including, we argue, a broad similarity of founding institutions and strikingly different geographic circumstance. Geographical and climatic circumstance clearly contributed to differently-timed resource booms (wheat, wool, gold) which may have influenced macroeconomic trajectory and in turn, through a hazardous growth hypothesis, divergence of stature. Indeed, this line of causation is at least as persuasive as the influence of resource booms on per capita income since it does not rely on an elusive link between extensive and intensive growth (Chambers and Gordon 1966; Altman 2003). Both institutions and geography appear to have contributed to the divergent patterns of stature inequality within and between countries.

Our admittedly preliminary Australia-Canada comparison suggests the possibility of bringing stature into the debate about the influence of geography and institutions on growth trajectories. Stature, as with influences captured by the Human Development Index (literacy, schooling and life expectancy) behaves differently from per capita income, and the differences are informative about the larger patterns of comparative growth. Making sense of these differences, however, relies heavily on the influences captured by the hazardous growth hypothesis (Steckel and Haurin 1994; Haines 2004) and the literature on the antebellum puzzle (Komlos 1996; Haines, Craig and Weiss 2003).

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Description of on Enlistment.

Age 21 years 5 months
 Height 5 feet 4 1/4 inches.
 Weight 142 lbs.
 Chest Measurement 32-35 inches.
 Complexion Fair
 Eyes Grey Good
 Hair Brown
 Religious Denomination R.C.

DISTINCTIVE MARKS.

CERTIFICATE OF MEDICAL EXAMINATION.

I have examined the above-named person, and find that he does not present any of the following conditions, viz.:-

Scrofula; phthisis; syphilis; impaired constitution; defective intelligence; defects of vision, voice, or hearing; hernia; haemorrhoids; varicose veins, beyond a limited extent; marked varicocele with unusually pendent testicle; inveterate cutaneous disease; chronic ulcers; traces of corporal punishment, or evidence of having been marked with the letters D. or B.C.; contracted or deformed chest; abnormal curvature of spine; or any other disease or physical defect calculated to unfit him for the duties of a soldier.

He can see the required distance with either eye; his heart and lungs are healthy; he has the free use of his joints and limbs; and he declares he is not subject to fits of any description.

I consider him fit for active service.

Fit

Date 30/4/15

Place Sydney

Signature of Examining Medical Officer.

Capt. A. Domb

CERTIFICATE OF COMMANDING OFFICER.

I CERTIFY that this Attestation of the above-named person is correct, and that the required forms have been complied with. I accordingly approve, and appoint him to the rank of Private

Date 11th June 1915

Place Liverpool

Signature of Commanding Officer.

Harry J. Hutchings
H. J. Hutchings

Figure 1. cont

4
DUPLICATE
Duplicate
ATTESTATION PAPER.

No. ~~124524~~
Folio. ~~X03273~~

CANADIAN OVER-SEAS EXPEDITIONARY FORCE.

QUESTIONS TO BE PUT BEFORE ATTESTATION.

(ANSWERS)

1. What is your name? *Baker, Ernest Mackeeva*
 2. In what Town, Township or Parish, and in what Country were you born? *Caroline, Manitoba Can.*
 3. What is the name of your next-of-kin? *Mrs. Mamma Baker, Sister*
 4. What is the address of your next-of-kin? *#396 N. Lake St. Irving Park Chicago*
 5. What is the date of your birth? *1st July 1897*
 6. What is your Trade or Calling? *Janitor*
 7. Are you married? *No*
 8. Are you willing to be vaccinated or re-vaccinated? *Yes*
 9. Do you now belong to the Active Militia? *No*
 10. Have you ever served in any Military Force? *No*
 11. Do you understand the nature and terms of your engagement? *Yes*
 12. Are you willing to be attested to serve in the CANADIAN OVER-SEAS EXPEDITIONARY FORCE? *Yes*
- Ernest Mackeeva Baker* (Signature of Man.)
Ros Mitchell (Signature of Witness.)

DECLARATION TO BE MADE BY MAN ON ATTESTATION.

I, *E. M. Baker*, do solemnly declare that the above answers made by me to the above questions are true, and that I am willing to fulfil the engagements by me now made, and I hereby engage and agree to serve in the Canadian Over-Seas Expeditionary Force, and to be attached to any arm of the service therein, for the term of one year, or during the war now existing between Great Britain and Germany should that war last longer than one year, and for six months after the termination of that war provided His Majesty should so long require my services, or until legally discharged.

Ernest M. Baker (Signature of Recruit)
Date *17th Sept* 1915. *Ros Mitchell* (Signature of Witness)

OATH TO BE TAKEN BY MAN ON ATTESTATION.

I, *E. M. Baker*, do make Oath, that I will be faithful and bear true Allegiance to His Majesty King George the Fifth, His Heirs and Successors, and that I will as in duty bound honestly and faithfully defend His Majesty, His Heirs and Successors, in Person, Crown and Dignity, against all enemies, and will observe and obey all orders of His Majesty, His Heirs and Successors, and of all the Generals and Officers set over me. So help me God.

Ernest M. Baker (Signature of Recruit)
Date *17th Sept* 1915. *Ros Mitchell* (Signature of Witness)

CERTIFICATE OF MAGISTRATE.

The Recruit above-named was cautioned by me that if he made any false answer to any of the above questions he would be liable to be punished as provided in the Army Act.

The above questions were then read to the Recruit in my presence. I have taken care that he understands each question, and that his answer to each question has been duly entered as replied to, and the said Recruit has made and signed the declaration and taken the oath before me, at *Windsor* this *18* day of *Sept* 1915.

J. M. [Signature] (Signature of Justice)
I certify that the above is a true copy of the Attestation of the above-named Recruit.
M. W. [Signature] (Approving Officer)

M. F. W. 25.
S.W. M. 7-15.
H. Q. 1173-29-241.

Figure 2. Canadian attestation paper

Description of Baker, Ernst Mackewa on Enlistment.

Apparent Age <u>17</u> years <u>2</u> months. <small>(To be determined according to the instructions given in the Regulations for Army Medical Services.)</small>		Distinctive marks, and marks indicating congenital peculiarities or previous disease. <small>(Should the Medical Officer be of opinion that the recruit has served before, he will, unless the man acknowledges to any previous service, attach a slip to that effect, for the information of the Approving Officer.)</small> <u>Slight left 9th toe</u> <u>Since I can follow right ankle</u> <u>inside</u>
Height <u>5</u> ft <u>3 3/4</u> ins.	Girth when fully expanded <u>33 1/4</u> ins. Range of expansion <u>4 1/2</u> ins.	
Complexion <u>Medium</u>	Eyes <u>Blue</u>	
Hair <u>Light</u>	Church of England <input checked="" type="checkbox"/>	
Religious denominations:	Presbyterian	
	Methodist	
	Baptist or Congregationalist	
	Other Protestants (Denomination to be stated)	
	Roman Catholic	
	Jewish	

CERTIFICATE OF MEDICAL EXAMINATION.

I have examined the above-named Recruit and find that he does not present any of the causes of rejection specified in the Regulations for Army Medical Services.

He can see at the required distance with either eye; his heart and lungs are healthy; he has the free use of his joints and limbs, and he declares that he is not subject to fits of any description.

I consider him fit for the Canadian Over-Seas Expeditionary Force.

Date 17th Sept 1915 F. Walsh
 Place Quebec C. P. S. Lewis
Insert here "fit" or "unfit." Medical Officer.

NOTE.—Should the Medical Officer consider the Recruit unfit, he will fill in the foregoing Certificate only in the case of those who have been attested, and will briefly state below the cause of unfitness:—

.....

.....

.....

CERTIFICATE OF OFFICER COMMANDING UNIT.

Ernst M. Baker having been finally approved and inspected by me this day, and his Name, Age, Date of Attestation, and every prescribed particular having been recorded, I certify that I am satisfied with the correctness of this Attestation.

[Signature] Lt. Col. (Signature of Officer)
 Commanding 71st Batt'n C.E.F.

Date Sept 17th 1915
O. C. 71st Battalion
C.E.F.

Figure 2. cont