# *Tall but Poor: Living Standards of Men and Women in Pre-famine Ireland.*

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## I. Introduction.

Why was Ireland so poor? Over the last decade the work of Joel Mokyr and Cormac Ó Gráda (1982, 1983, 1988, 1989) has made this question the principal research topic in Irish economic and social history. In a pioneering article that placed Irish living standards in a U.K. context, Mokyr and Ó Gráda (1988) argued that Ireland was poor, but less poor than commonly thought. In the absence of data on real wages or personal incomes, Irish historians have been forced to employ various proxies to measure Irish living standards. Schooling, life expectancy, literacy and the consumption of luxury commodities improved for the whole population. Average incomes probably rose, but there were losers as well as winners. Mokyr and Ó Gráda (1988, pp. 212-5) found that the average score was negative, implying that the lot of the poorer classes in Ireland deteriorated.

Here we use new data on heights to study socioeconomic differences and temporal patterns in the nutritional status of Irish workers before 1815. Our work shifts the focus of attention from the decades immediately before the Famine to this neglected earlier

period that lacks conventional measures of living standards. Combined with Mokyr and Ó Gráda's work, our analysis of height data clarifies the extent and possible causes of changes in living standards of Irish workers between 1780 and 1845.

In addition, we use Ireland as a case study to investigate the nexus between stature and living standards (as measured by income) in a pre-industrial economy. Richard Steckel (1983) found a high correlation between average height and the log of per capita income for a worldwide sample of countries in the mid-twentieth century, a finding approximately replicated by Floud (1984) for European countries near the turn of the nineteenth century. Yet, as historical research on stature has expanded in the decade since the height-per capita-income relationship was first systematically investigated, various pre-late-nineteenth century examples have emerged as diversions from the pattern found in evidence for the past century. Early nineteenth-century Ireland is one of these examples. Others have remarked on the tall stature of the Irish (see, for example, Floud, Wachter, and Gregory, 1990, and Mokyr and Ó Gráda, 1988) but little systematic work has been done on explanations for their growth. Nor have economic historians tackled the issue of how the Irish could have been so tall, given their poverty.

## II. Methology and Data

Economic historians have made a lot of progress in understanding stature as a measure of living standards and well-being (Steckel, 1978; 1986; 1993; Fogel et al., 1983; Tanner, 1978; and Eveleth and Tanner, 1991). Since growth rates are a function of food intake minus claims on the diet made by body maintenance, physical activity, and disease, stature is a net rather than a gross measure of nutrition during the growing years. Human growth rates are especially sensitive to environmental conditions in early childhood and adolescence, when growth velocity would ordinarily be high. Diseases that absorb or divert nutrients may also result in slower growth. Malnutrition and the disease environment

may interact to have an effect on height greater than the effect of either in isolation (Scrimshaw, 1975).

Our height sample consists of 5,005 Irish-born men and 3,370 Irish-born women transported to the penal colony of New South Wales between 1817 and 1840. For comparative purposes, we also present results from 11,030 English-born men and 2,929 English-born women convicts. The fine detail of the indent information, including over 1,000 distinct occupations and careful physical descriptions, bolster our confidence that the data were accurately and reliably compiled. A survey of 593 of the male convicts tried at the Old Bailey between 1816 and 1834 revealed that over 98 per cent of the sentences and crimes in the indents corresponded with those in the court records, 87 per cent of the ages recorded in the indents and the court records were within 2 years of each other and, when occupations were listed, they all agreed with those enumerated in the indents.

To further assess the representativeness of our data, and any selectivity bias, the occupational structure of the convict sample and the 1841 census were both coded using six broad occupational categories employed by Mokyr and Ó Gráda (1982, p. 379) in their study of Irish emigrants to Boston. In Table 1 there is broad agreement between the male occupations in the indents and the emigrant lists but an over-representation of labourers and servants and an under-representation of farmers in the indents compared with the 1841 census. Similarly, there were many more women in the farm-servant category and far fewer in the textile-worker categories in the indents compared to the Census. Mokyr and Ó Gráda thought that farm labourers and farmers were often confused in the emigrant lists, which was also likely in the indents. The border line between cottier, farm labourer and farmer was not well-defined in pre-industrial Ireland which led Mokyr (1983, p. 17) to note that 'Both rich and poor were landholders in Ireland, and terms like "farmer" and "labourer" had become fuzzy? It is also likely that female textile workers were frequently described as farm servants in the indents and the emigrant lists. It is hard to assess the

level of mis-reporting and following Mokyr and Ó Gráda (1982, p. 378) no adjustment is attempted here to reapportion some of the farm labourers as farmers and female farm servants and textile workers. On the basis of occupations, the Irish women and men are representative of the lower half of the working population.

We also evaluated the convict sample by comparing the transported convicts with offenders left at home. Since the work of Clark (1956), Robson (1965) and Shaw (1966), the English transportees have been categorised as persistent thieves engaged in a life of crime, by choice and training members of a professional criminal class. Australian historians have argued that the Irish transportees were different: They were older, more likely to be married, with fewer prior convictions and shorter sentences and they committed different crimes (Clark, 1953, p. 132; Inglis, p. 8). Irish crimes were expressions of poverty and political protest (Shaw, 1966, pp. 166-83). Relative to their transported English counterparts, Irish convicts were over-represented in the theft of small or inexpensive articles and in animal theft, largely pigs and horned cattle (Robson, 1965, p. 16). They were under-represented in burglary and housebreaking, and, when committed, those crimes mostly involved making away with kitchen utensils, meal and food (Robson, 1965, pp. 43-5). Overall, the crime of larceny predominated, much of it at the expense of employers and masters.

Transportation for riots, affrays, 'whiteboyism', threatening letters, and vagrancy were particularly (or exclusively) Irish offences, but accounted for less than 6 per cent of all Irish crimes (Robson, 1965, pp. 186-98). While agrarian protest, including incendiarism and animal maiming, involved rudimentary organization and secret oaths, the participants were not professional criminals. Agrarian protest was the 'moral economy' of the peasant masses, aimed at economic and political change (MacDonagh, 1968, pp. 144-8). More recently, Mokyr (1983, Ch. 5) has placed rural unrest firmly within the economic conflict between pasturage and arable farming. While Ireland was a violent society, its violence was 'regulated' and sanctioned, allowing the growth of

extra-legal or alternative government. Most Irish convicts had no previous convictions. The transported Irish were not significantly different from their working-class friends and relatives who remained in Ireland.

This view of the Irish as ordinary men and women who stole has been strengthened by recent work that questions whether the English transportees to Australia were members of a criminal classs, separate and distinct from the working class (Nicholas 1988, pp. 63-74). While this new interpretation is not without its critics (Shlomowitz, 1990; Nicholas, 1991), it has attracted considerable support among Australian historians (Garton, 1991). It is also consistent with recent work by historians of crime in England, which has shown that the great majority of crime was committed by ordinary men and women, who worked at jobs normally but also stole articles on occasion (Rude, 1985; Jones, 1982; Philips, 1977). On the basis of all the evidence, it seems fair to conclude that the Irish convicts were drawn from the lower half of the working population.[1]

Interpretations of well-being from height data can be complicated by minimum height standards, age and height heaping, ethnic differences in growth potential, and selectivity of those measured. Age and height heaping in the convict sample were assessed by tabulating frequency distributions of Irish and English male and female convict heights. The results showed no evidence of truncation bias, either shortfalls or overloading of the tails of the distributions. Our height distributions are reasonably smooth and symmetrical, and based on the Jarque-Bera test of normality given in Table 2; one cannot reject the hypothesis that these height distributions are normal or Gaussian.[2] The distributions for the English women and the rural-born Irish

[1] It is unlikely that the sample was biased by self-selection of short people into crime. There is no evidence that there were families of short, poor, criminals whose children were denied nutrients and trained into crime. Nor is there any evidence that short people had a higher propensity to commit crimes.

[2] In conducting the tests we rounded heights to the nearest inch for females and the nearest quarter-inch for males.

women displayed some evidence of heaping on the half and full inch. While undesirable, heaping plagues many data sources but simulations have shown that such rounding errors pose relatively minor problems for estimates of sample means primarily because their effects are largely self-cancelling (see Fogel et al., 1983).

## III. Height-by-age and time profiles

The height-by-age profiles in Figure 1 show that the rural-born Irish boys grew faster than the urban-born. The urban Irish were between 1 and 1.5 inches shorter than the rural Irish at age 16, a gap not closed until age 19. Compared with well-nourished boys today, the boys of the Industrial Revolution accelerated at least one year later and continued to grow until age 23, well beyond the modern standards of final attained height at about age 18 (see Tanner, Whitehouse, and Takaishi, 1966). Relative to children today, the height-by-age profiles of the Irish girls in Figure 2 displayed a similar delayed and dampened growth spurt. Although the sample sizes for the convict women are small before age 16, Figure 2 shows that the growth spurt started around age 14 (about 3 to 4 years later than that for well-nourished female children today) and lasted until 16.5 or 17.5, well beyond the average of age 13 for girls now.[3] Age at attained terminal height for the Irish women was 21, approximately four years later than the modern average at about age 17. This later and longer spurt in Figures 1 and 2 suggests that Irish boys and girls experienced deprivation due either to inadequate food intake, a poor disease environment, an increased work demand or some combination of these factors during their growing years.

The point estimates in Table 3, which averaged final attained heights for all births between 1770 and 1820, disguise much of the complexity in the Irish height advantage over the English. The five-year moving averages of final attained height of cohorts in Figures

[3] The sample sizes of the Irish males and rural females averaged over 50 observations at ages 15-16, but only 16 for urban females at ages 15-16.

3 and 4 show that from their 1780s peak (about 66.6 inches, or centile 20.3 of modern height standards), the height of Irish rural male cohorts fell 1 inch to a trough in 1800 that reached centile 11.2 of modern height standards (see Figure 3).[4] For the urban-born, heights also fell. Urban Irish cohorts born in 1797 were about 1.5 inches below the level achieved in the 1770s. The height profiles in Figure 3 provide clear evidence that the well-being of the bottom half of the Irish male population declined, at least before 1800. Irish working-class men were poor and became poorer as measured by stature.[5] In contrast, Figure 4 shows that the stature of women remained relatively constant rather than declined, which indicates that the living conditions of the bottom half of the female population changed little.

We checked the time profiles in Figure 3 and 4 for possible composition effects,which might result in trends which were mere artifacts of the changing skill and class composition of our sample. Heights, for example, may vary by occupation if taller individuals were attracted to jobs for which strength was unimportant. Women might have been apprenticed or encouraged to work in the same trades as their mothers. To test for occupational influences Armstrong's (1972) skill-class scheme was adapted to generate five occupational groups for the males (unskilled, skilled, public service, domestic service and professional/dealers) and four groups for the females (rural unskilled,manufacturing and transport, domestic service and 'all other occupations'). These variables were included as regressors in a model that also included dummy variables for five-year birth cohorts. Those born before 1790 and professional and dealers occupations for the men and those born before 1795 and 'all other occupations' for the women were the excluded categories. Since the height profiles for the urban and rural-born displayed

[4] We calculated the modern height centiles based on data in Tanner, Whitehouse, and Takaishi (1966).?

[5] Komlos (1993, p. 138) found that Irish soldiers' heights were falling in the 1830s and 1840s, which suggests that the declining living standards of the Irish evident in our data continued in the two decades before the Famine.

different time paths in Figure 3 and 4, separate regressions in Table 4 were run for men and women from each location.

The time profiles in Figures 3 and 4 persist in the year-of-birth dummies shown in Table 4. For the male urban Irish, the late 1790s height decline and the dips around 1810 are clearly identified in our regression results. Although the birth dummies were individually insignificant among rural males, as a group these variables were significant at 0.10. If a single time dummy for births after 1800 replaces the ten-year dummies, the coefficient is significant at 0.05 (t = -2.71). These results indicate that conditions for men deteriorated following the end of the century but that the precise timing of the decline is in question. The birth dummies for the females also track the height profiles for the rural and urban-born in Figure 4.

The regressions also show that occupational effects among men were unimportant except for public service, a category that had elevated stature due to the minimum height requirements of soldiers. The other occupational groups were not significantly different in height from the excluded class (professionals and dealers). Women in domestic-service occupations were significantly taller in the female regression equation. These jobs required extra strength and endurance, and there is some evidence of self-selection by women in this category. Generally, the regressions in Table 4 show that height profiles in Figures 3 and 4 were not artifacts of a changing occupational structure in the convict sample.

## IV. Comparisons

Table 3 and Figures 1 and 2 show that the English were significantly shorter that their Irish counterparts, an outcome attributable to a less vigorous growth spurt and a longer delay in achieving adult stature. However, cross-sectional arrangements of the data disguise important temporal phenomena.[6] The Irish were not always taller than the English. The more rapid fall in Irish male

[6] The complexity of the Irish height advantage is similarly disguised by the point estimates given by Mokyr and O'Grada (1988, pp. 227-29), which show that the Irish were taller than the English.

heights before 1800 wiped out the height advantages of the Irish over the rural-born English (see Figure 3), although Irish females maintained or slightly improved their height while English women experienced declining stature for births beyond 1790 (see Figure 4). These patterns of changing Irish heights raise something of an anomaly. The Irish economy was much poorer than the English, and its workers enjoyed a significantly lower material standard of living with a per capita income level little more than half that of England. After surveying the evidence, we advance an explanation for the tall stature of the Irish, given their poverty as conventionally measured.

The height advantage of the Irish is confirmed by data on army recruits. From information on the heights of over 11 thousand Irish and British recruits into the East India Company army between 1800 and 1815, Mokyr and Ó Gráda (1988, pp. 227-9; Ó Gráda, 1988, pp. 16-7; Mokyr and Ó Gráda, 1990, p. 11) discovered that Irish recruits were as tall as those of any other European nation, and possibly growing taller themselves. Irish recruits born in urban locations between 1802 and 1809 were significantly taller than those born in England and Wales, although Irish urban recruits were shorter than their British urban counterparts (Mokyr and Ó Gráda, 1990, p. 11)[7]. In the first anthropometric history of the United Kingdom, Floud, Wachter and Gregory (1990, pp. 200-1) found that Irish recruits into the British army born around 1815 were 0.45 to 0.59 inches taller than recruits born in England.

The height advantage of the Irish over the wealthier English shares similarities with the puzzling evidence that the working-class boys born in the highest nominal wage area in the U.K., London, were the shortest of all recruits born in England (Floud, Watcher and Gregory, 1990, p. 202). Floud, Watcher and Gregory suggested that urban disamenities, disease, unemployment, overcrowding and high costs of living accounted for the short stature of the

[7] The definition of urban as 'towns of a population of 10,000 or more' biases the urban recruits to the largest cities, under-representing smaller cities and towns (Mokyr and O'Grada, 1990, p. 8).

London boys. It is true that Irish urban dwellers, except those born in Dublin, escaped many of the worst features of overcrowding, poor housing and inadequate public health typical of the burgeoning towns in the industrializing regions of England. Also the smaller size of the Irish towns and their closer links to the countryside meant that the urban Irish had better access to food supplies than workers in London or Manchester. But even if urban location accounted for all of the height advantage of the urban-born Irish, we still have the anomaly of the Irish height advantage in rural areas.

The tall-but-poor anomaly also holds for other isolated, pre-industrial populations. Scotland was poorer than England, but the 519 male convict Scots transported to Australia were taller (65.82 inches for urban-born and 66.89 inches for the rural-born) than the English, and as tall or taller than the Irish.[8] Extending comparisons to the continent, army recruits from Lower Austria and Bohemia, the most economically-developed regions of the Austro-Hungarian Monarchy, were generally the shortest, while those from Hungary and Galicia, the least-developed provinces, were taller (Komlos, 1989, pp. 96-7). Union troops from less-developed Kentucky and Tennessee were tallest (69.1) followed by other slave states and the Midwest (at approximately 68.7), while troops from the more developed New England (68.3) and the Middle Atlantic states (68.0) were shortest (Gould, 1869, p. 123). Among southern whites who signed amnesty oaths during the 1860s those from the interior states of Kentucky, Tennessee, Missouri, and Arkansas tended to be 0.3 to 0.7 inches taller than residents from the more densely settled lower coastal states. A similar but less pronounced regional pattern existed among ex-slave recruits (Margo and Steckel, 1992). In the mid-nineteenth century Swedish soldiers from the less densely settled regions (North and East) were 1.2 to 2 inches taller than those from the more-densely settled western areas (Sandberg and Steckel, 1988). Ted Shay (1986) found that Japanese soldiers of the

[8] Urban-born Scots averaged 65.82 inches while the rural-born were 66.89 inches.

late nineteenth century were 1.2. to 1.6 inches taller from outlying prefectures such as Tottori and Iwate compared with those from the wealthier, more central and developed regions. The situation of a poor, isolated population being taller than a wealthy, more commercial population was not, then, unique to the Irish-English comparison.

**V. Possible Explanations**

Diet and claims on the diet made by disease during the growing years were major factors explaining the height advantage of the Irish over the English. Changes in the Irish diet in the hundred years after 1750 were complex, with significant regional variations, but it is possible to outline the major changes in which there is considerable agreement among Irish historians. We synthesize the existing literature, placing the changing diet in its broad historical context in order to understand the fluctuations in height of the Irish working-class population.

After 1750 the Irish diet narrowed and became more dependent on the potato, which was a nutritious food source. The mid-XVIIIth century Irish diet consisted of dairy products, oatmeal, eggs, meats, potatoes, and, in some regions, fish. Berries, wild fruit, nettles, rabbits, hedgehogs, and game must have been eaten by a wide section of the labouring poor (Clarkson and Crawford, 1988, p. 173). The spread of the potato had at first supplemented and added variety to the diet, which meant that the Irish peasant was often better fed than the English labourer (Burnett, 1966, p. 20). But by 1800 the potato had become the lynch-pin of the average working man's diet and of the whole system of tillage (Ó Gráda, 1989, p. 112).

From the mid-XVIIIth century, the commercialisation of subsistence agriculture saw the emergence of a miniature dual economy within the rural household, comprised of a subsistence sector (production of oats, wheat, pigs, cows, dairy products and cottage industry). As early as the 1760s, the marketing of butter and pork by farmers and poorer families meant that meat, butter and

milk were consumed in smaller amounts in rural households, and by 1800, when a thriving inter-regional trade in potatoes, corn and livestock was well established, the consumption of meat, corn and dairy products fell even lower (Kennedy, 1985, p. 16).

During the Napoleonic war, the boom in grain, dairy and meat exports to England saw the consumption of meat, milk and butter in Ireland further decline, especially for poor families (Cullen, 1981, pp. 99-101). The commercialization of subsistence agriculture and the impact of the Napoleonic war led Dickson (1989, p. 108) to argue that the final victory of the potato as the exclusive diet of the labourer and small farmer was achieved by 1800. Making the same point, Cullen (1981, p.105) argued that commercial exports, such as occurred during the Napoleonic wars, forced a structural shift in Irish agriculture; the potato was crucial for soil fertility and it displaced beef and butter in the diet. Clarkson and Crawford (1988, p. 179) agreed that regions exporting their agricultural surpluses left the poor to live on potatoes and buttermilk, which had little external market. While acknowledging inter-county differences in the consumption of beef, butter, fish and eggs, by the mid-1830s the dietary picture from the Poor Inquiry Report presented an 'overwhelming impression . . . of the uniformity of diets among the labouring poor; the differences were tiny' (Clarkson and Crawford, 1988, p. 178).

The fall in Irish male heights in Figure 3 is consistent with the narrowing of the Irish diet as alternatives to the potato greatly diminished or disappeared (Ó Gráda, 1989, p. 112).[9] However, despite the narrowing of the diet, the potato provided the Irish with a nutritional advantage over the English. Mokyr (1983b, p.7) estimated that the potato yielded 1400 calories per day, based on per capita consumption of 4.5 pounds, and Ó Gráda (1989, p.12) thought that potato consumption for the bottom third of the population reached 12 pounds daily,which is remarkably high.

[9] This point is consistent with Komlos' (1989, 1991) argument that commercialization and market integration of subsistence agriculture eroded average heights.

Not only rich in calories, the potato was abundant in protein, calcium, iron, thiamin, niacin and vitamin C (Mokyr, 1983, p. 10). Some labourers were able to keep a cow or chickens or grew vegetables in garden plots that supplemented the staple potato-diet (Connell, 1975, p. 151). Clarkson and Crawford (1988, pp. 176-7) found that more eggs were consumed in Connacht, more fish in Munster and that the east of Ireland had more varied, and better, diets than the west.

The Irish were also lucky before 1845 in that most 'famines' which affected the whole country were cereal crises, and only in 1765-6, 1783-4 and in 1800 did shortfalls in potato yields coincide with grain failures (Dickson, 1898, p.105; Connell, 1975, pp. 144-5). Other potato famines in the 1810s and 1820s were local, affecting regions and specific classes (Dickson, 1989, p. 107). The potato-based dual economy and the 'gap in famines' help explain why the poor Irish were so tall during a period of commercialization of agriculture and exports of foodstuffs to England.

Inadequacies in the English diet were also important in understanding why the Irish were as tall or taller than the wealthier English.[10] While more varied, the English diet was less nutritious and displayed significant regional variations. The wheaten loaf had triumphed in the south and west of England, while in the north and east oatmeal, made palatable by some milk, potatoes, eggs and vegetables, made up the average diet. Based on sample rural diets for 1795-97, Shammas (1984, pp.256-7) estimated that the different patterns of food consumption meant that the typical northern diet yielded 2823 calories per day, but only 2109 in the south. The diet of the English town labourer was inferior to that of the rural worker. The urban dwellers had poorer access to food supplies, a smaller chance of owning a plot to grow food supplements, and employment that precluded payment in kind while exposing workers to truck where they were liable to

[10] It is possible that lower income inequality contributed to the Irish height advantage over England. We call for additional research on inequality in our concluding remarks.

over-charging and short-measure for store-bought food. Towns also increased the dependence on the professional services of bakers, brewers and food retailers,which increased the chance of food adulteration, a phenomenon of urban, but not rural, life (Burnett, pp. 72-89).

War, blockade and harvest failures also explain the inadequate rural and urban diet for the English population after 1790 and the reliance of England on the Irish 'bread basket' (Mingay, 1977; Jones, 1974; Hueckel, 1976; Mokyr and Savin, 1976). The number of English harvest failures were significantly higher between 1790 and 1815 than before or since, and the closing of continental sources of grain imports and the risks and uncertainty involved in shipping during the Napoleonic wars decreased supplies and forced up grain prices. Only the remarkable elasticity of supplies of meat and grain from Ireland allowed England to avoid starvation (Thomas, 1985, p.143).

Gender was a significant factor in the height advantage of the Irish. Irish female heights were stable, or rose slightly, while the heights of females born in England fell. The height profile of the Irish women is consistent with co-dependent family-based production. In Irish households, all family members performed labour, each was vital in the creation of final output, so each had a claim on the resources generated by the household. Sharing the work was related to sharing the rewards of labour, including access to food and nutrients which afforded Irish women sufficient nutrients to guarantee growth (Nicholas and Oxley, 1993).

In contrast, English women grew up in households exposed to the full force of industrialization. There is abundant qualitative evidence that English women ate less well than men (Shorter, 1982). Unequal access to food for English women within common households can be related to expected labour-market outcomes. Industrialization saw that employment opportunities for English women decline, leading families to allocate more food to males and less to women who could no longer find jobs in the paid-labour market. For developing economies undergoing 'modernization',

econometric studies have confirmed probable biases in the distribution of nutrients within the family related to declining job opportunities for women in the paid-labour market (Nicholas and Oxley, 1993).

Diet and access to food were not the only factors accounting for the height advantage of the Irish. Neglect of new-born children was not uncommon during the period of the Industrial Revolution, due to ignorant management, bad feeding practices and uncleanliness. There were significant differences in child-rearing practices between the Irish and the English (Smith, 1990, pp. 71-88). The Irish were much more likely to breastfed than the English, and it was common for English children to be "reared artificially" (Smith, 1990, p. 71, p. 84). The Irish also had greater access to fresh milk for their children than the English, whose store-bought milk had a high probability of adulteration. Breast feeding also meant fewer illnesses for Irish children with the diversion of fewer nutrients to fight disease.

## VI. Regression Analysis

The available data resources for Ireland allow us to investigate further the determinants of stature. Attained height of an individual was a function of diet, of personal characteristics such as occupation and literacy, and of environmental features such as exposure to disease. Personal characteristics are available from the indents and county-level environmental variables were gathered from the 1821 census (Department of Industry and Commerce, 1936). Ideally we would have liked data that measured the quantity and quality of the diet, income per capita of the household in which an individual grew up, a measure of exposure to disease, and a measure of work effort. While direct measures of these variables do not exist, we were able to construct proxies for some of these variables. Failure to find significant relationships for our proxy variables in the reported regression equations may be attributable to inadequacies of the proxies for the desired variables or to lack of association between the desired variables or to lack of

association between the desired variables and stature.

The occupational groups (unskilled, skilled, public service, domestic service, professional/dealers) used to test for composition effects were employed here. Occupational height differences may have existed in part because occupational choice was governed by one's size and strength. Taller individuals, for example, may have selected jobs for which size was an asset while smaller people sought positions for which this attribute was unimportant. In addition, to the extent that positive inter-generational correlations existed for occupations of fathers and sons, the occupational categories may reveal income or wealth differences that affected proximate determinants of growth such as diet, housing and work effort. If the unskilled tended to have fathers who were also unskilled, for example, their stature may inform us about the net nutrition of children from labouring families.

Literacy may be a useful proxy for living conditions during the growing years. Because literacy was costly to the parents in terms of foregone income and direct outlays, one would expect that investments in literacy were one component of family resource allocation (Nicholas and Oxley, 1993). In good circumstances one would expect that parents invested heavily in child growth and education while in bad circumstances they economized on both. The relationship between literacy and net nutrition may be complicated by time lags, occupational structure, the demand for skilled jobs, the cost of education, public health measures, density of settlement, and other factors. Nevertheless, it is reasonable to suppose that a positive correlation existed between literacy and net nutrition during the growing years.

The frequency with which an individual is exposed to contagious diseases and the potency of the disease-causing organisms are hard to measure in the best of experimental circumstances that approximate the way people live simply because the organisms in question are not readily observable. Therefore, researchers usually resort to various proxies for the frequency of contact between people such as population density or

rates of geographic mobility. We employ three such variables: (1) The proportion of each country's population involved in manufacturing or handicraft activities, which we argue approximates the frequency of interpersonal contact brought about by trade; (2) The migration rate of convicts as measured by the ratio of the number of convicts who moved into or out of a particular county divided by the convict population of the county, which approximates the rate of interpersonal contact through migration; (3) The average number of children under age 5 per house in each county. In view of Steckel's (1988) finding that the number of siblings in the household significantly reduced the chances of a child's survival from 1850 to 1860, we argue that the number of children per house is a proxy for the probability of the spread of contagious childhood diseases.

We also experimented with a crude proxy for the diet - the average number of acres of land per house in each county (Houseden). This variable could measure the amount of land available for growing food, but we recognize its limitations in measuring diet: land may be of uneven quality or fertility, we do not know whether the land was in fact available to households for raising food, and if it was available for raising food we do not have information on foods produced that contributed to the diet.

Table 5 presents the results of the regression on individual heights. The table shows that individuals in public service - a class that includes military personnel recruited with minimum height standards - were systematically taller (1.52 inches) than professionals or dealers. Individuals in domestic service were systematically shorter (1.23 inches), possibly due to disadvantageous environmental backgrounds and selection into an occupation that did not require size or strength. Literate peple had a modest height advantage (0.43 inches) over the illiterate, which is consistent with the hypothesis that parents who made investments in their children's education also invested in their growth and development.

Our crude measure of diet - house density - is statistically

insignificant. Given that diet was important for growth, the result is probably due to the poor quality of the proxy.[11] The trade variable was statistically significant and reasonably large - increasing the proportion of the county's population involved in manufacturing or handicraft by 0.1 decreased average height by 0.15 inches. This result is robust to other specifications including alternative measures of density such as population per acre or number of people per square mile. Because it is an indirect measure of trade we note that other interpretations of the variable are possible. This measure of occupational structure was probably positively correlated with income. However, one would expect that, if income rose, other things being equal, heights would also rise. Given that the coefficient is negative, other things must not have been equal. We suggest that the trade involved with this type of economic activity probably increased interpersonal contact in ways that spread communicable diseases, which more than outweighed the health benefits from command over other resources made possible by the higher incomes from that trade. These environmental and disease factors help explain why an economically poor population such as the Irish were as tall or taller than the population of a much richer region.

Public health programmes substantially reduced the adverse health consequences of interpersonal contact, thereby lowering the costs to society of migration and trade.[12] We suspect, but obviously cannot conclude with the data at hand, that the inverse relationship we find between trade (or occupational structure) and health may apply only to societies that do not understand the germ theory of disease, or otherwise have in place effective measures of public health and personal hygiene. This conjecture is consistent with

[11] It is also possible that variations in the diet (as measured by the proxy) within the sample were small, which would give a high standard error for the coefficient. However, the standard deviation of house density was 3.65 compared with a mean of 10.03.

[12] It is also possible that adverse health associated with trade or urban living was attributable to higher food prices or loss of nutritional value of food in storage and transportation to urban areas.

Steckel's (1983) and Floud's (1984) findings on height and income and with work on child mortality in the United States by Steckel (1988) and by Preston and Haines (1991). Yet, the child mortality studies for the mid - and late - nineteenth century (just before the germ theory of disease became widely accepted) report that socio-economic status as measured by father's occupation and family wealth had little effect on the chances of a child's survival. The germ-theory revolution in medicine beginning in the late nineteenth-century may have helped to forge a relationship between socio-economic status and child health.

## VII. Concluding Remarks

The delayed growth spurt for Irish men and the downward trend in male heights for births indicate that the bottom half of the Irish population suffered declining living standards. Combined with Mokyr and Ó Gráda's (1988) subjective poverty index, this suggests that the well-being of the bottom half of the male population declined over the whole period 1780-1845. But Irish women did not suffer a similar decline in living standards before 1820. Although their delayed growth spurt indicates that females faced some nutritional stress, females heights were stable or slightly improved for births after 1790. This might be explained by the distribution of food resources within Irish pre-industrial family households.

While the Irish were poor, they were also tall, exceeding the stature of the much wealthier English. The Irish experience helps us understand why "tall-but-poor" characterizes several remote, pre-industrial populations. Our qualitative and statistical results suggest that a nutritious but monotonous diet and a favourable disease environment linked with commercial isolation were important factors in the Irish height advantage.

While these factors explain the Irish height advantage over the English, more research is required on the relationship between income and health, which is strong for the XXth century but appears weaker, if not inverse, in earlier periods. Moreover,

additional research is called for on the distribution of income or wealth in Ireland and in England and its contribution to stature and health. Studying other societies in transition from pre-industrial to industrial economies and from pre- to post-germ theory of disease will allow economic historians to gain insights into the relationships among height, health, and incomes as measures of well-being.

**TABLE 1 - Occupational Distribution of Transported Convicts, Emigrants to Boston, and the Irish Population, 1841**

Percentage Distribution by Occupational Category

| Sample | Labourers, Servants | Textile Workers | Farmers | Other Artisans | White Collar | Other |
|---|---|---|---|---|---|---|
| Convicts | | | | | | |
| Male | 72.2 | 5.9 | 1.1 | 15.2 | 2.6 | 3.2 |
| Female | 92.1 | 4.9 | 0.0 | 1.0 | 0.0 | 2.1 |
| 1841 Census | | | | | | |
| Male | 55.4 | 7.1 | 20.7 | 10.5 | 4.9 | 1.5 |
| Female | 33.7 | 59.9 | 1.9 | 0.7 | 3.4 | 0.4 |
| Emigrants | | | | | | |
| Male | 62.7 | 3.5 | 10.4 | 20.5 | 2.7 | 0.2 |
| Female | 78.6 | 11.1 | 0.5 | 8.1 | 1.6 | 0.7 |

*Source:* Convict indents; Mokyr and Ó Gràda (1982, p. 379); British Parliamentary Papers (1843, p. 440).

**TABLE 2 - Jarque-Bera Test for Normality**

| Sample | Jarque-Bera (Chi-Square critical value 5.99) |
|---|---|
| Irish Urban Males | 1.88 |
| Irish Rural Males | 1.99 |
| Irish Urban Females | 3.82 |
| Irish Rural Females | 1.37 |
| English Urban Males | 2.21 |
| English Rural Males | 2.24 |
| English Urban Females | 2.81 |
| English Rural Females | 2.37 |

*Source:* Calculated from convict indents.
a. The statistic tests whether the first four moments of the sample distribution are consistent with the normal distribution.
b. At 0.05 level of significance.

**TABLE 3 - Adult Heights and T-Tests for Differences in Adult Heights**

| | English Rural | English Urban | Irish Rural | Irish Urban |
|---|---|---|---|---|
| | | FEMALES | | |
| Height (Inches) | 64.65 | 60.75 | 61.29 | 61.14 |
| English Rural | | 10.71* | 5.71* | 4.18* |
| English Urban | | | 8.44* | 3.68* |
| Irish Rural | | | | 0.73 |
| Sample Size | 638 | 587 | 2528 | 249 |
| | | MALES | | |
| Height (Inches) | 65.96 | 65.44 | 66.10 | 65.82 |
| English Rural | | 7.12* | 1.94 | 1.39 |
| English Urban | | | 8.16* | 3.57* |
| Irish Rural | | | | 1.09 |
| Sample Size | 3133 | 1966 | 2013 | 718 |

*Source:* Convict indents.
* Significant at 0.05.

**TABLE 4 - Explaining Irish Heights by Occupation and Cohort of Birth[a]**

| Variable | Male[b] Rural | Female[b] Urban | Rural | Urban |
|---|---|---|---|---|
| Occupation | | | | |
| Unskilled | 0.224 | 0.239 | | -0.897 |
| | (0.748) | (0.636) | | (-2.274) |
| Unskilled Rural | | | -0.192 | |
| | | | (-1.326) | |
| Skilled | 0.452 | 0.131 | | |
| | (1.464) | (0.350) | | |
| Manuf. & Transport | | | -0.139 | 0.375 |
| | | | (-1.000) | (0.932) |
| Public Service | 1.839 | 0.802 | | |
| | (5.064) | (1.781) | | |
| Domestic Service | -0.350 | -0.028 | 0.028 | 0.278 |
| | (-1.009) | (-0.062) | (2.009) | (0.698) |
| Year of Birth | | | | |
| 1780 - 1789 | -0.251 | -0.582 | | |
| | (-0.596) | (-1.287) | | |
| 1790 - 1799 | -0.167 | -0.855 | -0.266 | -0.899 |
| | (-0.420) | (-2.053) | (-1.130) | (-0.908) |
| 1800 - 1809 | -0.529 | -0.813 | -0.105 | -0.536 |
| | (-1.341) | (-1.848) | (-0.471) | (-0.564) |
| 1810 + | -0.460 | -1.029 | -0.104 | -0.149 |
| | (-1.163) | (-2.332) | (-0.452) | (-0.156) |
| Constant | 66.15 | 66.40 | 61.40 | 61.60 |
| | (140.59) | (126.96) | (283.15) | (66.72) |
| $R^2$ | 0.03 | 0.02 | 0.004 | 0.04 |
| Observations | 2.013 | 718 | 2.528 | 249 |

*Source:* Convict indents.

a. T-values in parentheses.

b. The omitted class is a professional/dealer born before 1780 (males) or all other occupations born before 1790 (females). The males were aged 23-49 and the females were aged 19-49.

**TABLE 5 - Explaining the Heights of Irish Male Convicts by Occupation, Literacy, Trade, Migration and Density**

| Variable | Coefficent | T-Value |
|---|---|---|
| **OCCUPATION**[a] | | |
| Unskilled | -0.109 | -0.27 |
| Skilled | 0.203 | 0.50 |
| Public Service | 1.524 | 3.20 |
| Domestic Service | -1.234 | -2.66 |
| LITERATE | 0.426 | 2.38 |
| TRADE | -1.588 | -2.16 |
| MIGRATION | 0.211 | 0.46 |
| CHILD | -3.919 | -1.46 |
| HOUSEDEN | 0.00158 | 0.05 |
| CONSTANT | 65.877 | 87.99 |
| Sample Size | 1923 | $R^2 = 0.03$ |

*Source:* Calculated from convict indents and Irish census of 1821 (Department of Industry and Commerce, 1936).
a. Based on Armstrong (1972) classifications. The omitted class is an illiterate professional/dealer. The men were aged 23-49.

**FIGURE 1 - Male Irish and English Height by Age.**

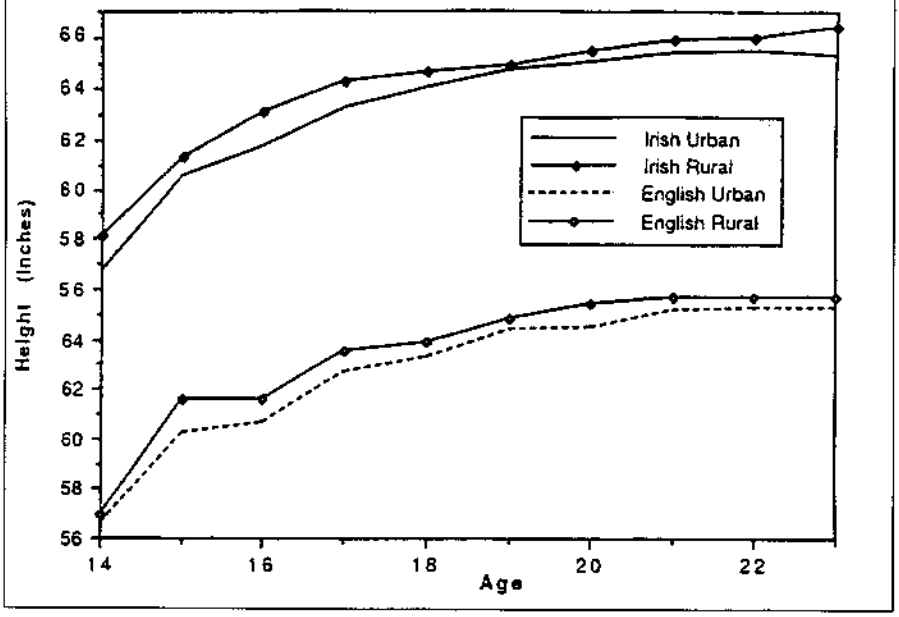



**FIGURE 2 - Female Irish and English Height by Age.**

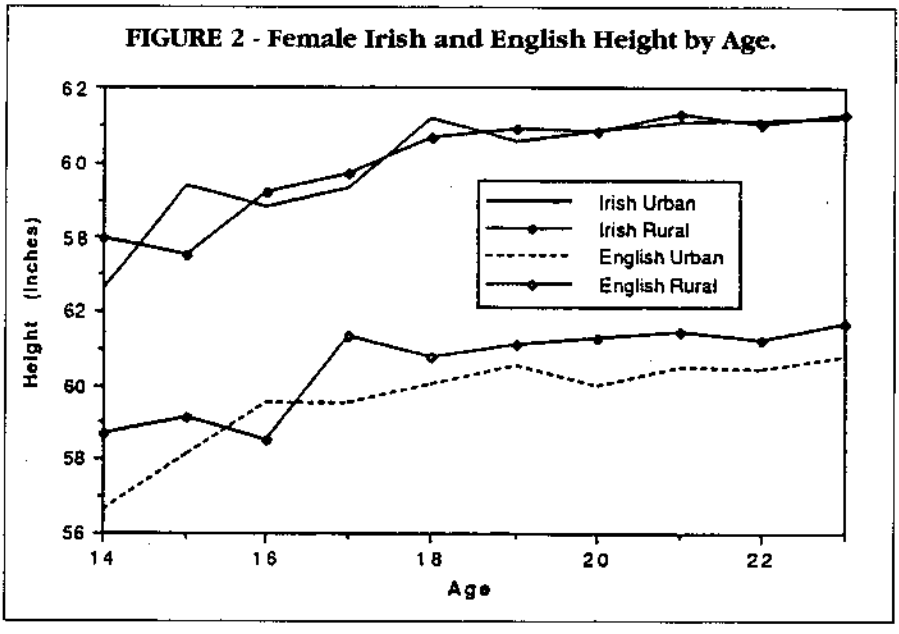


**FIGURE 3 - Irish and English Male Height Profile**
**(5 year moving average for ages 23-49 years)**

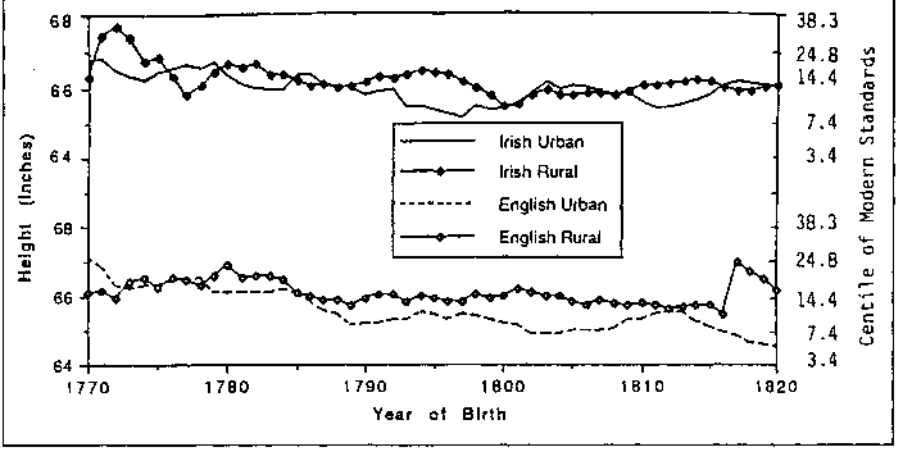
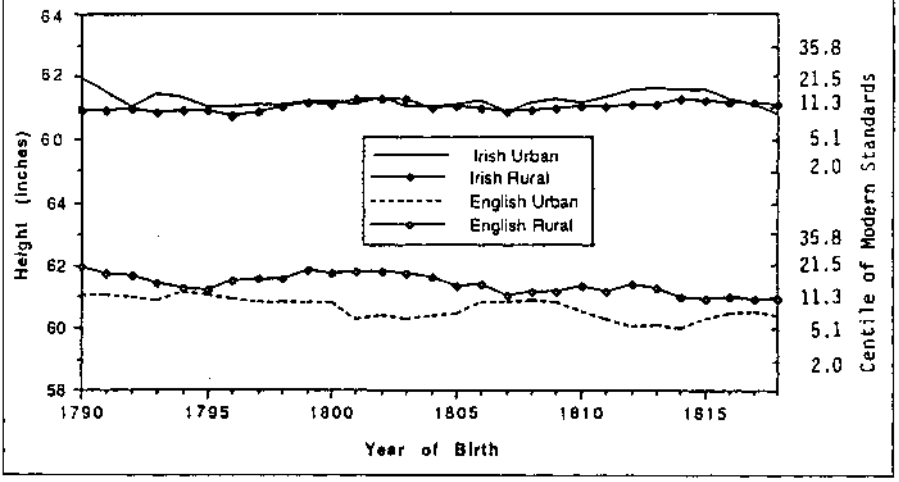



**FIGURE 4 - Irish and English Female Height Profile**
**(5 year moving average for ages 21-49 years)**



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