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HEALTH, HEIGHT, NUTRITION, AND MORTALITY: EVIDENCE ON THE "ANTEBELLUM PUZZLE" FROM UNION ARMY RECRUITS IN THE MIDDLE OF THE NINETEENTH CENTURY

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ABSTRACT

The "Antebellum Puzzle" describes the situation of declining stature and possibly rising mortality in the three decades prior to the American Civil War (1861-65). It is a puzzle, since this period was one of rapid economic growth and development in the United States. Much of the debate has centered on whether the American diet, both in terms of protein and caloric intake, deteriorated in the middle of the 19th century. But the mortality environment also appears to have worsened (or at least did not improve), connected with factors such as urbanization, commercialization, and increased geographic mobility. This paper uses data on the heights of Union Army recruits as an indicator of the standard of living of Americans during this period. Particular attention is paid to New York State and comparisons to the rest of the nation. In New York State, mortality was not improving in the antebellum period and was deteriorating in New York City. For the United States and for New York State, urbanization was negatively related to heights, as was the census death rate in 1850 and a measure of mobility (proportion of the local population foreign born). Although, New York State's agriculture was rapidly commercializing in this era and specializing in dairy products, its nutrition may have been deteriorating overall, with substantial local variation. Mortality was also not improving and worsened in some areas. Both contributed to a decline in this biological indicator of the standard of living. In this sense, both New York and the whole United States were experiencing "Smithian" economic growth (induced by transport improvements and widening markets) with negative externalities. New York State was an area in advance of much of the nation in terms of both urban/industrial and agricultural development in the antebellum period.

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INTRODUCTION

Interest in the biological standard of living has blossomed in recent years, following the lead of a number of scholars, including Robert Fogel, Richard Steckel, John Komlos, Roderick Floud, and others [Fogel 1986, 1993; Steckel, 1992, 1995; Steckel and Floud, 1997; Komlos, 1987, 1994, 1995a, 1995b, 1996; Floud, Wachter, and Gregory, 1990]. This is in line with concern that the standard of living might better be measured by outcomes (e.g., health, height, mortality, morbidity) or real inputs (e.g., calorie or protein consumption) rather than simply income and wealth and their distribution. [See, for example, Steckel, 1983, 1995.] The World Bank has, for some years, been stressing similar measures in its "Basic Needs Indicators" [Chenery and Syrquin, 1975].

This direction of research has overlapped with the study of the demographic transition, most particularly the mortality transition. The transition from high to low levels of fertility and mortality has characterized every developed nation. One indicator of this transition and of fundamental well-being is survivorship, which is usually (but not necessarily) accompanied by better health [Riley, 1989]. In order to create indicators of this biological standard of living and well-being, historical data on heights and weights have been extensively retrieved and utilized. One such data set, the heights and weights of West Point Cadets for the period 1843 to 1894, was analyzed by John Komlos [1987] who found a decline in height (of about 1.4 cm) between the birth cohorts of the 1820s and the 1860s. Several additional studies have found a similar result for other populations (free blacks in Maryland, Georgia convicts, students at Amherst College, Ohio National Guardsmen, Pennsylvania soldiers) [Komlos, 1996]. While there is some disagreement on this result and its interpretation, it appears to be a real phenomenon. Komlos [1987, 1996] looked to a deterioration in diet, notably a reduction in both protein and calorie intake. This is rather surprising, since the United States was experiencing relatively rapid growth in real output per capita from at least the 1830s -- about 1.5% per annum growth in real GDP per capita over the period 1840 to 1860 [Gallman, 1992, Table 2.7]. The agricultural sector was also expanding quite rapidly during this period, although output per worker may have slowed its growth in the 1840s before accelerating again in the 1850s [David, 1967]. This anomaly has become known as the "Antebellum Puzzle".

EVIDENCE ON THE MORTALITY TRANSITION IN THE UNITED STATES

There is, however, additional evidence that the standard of living may not have been improving, on average, in the three to four decades prior to the American Civil War. That evidence comes from mortality rates and expectations of life, two of the World Bank's “Basic Needs Indicators”.

Overall, we suffer from a lack of statistical information on historical mortality in the United States in the 19th century. This is in contrast to fertility, for which we can use census child-woman ratios going back to 1800. Vital registration was uneven in both quality and coverage, having been left up to individual state and local governments. The official Death Registration Area was not formed until 1900 with ten states and the District of Columbia (only comprising about 26% of the nation's population at that time). It did not cover the entire United States until 1933.

Consequently, we must use other data for the study of historical mortality. On the national level, there exist the Federal census data on deaths in the year prior to the census which was included in the censuses of 1850 to 1900. These have known shortcomings [Condran and Crimmins, 1979; Haines, 1979] and appear to have been undercounted on average by about 40%. They can be used, however, and form the basis for national-level mortality estimates for the period 1850-1900 [Haines, 1979, 1998]. Some of these results are given in Table 1, which presents the expectations of life at ages 0, 10, and 20 (e(0), e(10), and e(20)) and the infant mortality rate (infant deaths per 1000 livebirths) for the white population (from 1850) and for the black population (from 1900). The data for 1900 and 1910 are based on extensions from indirect estimates of child mortality using the public use microsamples of the U.S. censuses of 1900 and 1910 [Preston and Haines, 1991; Haines and Preston, 1997]. From 1920 to 1990, these are the official published data and, for 1920 and 1930, reflect the as yet incomplete Death Registration Area.

Overall, it appears from Table 1 that mortality was not fully under control until about 1880. There was apparent decline from 1850 to 1870, but then death rates rose again in 1880. Significant fluctuations in death rates are characteristic of pre-transition mortality. What was happening before 1850? We have much less evidence, but what we have is strongly suggestive. Figure 1 (based on Steckel, 1992, Table 6.8) presents parallel series of e(10) values and heights of native-born adult white males from the colonial period to the 20th century.[1] The period mortality data show a definite deterioration shortly after 1800 and a strong dip in expectation in life from about 1830 to about 1860. These e(10) values are based on genealogical data subsequently reported and analyzed by Pope [1992]. (Some of the actual e(10) values and a variety of other historical mortality indicators for the period from 1800 are given in Appendix Table A.) The genealogical results are not, however, based on national data and are difficult to extend to infant and child mortality. They do, as mentioned, suggest deteriorating mortality over the several decades prior to the Civil War, the same period over which heights declined. The "Antebellum Puzzle" thus becomes more complex.

For New York State, we have several pieces of evidence. The City of New York began registering deaths from 1804 onwards, and the results are relatively complete [Duffy, 1968, pp. 532-538]. The crude death rate (deaths per 1,000 population per annum) for New York City is charted in Figure 2 over the period 1804 to 1900. The pattern is one of rising mortality from about 1820, sharply rising for the 1840s and 1850s, and a gradual subsidence after 1865. Antebellum mortality in America's metropolis was characterized by sharp fluctuations, especially during cholera epidemics. Cholera first made its appearance in the United States in 1832 and returned periodically as epidemics until the late 19th century [Rosenberg, 1962]. The years 1832, 1834, 1849, 1851, and 1854 saw very high mortality from a variety of sources, including cholera. New York City grew rapidly over the century (from a population of 79,000 in 1800 to 242,000 in 1830, 1,175,000 in 1860 and 1,441,000 (Manhattan only) in 1900). It had a large influx of immigrants, especially in the 1840s and 1850s and recurrent problems of poor sanitation, water supply, and public health before the end of the century [Duffy, 1968; 1974]. This is evidence, then, of the "urban mortality penalty" being paid by the United States over the century. As late as 1900, the e(0) for whites in urban areas in the Death Registration Area was about 40.5 years, while it was about 46 years in rural places.[2] The white infant mortality rate was about 137 per 1,000 livebirths for cities in the Death Registration Area and about 100 in rural areas (Appendix Table B).

Second, Appendix Table B provides some life table data for selected cities and states (as well as an estimated national table for the United States for 1830-60 [Meech, 1898]) for the period before the Civil War. Those data show very little trend and a definite "urban penalty", larger for larger cities. e(0) was in the low 40s and remained there until the Civil War. Increased urbanization alone played a significant role. Cities increased their share of the population from about 6% in

1800 to about 20% in 1860. The greater stature of southerners at the time of the Civil War can be partly explained by this [Margo and Steckel, 1983].

Third, there exist census mortality data prior to (and parallel with) the Federal census data. The State of New York began taking its own censuses in the late 18th century. Census deaths began to be reported in the census of 1825 and were given thereafter in the censuses of 1835, 1845, 1855, 1865, and 1875 [New York State, 1826, 1836, 1846, 1857, 1867, 1877]. Simple crude death rates are presented in Table 2 and are charted in Figure 3. Despite the undercount in the data, they are useful for a general view of trends and for cross-sectional analysis. Table 2 and Figure 3 show no real trend for either New York State as a whole or for New York State less New York City before 1860.[3] The last column shows death rates based on registration data for New York City and provides a sense of the undercount of the census data (in the previous column). Despite differences in undercount, there is no evidence of a significant downward trend in death rates before the 1870s. This is consistent with the view that the sustained modern mortality transition did not take place until after 1870. This all contributes to a further understanding of the "Antebellum Puzzle" as an interaction of economic, demographic, and biological factors.

THE ANTEBELLUM PERIOD IN NEW YORK STATE

One of the chief suspects in the "Puzzle" has been a deterioration in diet, notably reduced daily caloric and protein intake. If this were combined with a deteriorating disease environment, net nutrition available for body growth would be diminished [Fogel, 1993; Steckel, 1995]. It has already been shown that it is likely that the mortality environment in New York State did not improve and may have deteriorated before 1860. What was happening in the economy, and especially agriculture, in the Empire State in the era?

Evidence is provided in Table 3 on selected livestock and livestock products from 1821 to 1880. The New York State censuses afford an opportunity to explore conditions in agriculture earlier than 1840, the first Federal census to do so.[4] The per capita figures use the state's population less New York City as the denominator. New York City is excluded since it was a large net consumer and not a significant producer of foodstuffs. The rapid population growth of the state (column (2) upper panel, Table 3) and changes in agricultural structure meant that, over the course of the century, livestock numbers per capita generally fell. Hogs per person decreased up to 1860, as did the total cattle stock. This was perhaps offset to some extent by an increase in slaughtering weights [Cuff, 1992], but availabilities were likely not growing. After an initial surge in numbers based on a growth in wool production, numbers of sheep began to decline from the 1840s both in relative and (later) absolute terms.

The most notable aspect of New York agriculture in the middle of the 19th century was the rise in specialization in commercial dairy products [Ellis, et al., ch. 22; Hendrik, ch. 17]. The number of milk cows gradually increased and held fairly steady on a per capita basis. Amounts of marketed butter, cheese, and fresh milk were growing up to the Civil War -- with some distortion from the war itself. This development is illustrated by the fact that 6.3 million pounds of cheese (almost all from New York State) arrived in Albany over the Erie Canal in 1834, and rose to 15.2 million pounds in 1837 and 24.4 pounds by 1843 [Hendrick, 1933, p. 364]. Much of the butter and cheese production had been a household industry until, in 1851, the first commercial cheese factory was opened in upstate New York [Ellis, et al., 1967, p. 274]. These facilities spread rapidly, and there were 435 of them in 1865, producing over 33 million pounds of cheese [New York State, 1867, p. 415]. Milk was increasingly sent to the New York City market via the new, and faster, railroads. Shipment of fresh milk via the Erie Railroad increased from 385,000 quarts in 1842 to 24.4 million quarts in 1861. Beyond a doubt the "rise of the dairy industry was by far the most significant development in the agricultural history of the state between 1825 and 1860" [Eliis, et al., 1967, pp. 273, 275].

The completion of the Erie Canal in 1825, followed in quick succession by other lateral and feeder canals (including the Champlain, Chenango, Oswego, Black River, Cayuga and Seneca, Chemung, and Genessee Valley canals), accelerated the rapid commercialization of New York agriculture. Quickly thereafter the railroad appeared. New York State saw rapid construction in the 1840s and 1850s. By 1854, the state had 989 miles of operating canals and 2,345 miles of railroads in service, with an additional 564 miles of railroads under construction [U.S. Bureau of the Census, 1854, p. 189]. With the creation of this transportation infrastructure, New York experienced a striking example of "Smithian" growth in productivity and output induced by specialization, division of labor, and technical change occasioned by the extension of the market. New York still ranked third in the nation in wheat production in 1850, a considerable portion of which was marketed through New York City to a growing national and international market. Incomes and land values rose as subsistence agriculture and home manufacturing declined.

But did the biological standard of living deteriorate? If mortality worsened because of either exogenous factors (e.g., the appearance of cholera) or endogenous factors, such as the greater chance for spread of infection because of increased contact through transport, travel, movement of increasing numbers of immigrants, and the rapid growth of relatively unhealthy cities, then the biological standard of living may have suffered. Further, commercialization of agriculture may have been a mixed blessing. Subsistence agriculture provides an opportunity (not always taken) to produce a variety in the diet, including breadstuffs, meats, dairy products, and fresh and preserved vegetables and fruits. Commercialization and specialization may reduce that variety and require rural residents to purchase many foodstuffs on the market. The diet could have become less varied and possibly less abundant.

EVIDENCE FROM UNION ARMY RECRUITS

One source of insight into the puzzle is the muster records of a sample of 39,633 white Union Army recruits whose heights were measured at mustering.[4] 29,041 of the sample were native born. Since human growth usually continues until early adulthood, only recruits aged 21 and over were taken, about 65% of the native white sample. Of that sub-sample (18,794), county of birth could be ascertained with reasonable certainty for only 15,359 of the soldiers.[6]

Some idea of the issue of the “Antebellum Puzzle” itself may be seen in Figures 4 and 5, which give mean heights (in centimeters) by birth year for native-born Union Army recruits aged 21 and over for the nation as a whole and for those born in New York State. The decline in heights for those born after about 1830 is apparent. It held true for New York State as well as for the whole U.S., although the decline was less severe in New York, where mean heights for those born in the early 1840s did not fall below 172 cm. Generally, however, heights in New York State were comparable to the national average.

For these native-born recruits, county of birth was used to link the recruit record to aggregated county-level information from the U.S. Censuses of 1840 and 1850.[7] The census-based county crude death rate for 1850 (deaths per 1,000 population per annum) was taken as a measure of the mortality environment.[8] The proportion of the county urban in 1850 (in incorporated areas of 2,500 and over) was included as a proxy for the unfavorable disease environment created by 19th century cities [Preston and Haines, 1991, chs. 1-2]. The proportion of long distance migrants in the county (proportion foreign born) was used as a measure of contagion due to mobility as well as the inequality effects of recent immigration. Families per dwelling was originally included as a measure of crowding and contagion, but it was highly collinear with urbanization (with a zero-order correlation of .73) and was dropped. The availability of water transport (canals, navigable rivers, lakes, coastal ports) and railroads was used as a measure of commercialization (i.e., integration into regional, national, and/or international markets) and also of contagion via greater mobility of persons.[9] Two measures of protein availability were considered: cheese production per 1,000 population per annum and hogs per capita. These were rather imperfect and were replaced by a direct estimate of protein availability per capita by county using agricultural production data from the census of 1840. The census of 1840 was chosen for the nutrition variable because it was closer to the formative early years of the recruits. The mortality data were not available for 1840 at a national level. Urbanization was taken for 1850. This was highly correlated with that for 1840 (r=.956) and the choice made little difference in the results.

Of the variables examined for the individual recruits, occupation was coded as dummy variables for farmers and laborers. These were well represented occupations and stood at the extremes of the height distribution, farmers generally being the tallest and laborers generally being the shortest. Farmers were also more likely to have had substantial wealth and to have lived in healthier rural places, whereas laborers were unskilled workers with little or no wealth at the bottom of the socioeconomic status distribution. The recruit’s age was included to account for any time trend in heights -- the “Antebellum Puzzle” itself. Region of birth was measured by a set of dummy variables. It would give regional effects not accounted for by the other variables. Finally, there were dummy variables for year of enlistment. Recruits were taller in the earlier years of the war.[10]

The results from three ordinary least squares regressions combining the individual-level and county-level data are reported in Table 4 for the national sample and in Table 5 for the New York recruits. The first equation is for all (white) native born recruits who were age 21 or older and who could be linked to county of birth (14,816 in number). The second equation includes the proportion urban (in incorporated areas of 2,500 population and over) and the proportion foreign born, both measured for 1850. This specification omits the death rate because of collinearity problems.[11] The third equation replicates the first specification with the addition of the nutrition measure — grams of protein potentially available from both animal and vegetable sources per person. This was calculated from 1840 census data on livestock and crops using the procedures of Craig and Weiss [1996]. This third equation also excludes recruits born in highly urbanized counties (e.g., New York, Philadelphia, Suffolk (Boston)) on the grounds that these areas imported most of their food from other counties. Hence the low protein availability measured there would not accurately reflect potential supply and nutrition. Table 5 duplicates Table 4 for those recruits born in New York State (3,041 in number) and hence omits region of birth. The recruit's height (in centimeters) is the dependent variable.

Among the results are the following. Mortality exercised a negative influence on stature in the zero-order effects (i.e., the correlations), and it had a considerably greater effect on the recruits born in the more urbanized state of New York. There a ten point increase in the crude death rate would have lowered stature by 1.3 centimeters. The effect was only about .3 centimeters in the national sample. The coefficients were statistically significant except in the last equation of Table 5 (for New York State less New York City). Urbanization also had a strong and depressing effect on height. Moving from a wholly rural to a wholly urban county would reduce stature by about two centimeters (and more than that in New York State). The highly correlated variable of proportion foreign born had a negative effect, though statistically insignificant throughout.[12] Its coefficient would have been larger and significant if the urban variable had been omitted. One clear result is that being born in a more urban county, with its greater population mobility and higher death rates, had a consistent and negative effect on height.[13]

As expected, recruits who were farmers were taller, while laborers shorter, both significantly so. Being from a county with more long distance migrants (the foreign born) caused a reduction in height in the overall model, consistent with a contagion as well as an inequality view, though the estimated coefficients did not meet the significance levels.[14] Region of birth did show an important influence on height in Table 4, even holding other factors constant. The Midwest did better, as did the South east of the Mississippi, relative to New England and especially the Middle Atlantic region, with their large urban and immigrant populations. Recruits from the Midwest were 1-2 centimeters taller than those from the Middle Atlantic Region, all other things being held constant. The transport variables had coefficients consistent with the contagion hypothesis. For the New York models, the water transport variable was statistically insignificant, likely because by 1850 most New York State counties were already well connected by water transport.[15] The variable for protein availability did show the expected positive sign, and it was statistically significant in the overall sample but not in the New York sample. This may well have been because of the more advanced state of agricultural and overall economic development in New York.

The coefficients on year of enlistment did show that those recruited early in the war were taller than those recruited later. Finally, the age (i.e., birth year) coefficient was significant and positive, pointing to smaller heights among younger recruits. Since only older recruits were taken (assuming they had reached their adult terminal heights), this indicates that the “Antebellum Puzzle” was present for both the overall sample and that of the New York born recruits.[16] This is also clearly seen also in Figures 4 and 5.

CONCLUDING COMMENTS

These results confirm that the “Antebellum Puzzle” of declining heights in the face of robust economic growth was a real phenomenon. The age (i.e., approximate birth cohort) effects in the regression models were persistent, robust, and in the expected direction. The results in Tables 4 and 5 also suggest some of the causes. Rapid economic development in the United states in the three decades prior to the Civil War were characterized by fast urban growth, significant migration from abroad, considerable internal mobility, great changes in the transportation infrastructure, and increased commercialization, including in agriculture. These all contributed to a worsening mortality environment which had adverse consequences for human growth. This may be characterized as “Smithian” growth via extension of markets with negative externalities. That the shortest recruits were born in New

England and the Middle Atlantic region and from more urban counties with higher proportions of foreign born supports this. All this suggests that mortality was not unimportant to the "Antebellum Puzzle". Being born in a county with water or railroad transport connections in 1850 also is consistent with both a contagion and a commercialization view. The result that farmers were taller and that laborers were shorter is also supportive of these rural-urban effects. The latter is, however, also indicative of the possibility of rising inequality. Laborers were more likely to be urban dwellers and to be low on the socioeconomic status scale. Farmers were more likely to have had more wealth and an independent source of food, in addition to having been rural folk.

The issue of deteriorating nutrition also received support here. Other inquiries [Komlos, 1987, 1996; Craig and Weiss, 1998] do point to that. If so, it could well have been a consequence of increased commercialization and the loss of a varied subsistence diet, as well as rising inequality. A more direct test of commercialization was attempted using town data for New York State and the state census of 1855. Those results (not reported directly here) show that the a simple measure such as cows, hogs, butter, or cheese per person in the town yielded a positive regression coefficient. This is more consistent with a positive role for local nutritional availability than of the negative impact of commercialization.

Overall, then, the “Antebellum Puzzle” seems to have resulted from a complex of factors, including urbanization, increased population mobility, worsening mortality conditions, greater contact via improved transport infrastructure, and deteriorating nutrition. It seems that the growing prosperity of the United States in the antebellum period was partly purchased at a price of some deterioration of the biological standard of living. This situation did not rectify itself until the end of the 19th century, when heights began to rise and when mortality began to decline, especially in urban areas.

FOOTNOTES

1. The data in Steckel [1992] are based, in turn, in materials cited in Fogel [1986] plus additional materials. The underlying numbers for Figure 1 are given in Appendix A.

2. The Death Registration Area was formed in 1900 from ten states (Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Indiana, and Michigan) and the District of Columbia. These areas were deemed to have acceptable levels of death registration. The Death Registration Area was then expanded until it included the entire United States (by 1933).

3. The rise in death rates at the end of the century is explained by the increasing inclusion of the more accurate registration data.

4. The New York State Census enumerated livestock from 1821 onwards and also made inquiries about butter, cheese, and milk production after 1845. The Federal Census began reporting on livestock in 1840 and on livestock products in 1850.

5. These records are being linked to a large number of other data from military pension files, military service records, and the census [Fogel, 1993]. About half of the process is complete, but those data will not be used in this version of the present paper. There is also little evidence of truncation in the sample of recruits due to minimum height requirements. See Margo and Steckel [1983].

6. The original links made in the sample to data on towns and counties from the 1850 and 1860 Federal censuses for both place of birth and place of recruitment were based on exact matches of place names with no possibility of multiple matches. There were problems with this procedure. Misspellings were not uncommon and resulted in non-matches. There were also some states (notably Pennsylvania and several in the Midwest) with numerous places having the same name. For example, there were 45 places named “Washington” in Indiana alone in 1860. Some effort was made here to correct misspellings and to assign more likely matches. For instance, 127 Pennsylvania recruits were listed as born in “Lancaster.” There was (and is) a city of Lancaster in Lancaster County, as well as a town of Lancaster in Butler County. Based on the unit and the clustering of birthplaces in the same unit, it was decided to assign them to Lancaster County. In general, ambiguous cases were assigned to the county name when that seemed reasonable. In this way, the number of matches at all ages was increased from 14,583 to 23,552.

7. This information was taken from ICPSR data set number 0003 and from data on

agriculture from those censuses, some of which was kindly provided by Lee Craig and Thomas Weiss.

8. Mortality data collected from the census must be used with caution. The data were collect subsequent to a question on whether there was one or more deaths in the family or household in the year prior to the census (in this case June 1, 1849 to May 30, 1850). There was substantial underreporting of deaths, particularly at the youngest and oldest ages. [Haines, 1979; Condran and Crimmins, 1979.] The Census Bureau was aware of the problem, stating in connection with the mortality report of the 1860 census: “It is very apparent that the whole number of deaths which occurred in the year was not furnished.” The report goes on to note likely causes: death of a family or household head, resulting in the breakup of the family or household and not report; lack of information by the respondent; deaths not in families or households (e.g., institutions, boarding houses, ships); reference period error (i.e., not remembering whether the death occurred within the time period asked); deaths of non-relatives. [U.S. Bureau of the Census, 1866, pp. xxiii-xxiv.] Some comparisons of census mortality data to registration data for Massachusetts and New Jersey in 1879/80 indicate overall underreporting in the census of about 35-45%. [Condran and Crimmins, 1979, Table 6.] There is, however, no strong reason to believe that underreporting varied greatly by location or region in 1850. Differences in age/sex composition likely had no great impact on differential undercount of total deaths. Finally, a significant cholera epidemic took place during the early part of the census year (in 1849), and, ironically, helped bring mortality levels closer to those of “normal” years. [Vinovskis, 1978; Rosenberg, 1962.] In general, the crude death rates and the regression coefficients estimated from them should be inflated by about 40%.

9. Transport proximity was coded as a set of dummy variables based on historical maps. The presence of rail or water transport was coded as a 1, otherwise 0. These data were kindly furnished by Lee Craig and Thomas Weiss.

10. The expected signs would be negative for laborers, the crude death rate, and proportions urban, and foreign born. The sign expectations would be positive for farmers and for measures of protein availability. The expected signs for commercialization (water and rail transport) are ambiguous. Commercialization could produce taller, healthier persons via greater incomes, but it could also create greater contact with new disease vectors and possibly a degradation of diet as

farmers specialized and lost the varied produce of the subsistence farmer. In addition, the relative price of nutrients would have been higher.

11. For example, the crude death rate for 1850 was correlated .534 with the proportion urban and .476 with the proportion foreign born.

12. The correlation between the proportion urban and the proportion foreign born was .76 over counties for the national sample.

13. This would also have been true if individual place of enlistment had been classed as urban or rural. This was not used because of the smaller sample size resulting from the use of that variable.

14. A similar result would have held if the variable for population mobility had been the proportion of all those born outside the county, including both the native and foreign born.

15. Only three of the 62 New York counties (Cortland, Hamilton, and Otsego) were reported as having no such transport connection in 1850.

16. The age effect persisted also for recruits born and enlisted in New York State.

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APPENDIX TABLE A. MEAN HEIGHTS OF NATIVE-BORN WHITE MALES & EXPECTATION OF LIFE AT AGE 10. UNITED STATES, 1720-1970.

(1)	(2)	(3)	(4)	(5)	(6)
EXPECTATION OF LIFE AT AGE 10 (a)				STATURE	
YEAR ON WHICH OBSERVATION CENTERED	e(10)	YEAR ON WHICH OBSERVATION CENTERED	e(10)	YEAR ON WHICH OBSERVATION CENTERED	MEAN HEIGHT (cm)
1720-24	51.8			1710	171.5
1725-29	52.7			1715	172.2
1730-34	52.0			1720	171.8
1735-39	51.2			1725	172.1
1740-44	52.9			1730	172.1
1745-49	52.3			1735	171.7
1750-54	52.5			1740	172.1
1755-59	52.9			1745	172.0
1760-64	53.9			1750	172.2
1765-69	53.7			1755	172.1
1770-74	54.8			1760	
1775-79	55.2			1765	
1780-84	56.4			1770	
1785-89	56.5			1775	
1790-94	56.7			1780	173.2
1795-99	55.4			1785	173.2
1800-04	55.2			1790	172.9
1805-09	53.0			1795	172.8
1810-14	52.3			1800	
1815-19	51.9			1805	
1820-24	51.4			1810	
1825-29	51.1			1815	173.0
1830-34	51.0			1820	172.9
1835-39	50.2			1825	173.1
1840-44	48.7			1830	173.5
1845-49	48.2	1850	47.3	1835	173.1
1850-54	47.9			1840	172.2
1855-59	47.8	1860	49.4	1845	171.6
1860-64	49.2			1850	171.1
1865-69	51.4	1870	50.6	1855	170.8
1870-74				1860	170.6
1875-79		1880	48.3	1865	171.1
1880-84				1870	171.2
1885-89		1890	50.4	1875	170.7
1890-94				1882.5	168.9
1901	51.4	1900	51.2	1887.5	169.2
1910	52.4			1892.5	169.0
1919-20	54.6			1897.5	170.0
1930	55.3			1902.5	170.0
1940	58.9			1906.5	171.6
1950	61.6			1911	172.2
1960	62.8			1916	172.9
1970	63.2			1921	173.2
1980	65.5			1931	175.5
1990	66.7				

(a) White population only for 1901-1990 in Col. (2) and 1850-1900 in Col. (4).

SOURCE: Cols. (1)-(2) for 1720-1869, Fogel (1986); for 1901-1990, NCHS (1994). Cols (3)-(4), Haines (1998). Cols. (5)-(6), Fogel (1986); Steckel & Haurin (1990).

APPENDIX TABLE B. Child Mortality and Expectations of Life. United States, 1830-1941.

Source	Region	Period	Sex	Child Mortality[a] q(1)	q(2)	q(5)	e_0	e_{10}	e_{20}
Jaffe & Lourie [1942]	44 New England Towns	1826-35	Total					51.0	42.9
	Salem, MA & New Haven, CT	1826-35	Total					46.0	37.8
	Boston, New York City & Philadelphia	1826-35	Total					35.9	28.0
	Estimated U.S.	1826-35	Total					49.8	41.7
Jacobson [1957]	Massachusetts-Maryland, White	1850	Male	.16064	.21394	.27245	40.4	47.8	40.1
			Female	.13079	.18262	.24122	43.0	48.6	41.7
Meech [1898]	United States, Whites	1830-60	Male	.16195	.21569	.27468	41.0	48.4	40.9
			Female	.13430	.18752	.24769	42.9	48.8	41.4
Haines & Higgins [1997]	Rochester, NY	1838-42	Male	.12727		.29258	40.2	46.0	38.0
			Female	.11340		.22919	41.8	46.3	38.7
		1853-57	Male	.14534		.23457	43.9	48.7	40.6
			Female	.11883		.19973	47.0	49.9	42.1
Kennedy [1853]	Massachusetts	1850	Male				38.3	48.0	40.1
			Female				40.5	47.2	40.2
Elliot [1857]	Massachusetts (166 towns)	1855	Total	.15510	.22670	.28540	39.8	47.1	39.9
Haines	Massachusetts	1855-56	Total	.12994		.24262	44.2	49.8	42.2
Haines	Massachusetts	1859-61	Male	.14246		.24846	43.5	49.6	41.9
			Female	.13643		.22466	45.1	52.8	42.4
Vinovskis [1972]	Massachusetts	1859-61	Male			.22646	46.4	51.6	44.0
			Female			.19193	47.3	50.1	43.0
Haines [1977]	Seven New York Counties	1850-65	Male	.14655	.18067	.21268	45.9	49.2	
			Female	.12389	.15821	.19105	48.9	51.4	
			Total	.13549	.16972	.20213	47.4	50.3	
Haines [1979]	United States [U.S. Model]	1850	Male	.24092	.28396	.32195	37.2	46.2	38.4
			Female	.21712	.25937	.29845	39.4	47.5	39.8
		1860	Male	.20210	.23979	.27361	41.6	48.3	40.3
			Female	.19153	.23041	.26684	42.1	48.7	40.9
		1870	Male	.19210	.22788	.26007	43.0	49.2	41.1

			Female	.17724	.21234	.24531	44.9	50.6	42.6
		1880	Male	.22015	.25997	.29538	39.7	47.5	39.6
			Female	.22980	.27175	.31019	39.1	48.0	40.3
		1890	Male	.16334	.19744	.22875	44.8	49.1	41.0
			Female	.15765	.19232	.22546	45.6	50.0	41.9
		1900	Male	.13356	.16480	.21252	47.1	49.4	41.1
			Female	.12476	.15572	.18611	48.4	50.5	42.3
	United States, White [U.S. Model]	1850	Male	.22829	.26997	.30697	38.4	46.6	38.8
			Female	.20596	.24684	.28486	40.6	51.4	43.9
		1860	Male	.18774	.22351	.25579	43.2	49.1	41.0
			Female	.17515	.21158	.24598	44.1	49.6	41.7
		1870	Male	.18513	.21955	.25056	44.1	49.9	41.8
			Female	.16633	.19968	.23114	46.4	51.4	43.3
		1880	Male	.21436	.25326	.28794	40.4	47.9	40.0
			Female	.21526	.25553	.29268	40.6	48.6	40.9
		1890	Male	.15675	.18926	.21914	46.0	50.0	41.7
			Female	.14490	.17722	.20829	47.4	51.0	42.8
		1900	Male	.12784	.15730	.18497	48.5	50.4	42.0
			Female	.11206	.14012	.16781	50.7	51.9	43.5
Fogel	United States,	1850-60	Male					46.7	
Pope [1992]	United States [Genealogies]	1820-29	Male						43.3
			Female						44.9
		1830-39	Male						44.6
			Female						44.6
		1840-49	Male						41.5
			Female						37.1
		1850-59	Male						40.8
			Female						39.5
		1860-69	Male						41.2
			Female						42.2
		1870-79	Male						44.3
			Female						42.2
		1880-89	Male						45.8
			Female						42.9
Haines	Massachusetts	1864-66	Male	.16002	.22431	.28639	38.4	45.8	38.7
			Female	.14267	.20352	.26706	41.6	48.7	41.8

Haines	Massachusetts	1869-71	Male	.16675	.21849	.26214	42.6	49.3	41.5
			Female	.16090	.19413	.23881	44.4	49.8	42.5
Haines	Massachusetts	1874-76	Male	.17941	.24772	.29812	40.0	48.9	41.3
			Female	.15449	.21967	.27050	41.8	49.4	42.2
Haines	Massachusetts	1879-81	Male	.17086	.22341	.27712	41.7	49.5	41.6
			Female	.16535	.19633	.25045	43.3	49.6	42.3
Billings [1886]	Massachusetts	1878-82	Male	.18080	.23250	.28342	41.7	49.9	42.2
			Female	.15257	.20245	.25408	43.5	50.0	42.8
Billings [1886]	New Jersey	1879-80	Male	.15153	.19398	.24132	45.6	51.6	43.3
			Female	.13121	.16939	.21217	48.0	52.5	44.5
Haines	Massachusetts	1884-86	Male	.16923	.22925	.27210	41.9	49.0	41.1
			Female	.14507	.20531	.24668	43.9	49.8	42.2
Haines	Massachusetts	1889-91	Male	.17615	.23742	.27354	41.8	49.0	41.1
			Female	.14957	.20973	.24613	44.0	49.9	42.2
Glover [1921]	Massachusetts	1890	Male	.16777	.20851	.25322	42.5	48.4	40.7
			Female	.14755	.18738	.23415	44.5	49.6	42.0
Abbott [1898]	Massachusetts	1893-97	Male	.17233	.20726	.24234	44.1	49.3	41.2
			Female	.14699	.18115	.21593	46.6	50.7	42.8
Haines	Massachusetts	1893-97	Male	.17466	.23913	.27331	42.1	49.2	41.0
			Female	.14660	.21036	.24417	44.8	50.6	42.7
Glover [1921]	DRA, Total	1900-02	Male	.13574	.16614	.19452	47.9	50.4	42.0
			Female	.11267	.14092	.16881	50.7	51.9	43.6
			Total	.12448	.15383	.18196	49.2	51.1	42.8
	DRA, Whites	1900-02	Male	.13345	.16331	.19136	48.2	50.6	42.2
			Female	.11061	.13832	.16574	51.1	52.2	43.8
	DRA, Blacks	1900-02	Male	.25326	.31098	.35615	32.5	41.9	35.1
			Female	.21475	.26990	.31944	35.0	43.0	36.9
	DRA, Urban, Whites	1900-02	Male	.15097	.18683	.22128	44.0	47.5	39.1
			Female	.12545	.15883	.19195	47.9	50.3	41.9
	DRA, Rural, Whites	1900-02	Male	.10900	.13065	.15043	54.0	54.4	46.0
			Female	.08979	.10967	.12983	55.4	54.4	46.1
Preston/ Haines [1991]	U.S., Total	1895/00	Male	.12973	.15836	.18522	49.7	50.6	42.1
			Female	.11029	.13930	.16706	51.6	52.8	44.5
			Total	.12047	.14906	.17636	50.1	51.6	43.3
	U.S., Whites	1895/00	Male	.11988	.14569	.16990	50.4	51.4	42.9
			Female	.10120	.12702	.15174	53.4	53.7	45.3
	U.S., Blacks	1895/00	Male	.18346	.22656	.26698	40.4	46.2	38.3
			Female	.15657	.20040	.24234	43.3	48.3	40.7

Glover [1921]	DRA, Total	1909-11	Male	.12495	.15016	.17282	49.9	51.1	42.5
			Female	.10377	.12743	.14883	53.2	53.3	44.7
			Total	.11462	.13908	.16113	51.5	52.2	43.5
	DRA, Whites	1909-11	Male	.12326	.14799	.17028	50.2	51.3	42.7
			Female	.10226	.12545	.14651	53.6	53.6	44.9
	DRA, Blacks	1909-11	Male	.21935	.27155	.31411	34.0	40.6	33.5
			Female	.18507	.23303	.27232	37.7	42.8	36.1
	DRA, Urban Whites	1909-11	Male	.13380	.16247	.18815	47.3	49.1	40.5
			Female	.11123	.13831	.16266	51.4	52.2	43.5
	DRA, Rural Whites	1909-11	Male	.10326	.12105	.13777	55.1	54.5	45.9
			Female	.08497	.10119	.11679	57.4	55.5	46.9
	DRA, Whites	1919-21	Male	.08025	.09815	.11158	56.3	54.2	45.6
			Female	.06392	.07757	.09279	58.5	55.2	46.5
	DRA, Blacks	1919-21	Male	.10501	.12782	.14805	47.1	46.0	38.4
			Female	.08749	.10851	.12851	46.9	44.5	37.2
	DRA, Whites	1929-31	Male	.06232	.07163	.08262	59.1	55.0	46.0
			Female	.04963	.05798	.06784	62.7	57.6	48.5
	DRA, Blacks	1929-31	Male	.08732	.10245	.11588	47.6	44.3	36.0
			Female	.07204	.08538	.09815	49.5	45.3	37.2
	U.S., Total	1939-41	Male	.05238	.05762	.06376	61.6	56.1	46.9
			Female	.04152	.04621	.05152	65.9	59.7	50.4
			Total	.04710	.05206	.05780	63.6	57.8	48.5
	U.S., Whites	1939-41	Male	.04812	.05276	.05850	62.8	57.0	47.8
			Female	.03789	.04204	.04691	67.3	60.8	51.4
	U.S., Blacks	1939-41	Male	.08238	.09088	.09918	52.3	48.3	39.5
			Female	.06584	.07328	.08094	55.6	50.8	42.0
<u>Selected Cities</u>									
Haines	Suffolk Co., MA (Boston)	1855-56	Total	.17384		.34455	34.5	44.4	37.0
Haines	Suffolk Co., MA (Boston)	1859-61	Male	.18027		.34388	36.3	44.4	36.7
			Female	.15940		.29495	39.1	46.8	39.0
Haines	Suffolk Co., MA (Boston)	1864-66	Male	.19414	.28120	.35732	32.3	41.7	34.4
			Female	.19747	.28115	.35300	35.6	46.8	39.3
Haines	Suffolk Co., MA (Boston)	1874-76	Male	.20041	.29428	.35731	34.0	45.1	37.5
			Female	.18387	.27161	.33309	36.5	47.1	39.9
Billings [1886]	Boston, Whites	1879-80	Male	.21739	.28518	.34218	37.0	47.5	39.6
			Female	.18873	.25365	.30823	39.1	48.4	40.7
Haines	Suffolk Co.,	1884-86	Male	.20160	.28245	.33710	34.8	44.0	36.3

	MA (Boston)		Female	.17732	.25915	.31453	37.1	45.9	38.4
Haines	Suffolk Co.,	1894-96	Male	.17870	.26501	.31567	36.0	44.0	36.1
	MA (Boston)		Female	.15023	.23576	.28472	39.8	47.3	39.5
Glover	Boston	1900-02	Male	.15736	.19875	.24002	41.6	46.0	37.8
[1921]			Female	.13548	.16983	.21017	45.1	48.5	40.2
Glover	Boston	1909-11	Male	.13527	.16333	.19050	46.0	47.7	39.1
[1921]			Female	.11330	.13851	.16181	50.3	50.9	42.4
Haines	Suffolk Co.,	1929-31	Male	.07230		.10094	54.6	51.5	42.5
	MA (Boston)		Female	.07979		.08220	58.4	54.3	45.2
Haines	Philadelphia	1860-61	Total	.18531		.32837	37.3	47.9	40.1
	Philadelphia	1869-71	Total	.21300		.33249	36.2	45.7	38.0
	Philadelphia	1879-81	Total	.21915		.32047	38.1	46.8	39.0
	Philadelphia	1889-91	Total	.19668		.29722	39.5	47.6	39.7
Glover	Philadelphia	1900-02	Male	.15027	.18978	.23006	42.5	46.3	38.1
[1921]			Female	.12741	.16369	.20232	46.2	49.1	40.9
Glover	Philadelphia	1909-11	Male	.14174	.17456	.20558	45.5	48.1	39.5
[1921]			Female	.11926	.14959	.17796	49.6	51.2	42.6
Haines	Philadelphia	1919-21	Total	.08540		.12526	52.7	51.0	42.5
	Philadelphia	1929-31	Total	.06304		.08693	57.3	53.2	44.2
Billings	New York City	1878-81	Male	.26278	.35464	.42751	29.0	42.4	34.4
[1886]			Female	.22411	.31513	.38744	32.8	45.3	37.3
Billings	New York City,	1879-80	Male	.23421	.32245	.38085	33.3	44.9	36.6
[1886]	Whites		Female	.20427	.28527	.34167	36.8	46.9	38.6
Billings	Brooklyn,	1879-80	Male	.19477	.27036	.33101	37.5	48.1	39.8
[1886]	Whites		Female	.16424	.24336	.30545	39.7	49.1	41.0
Glover	New York City	1900-02	Male	.15673	.20308	.24435	40.6	44.9	36.4
[1921]			Female	.13298	.17564	.21542	44.9	48.2	39.7
Glover	New York City	1909-11	Male	.13186	.16799	.19907	45.3	47.4	38.7
[1921]			Female	.11405	.14762	.17708	49.5	50.9	42.2
Billings	Chicago,	1879-80	Male	.20526	.27950	.34394	38.1	50.6	42.7
[1886]	Whites		Female	.15107	.22919	.29958	41.3	51.6	43.8
Glover	Chicago	1900-02	Male	.12010	.15142	.18191	46.3	47.7	39.5
[1921]			Female	.09762	.12764	.15676	50.8	55.0	42.9
Glover	Chicago	1909-11	Male	.13066	.16079	.18980	45.9	51.5	39.0
[1921]			Female	.10431	.13196	.15959	51.7	52.4	43.8

[a] q(1) is the probability of dying before reaching age 1. It is the infant mortality rate. q(2) and q(5) are the probabilities of dying before reaching ages 2 and 5, respectively. e_0, e_{10}, and e_{20} are the expectations of life at birth and at ages 10 and 20.

Source: Jaffe & Lourie [1942]. Jacobson [1957]. Meech [1898]. Pope [1992]. Meeker [1972], Table 1. Glover [1921]. Haines [1977, 1979a, 1998]. Preston & Haines [1991], ch. 2. Vinovskis [1972]. Fogel [1986], Table 3. U.S. Bureau of the Census [1886] (Billings). Abbott [1898]. Various Massachusetts and Philadelphia vital statistics and census data calculated directly from census and vital registration data by the author.

TABLE 1. MORTALITY IN THE UNITED STATES, 1850-1990.

APPROX DATE	EXPECTATION OF LIFE: AT BIRTH		AT AGE 10		AT AGE 20		INFANT MORTALITY RATE	
	WHITE	BLACK(a	WHITE	BLACK(a	WHITE	BLACK(a	WHITE	BLACK(a)
1850	38.4		47.3		39.5		216.8	
1860	43.6		49.4		41.3		181.3	
1870	45.2		50.6		42.5		175.5	
1880	40.5		48.3		40.4		214.8	
1890	46.8		50.4		42.2		150.7	
1900	51.8	41.8	52.5	47.2	44.1	39.5	110.8	170.3
1910	52.7	43.1	53.0	47.9	44.5	40.1	106.1	161.9
1920	57.4	47.0	54.6	45.3	46.0	37.8	82.1	131.7
1930	60.8	48.5	56.3	44.8	47.2	36.6	60.1	99.9
1940	64.9	53.9	58.8	49.5	49.5	40.7	43.2	73.8
1950	69.0	60.7	61.5	54.5	51.9	45.2	26.8	44.5
1960	70.7	63.9	62.8	57.4	53.2	47.9	22.9	43.2
1970	71.6	65.2	63.3	56.8	53.7	47.3	17.8	30.9
1980	74.5	68.1	65.6	60.4	56.0	50.8	11.0	21.4
1990	76.1	69.1	66.9	60.7	57.2	51.1	7.6	18.0

(a) For 1950 and 1960, black and other population.

SOURCE: Haines [1994]. Preston & Haines [1991], Table 2.5. For 1910, unpublished tabulations from the 1910 Census Public Use Microsample, based on Haines & Preston [1997]. For 1920-1990, National Center for Health Statistics [1994].

TABLE 3. SELECTED LIVESTOCK DATA. NEW YORK STATE, 1825-1880.

YEAR	POP-NYC(a)	HOGS TOTAL	CATTLE TOTAL	COWS	KILLED FOR BEEF	SHEEP	BUTTER (lbs)	CHEESE (lbs)	MILK SOLD (gals)
1821	1249106		1215049			2147351			
1825	1448370	1467573	1513421			3496539			
1835	1906428	1554358	1885771			4261765			
1840	2116211	1900065	1911244			5118777			
1845	2233272	1584344	2072330	999490		6443855	79501733	36744976	
1850	2581847	1018252	1877639	931324		3453241	79766094	49741413	
1855	2836402	1069792	2105465	1068427	225338	3217024	90293074	38944250	20957861
1860	3067066	910178	1973173	1123634		2617855	103097279	48548289	
1865	3105391	1077226	1824221	1149392	221481	5521610	84584458	72195337	29631522
1870	3440467	518251	2045324	1350661		2181578	107147526	22769964	135775919
1875	3657072	960393	2250170	1339816	85571	2118547	107873361	7778413	41511599
1880	3876572	751907	2339721	1437855		1715180	111922423	8362590	231965533
	PER CAPITA								
1821			0.973			1.719			
1825		1.013	1.045			2.414			
1835		0.815	0.989			2.235			
1840		0.898	0.903			2.419			
1845		0.709	0.928	0.448		2.885	35.599	16.453	
1850		0.394	0.727	0.361		1.338	30.895	19.266	
1855		0.377	0.742	0.377	0.079	1.134	31.834	13.730	7.389
1860		0.297	0.643	0.366		0.854	33.614	15.829	
1865		0.347	0.587	0.370	0.071	1.778	27.238	23.248	9.542
1870		0.151	0.594	0.393		0.634	31.143	6.618	39.464
1875		0.263	0.615	0.366	0.023	0.579	29.497	2.127	11.351
1880		0.194	0.604	0.371		0.442	28.871	2.157	59.838

SOURCE: Federal and state censuses.

(a) Population of New York State less New York County (New York City).

TABLE 4. OLS REGRESSIONS. NATIVE-BORN UNION ARMY RECRUITS, NATIONAL SAMPLE, 1861-1865.

	Zero order correlation	Coeff.	Signi	Coeff.	Signi	Zero order correlation	Coeff.	Signi
Dependent Variable : Height in cm		ALL RECRUITS		ALL RECRUITS			ALL RECRUITS	
Independent Variables								
Constant		171.6311	***	171.4383	***		171.4963	***
Age	0.0443	0.0519	***	0.0502	***	0.0418	0.0488	***
Farmer	0.1154	0.8687	***	0.7270	***	0.1040	0.7613	***
Laborer	-0.0577	-0.3540	*	-0.4403	**	-0.0591	-0.5164	**
Region of birth								
New England	-0.0133	0.4754	***	0.4046	**	-0.0192	0.3891	**
Middle Atlantic	-0.1193	NI		NI		-0.1079	NI	
East North Central	0.0890	1.0845	***	1.0144	***	0.0823	0.9690	***
West North Central	0.0319	2.0052	***	1.9075	***	0.0226	1.5346	***
South Atlantic	0.0107	0.6456	***	0.6974	***	0.0077	0.5837	***
East South Central	0.0601	1.2910	***	1.2522	***	0.0599	1.1599	***
West South Central	-0.0148	-1.7178	---	-1.3298	---	-0.0049	-1.2858	---
Year of Enlistment								
1861	0.0499	1.4402	***	1.4706	***	0.0526	1.4955	***
1862	0.0288	1.0519	***	1.0654	***	0.0247	1.0860	***
1863	-0.0263	0.4712	*	0.5317	**	-0.0232	0.5440	**
1864	-0.0323	0.5235	***	0.5042	***	-0.0621	0.5741	***
1865	-0.0554	NI		NI		-0.0585	NI	
COUNTY (US): 1840/1850								
Crude Death Rate (1850)	-0.0448	-0.0288	***	NI		-0.0339	-0.0251	**
Proportion Urban (1850)	-0.1333	NI		-2.0327	***	-0.1059	NI	
Proportion foreign born (1850)	-0.1196	NI		-0.2887	---	-0.0948	NI	
Water transport (1850)	-0.0919	-0.4417	***	-0.2936	**	-0.0851	-0.4387	***
RR transport (1850)	-0.1199	-0.7411	***	-0.4692	***	-0.1078	-0.6246	***
Protein per capita per day (gms)		NI		NI	*	0.0813	0.0025	*
N		14816		14816			13922	
Adjusted R-squared		0.040		0.043			0.034	
F-ratio		38.04	***	40.14	***		29.58	***

SOURCE: Union Army recruits sample, ICPSR No. 9425.
The subsample is of white native-born recruits aged 21+ for whom birthplace could be ascertained and matched with aggegated census data for 1850 (by county).

*** = signficant at least at a 1% level
** = signficant at least at a 5% level
* = signficant at least at a 10% level
--- = not signficant at least at a 10% level
NI = not included

TABLE 5. OLS REGRESSIONS. NATIVE-BORN UNION ARMY RECRUITS, NEW YORK STATE SAMPLE, 1861-1865.

		Zero order correlation	Coeff.	Signi	Coeff.	Signi	Zero order correlation	Coeff.	Signi
Dependent Variable : Height in cm			NEW YORK BORN		NEW YORK BORN			NEW YORK BORN LESS NYC	
Independent Variables									
Constant			173.2975	***	172.2770	***		172.5550	***
Age		0.0533	0.0486	***	0.0436	***		0.0435	***
Farmer		0.1221	1.0495	***	0.8442	***		0.8865	***
Laborer		-0.0704	-0.9392	**	-0.9440	**		-1.4228	***
Year of Enlistment									
	1861	0.0273	1.3104	**	1.1559	**		1.0445	**
	1862	0.0477	0.6970	*	0.7188	*		0.7122	*
	1863	-0.0232	0.3196	---	0.3424	---		0.2543	---
	1864	-0.0497	-0.0742	---	-0.0529	---		-0.0098	---
	1865	-0.0461	NI		NI			NI	
COUNTY (US): 1840/1850									
Crude Death Rate (1850)		-0.1329	-0.1278	***	NI			-0.0505	---
Proportion Urban (1850)		-0.1791	NI		-2.3821	***		NI	
Proportion foreign born (1850)		-0.1631	NI		-1.3109	---		NI	
Water transport (1850)		-0.0010	-0.1488	---	0.0855	---		0.0321	---
RR transport (1850)		-0.0914	-1.1878	***	-0.7751	**		-1.1952	***
Protein per capita per day (gms)			NI		NI	*		0.0035	---
N			3041		3041			2712	
Adjusted R-squared			0.036		0.044			0.021	
F-ratio			12.31	***	13.83	***		6.16	***

SOURCE: Union Army recruits sample, ICPSR No. 9425.
The subsample is of white native-born recruits aged 21+ for whom birthplace could be ascertained and matched with aggegated census data for 1850 (by county).

*** = signficant at least at a 1% level
** = signficant at least at a 5% level
* = signficant at least at a 10% level
--- = not signficant at least at a 10% level
NI = not included

Figure 1

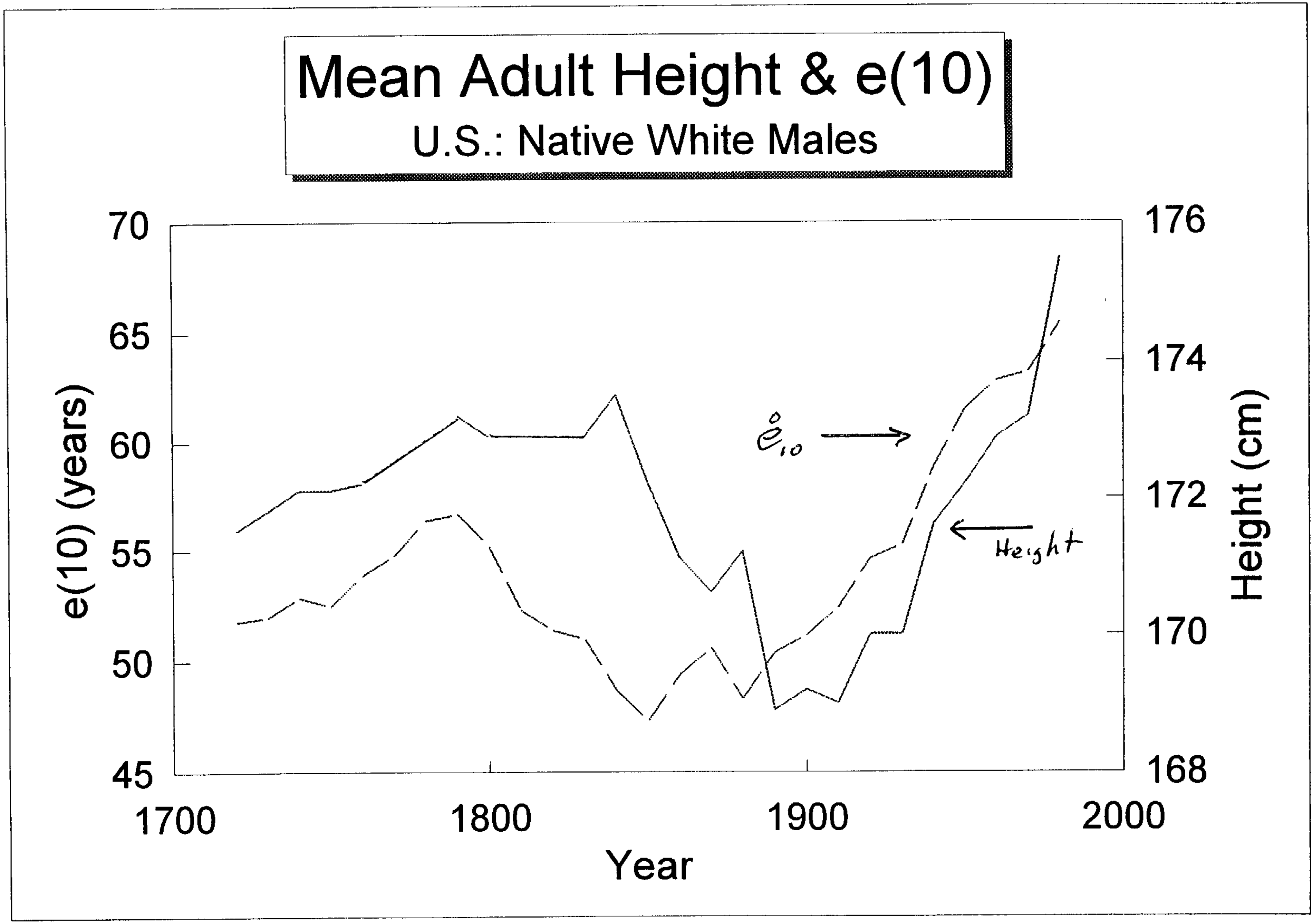

Mean Adult Height & e(10)
U.S.: Native White Males
e(10) (years)
70
65
60
55
50
45
Height (cm)
176
174
172
170
168
1700
1800
1900
2000
Year
Height

TABLE 2. CRUDE DEATH RATES BY SEX. NEW YORK STATE, 1825-1900.

	NEW YORK STATE			NEW YORK STATE LESS NEW YORK CITY (a)			NEW YORK CITY(b)		TOTAL(ii)/
YEAR	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	TOTAL(i)	TOTAL(ii)	TOTAL(i)
1825	15.22	12.63	13.95	14.15	12.43	13.21	19.50	27.98	1.435
1835	15.86	14.26	15.07	14.66	13.51	14.09	21.94	31.26	1.425
1845	14.28	13.58	13.93	13.49	13.37	13.43	16.95	25.79	1.522
1850	15.59	13.83	14.72	13.71	12.39	13.06	23.05	39.88	1.730
1855	14.46	12.26	13.36	13.10	11.76	12.44	17.50	43.53	2.487
1860	13.00	11.20	12.10						
1865	10.56	8.82	9.67	10.57	9.19	9.87	8.83	35.01	3.965
1870	16.98	14.58	15.77						
1875	12.43	10.52	11.46	12.08	10.73	11.40	11.69	28.68	2.453
1880	18.34	16.44	17.38	15.59	14.21	14.89	25.37	25.93	1.022
1890	21.94	19.14	20.53	18.78	16.80	17.79	28.63	27.97	0.977
1900	18.99	16.86	17.92	17.58	16.00	16.78	21.26	22.60	1.063

SOURCE: Federal and state censuses. Data through 1890 are from the census question on deaths in the year prior to the census date. Total (ii) for New York City is based on vital statistics, as are Total (i) for New York City for 1880 and all results for 1890 and 1900.

(a) Population of New York State less New York County (New York City).

(b) Total (i) from census reports. Total (ii) based on vital statistics.

Figure 2

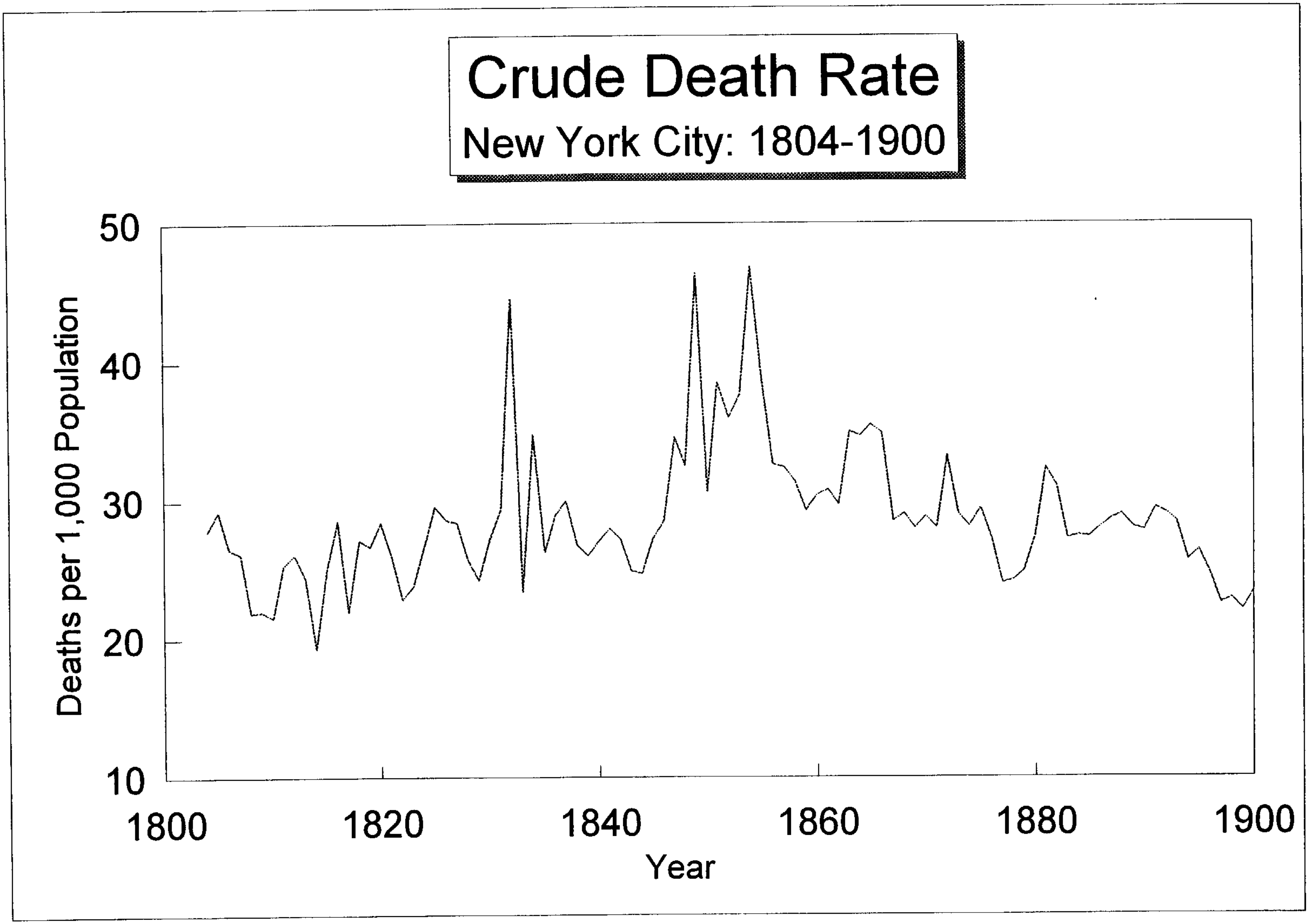

Crude Death Rate
New York City: 1804-1900
Deaths per 1,000 Population
50
40
30
20
10
1800
1820
1840
1860
1880
1900
Year

Figure 3

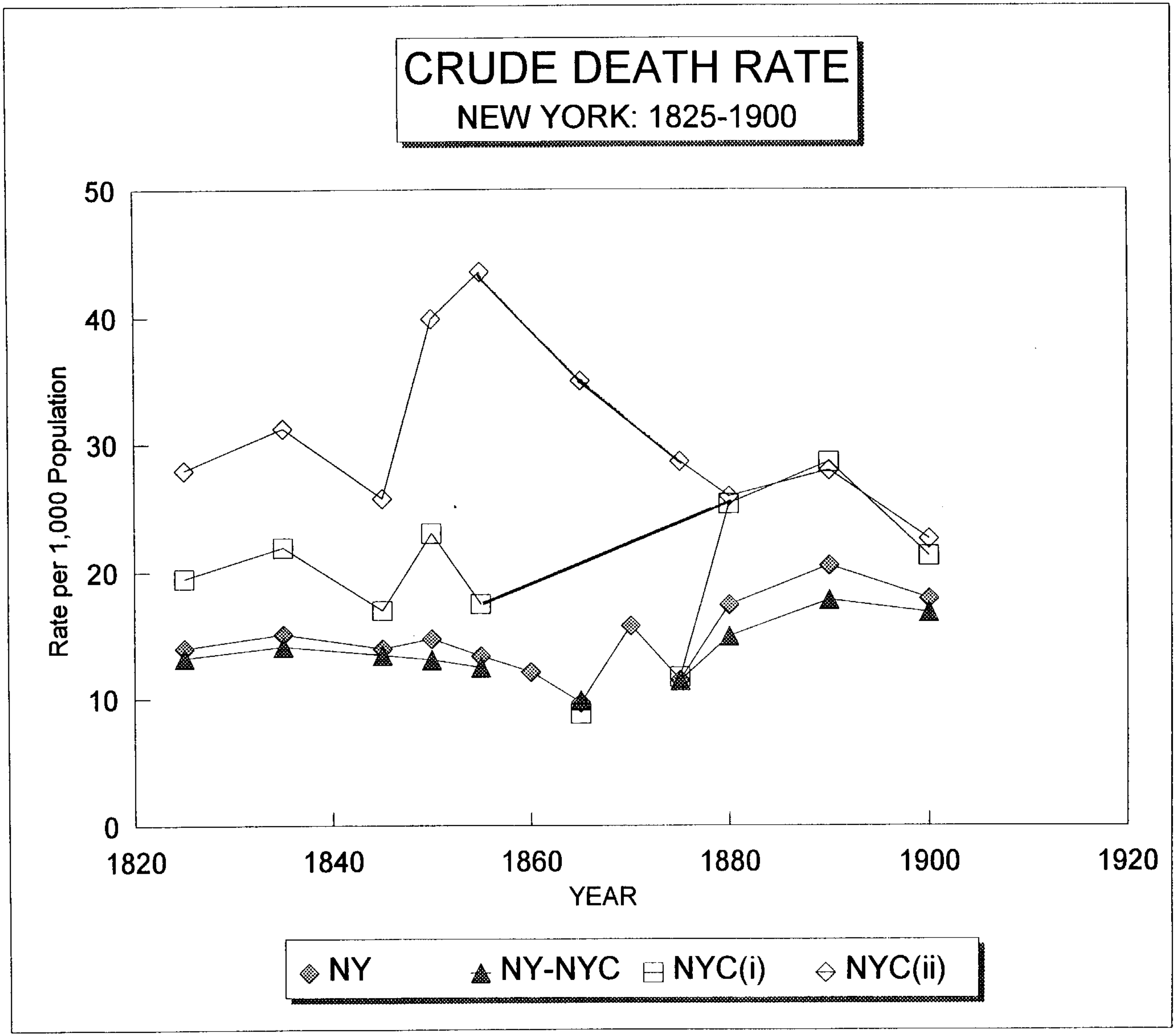

CRUDE DEATH RATE
NEW YORK: 1825-1900
Rate per 1,000 Population
0
10
20
30
40
50
1820
1840
1860
1880
1900
1920
YEAR
NY
NY-NYC
NYC(i)
NYC(ii)

Figure 4

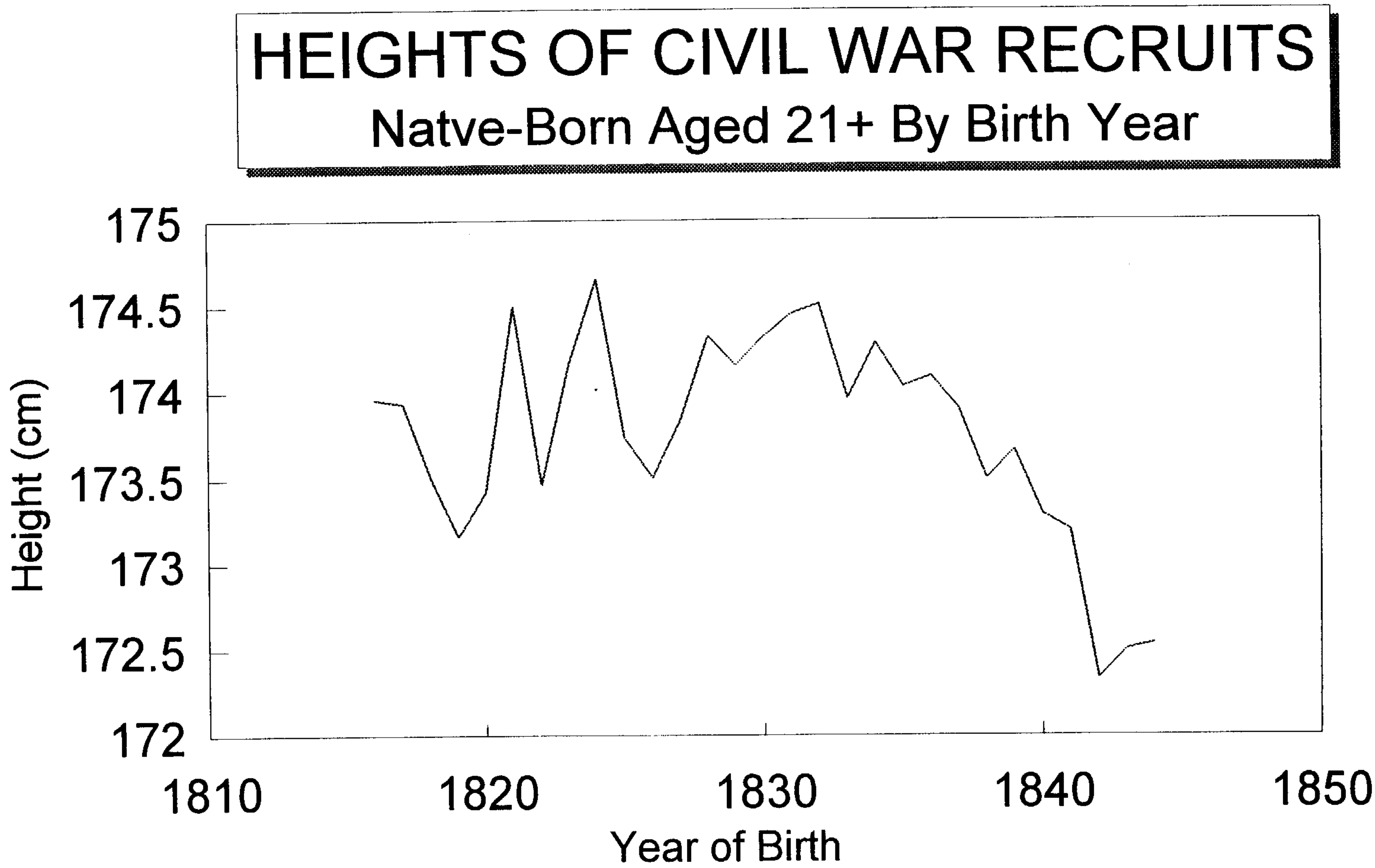
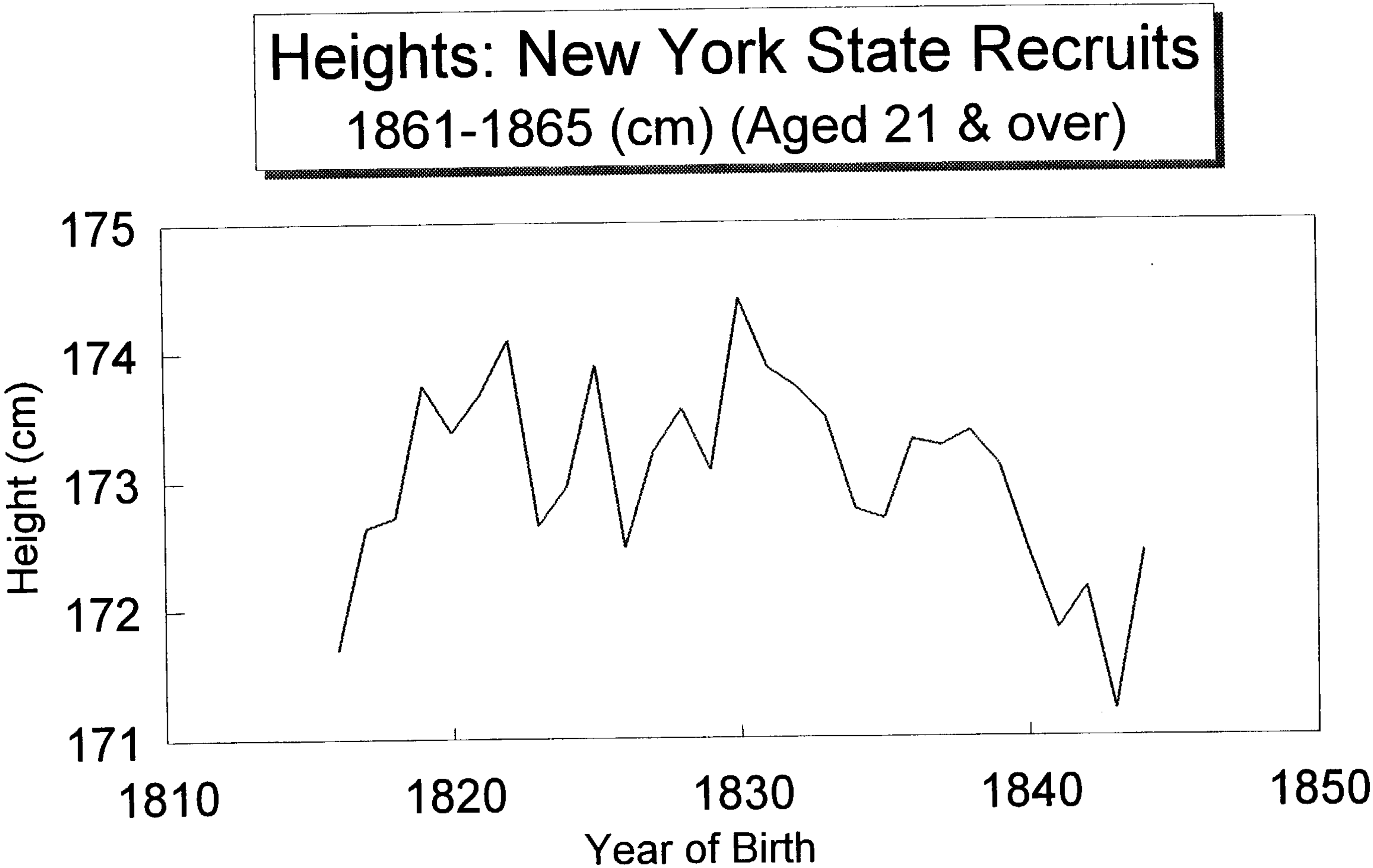

HEIGHTS OF CIVIL WAR RECRUITS
Natve-Born Aged 21+ By Birth Year
175
174.5
174
173.5
173
172.5
172
Height (cm)
1810
1820
1830
1840
1850
Year of Birth

Figure 5


Heights: New York State Recruits
1861-1865 (cm) (Aged 21 & over)
Height (cm)
175
174
173
172
171
1810
1820
1830
1840
1850
Year of Birth