July 2008

Reassessing the Standard of Living in the Soviet Union: An Analysis Using Archival and Anthropometric Data

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Abstract: Both Western and Soviet estimates of GNP growth in the USSR indicate that GNP per capita grew in every decade, sometimes rapidly, from 1928 to 1985. While this measure suggests that the standard of living improved in the USSR throughout this period, it is unclear whether this economic growth translated into improved well-being for the population as a whole. This paper uses previously unpublished archival data on infant mortality and anthropometric studies of children conducted across the Soviet Union to reassess the standard of living in the USSR using these alternative measures of well-being. In the prewar period these data indicate a population extremely small in stature and sensitive to the political and economic upheavals visited upon the country by Soviet leaders and outside forces. Remarkably large and rapid improvements in child height, adult stature and infant mortality were recorded from approximately 1945 to 1970. While this period of physical growth was followed by stagnation in heights and an increase in adult male mortality, the physical growth record of the Soviet population compares favorably with that of other European countries at a similar level of development in this period.

*I thank David Canning, John Gibson, Mark Harrison, Derek Jones, John Komlos, Robert Margo, Lara Shore-Sheppard, Andrei Shleifer and participants at the Harvard Economic History Workshop, the Williams Economics Department seminar, the WDI/CEPR Conference on Transition Economics in Riga, Latvia, and three anonymous referees for helpful comments and suggestions. Research for this paper was supported in part by a grant from the International Research & Exchanges Board (IREX) with funds provided through the John J. and Nancy Lee Roberts Fellowship Program. None of these organizations or individuals is responsible for the views expressed in this paper.

Despite the obvious and ultimately fatal shortcomings of the Soviet system of central planning, the Soviet growth model nevertheless achieved impressive rates of economic growth and promoted the rapid industrialization of the USSR, particularly in the decades from the 1930s to the 1960s. Both Western and Soviet estimates of GNP growth in the Soviet Union indicate that GNP per capita grew in every decade in the postwar era, at times far surpassing the growth rates of the developed western economies. By this measure – and according to the propaganda spread by Soviet promoters – the standard of living in the country rose concurrently with rising GNP per capita. Yet due to the highly restricted publication of data and the questionable quality of the data that were published, much remains unknown about the standard of living in the Soviet Union. Some trends, such as the decline in male life expectancy that began in 1965, suggest a deterioration of living standards; however this decline itself remains a puzzle, and little additional evidence has been available to assess other aspects of living standards in the USSR in the prewar or postwar periods. The question of whether the standard of living rose or fell in the Soviet Union during industrialization and in the postwar period is important, as our judgment of the Soviet growth model must rest not only on the rates of economic growth it achieved, but also on whether this growth translated into improved well-being for the population as a whole.

This paper reassesses the standard of living in the Soviet Union using a number of previously unexploited data sources. The focus is on alternative measures of well-being, in particular child and adult heights and infant mortality, each of which directly measures the well-being of a population in terms of nutrition and health status. These biological indicators are a useful supplement to traditional measures of living standards, such as real income or wages, because the latter may be misleading if measured incorrectly and in any case can only measure the means by which the good health and nutrition of a population can be achieved. In addition, it

is important to examine alternative measures of well-being in the Soviet Union because GNP and other economic data were of unusually poor quality and reliability in that country.

The data used in this paper comprise previously unpublished data on infant mortality across Russia's regions from 1956 to 1979, collected from the Soviet archives, and the results of anthropometric studies of children and adolescents conducted across the Soviet Union from the 1920s to the early 1990s. These data are supplemented by a study of trends in adult heights by year of birth which provides a window on living conditions in the early childhood years of each cohort. These data paint a picture of a society far behind other developed countries in the health status of its population in the prewar period. For example, in Moscow and St. Petersburg average child heights reached no more than the 20th percentile of U.S. child growth prior to World War II. But substantial and rapid improvements in child stature were recorded in subsequent years, and by the late 1960s average child height in some regions reached the 50th percentile of U.S. child growth. A period of stagnation followed, marked by a large and growing infant and adult mortality gap with western countries and by stable or declining child heights. Nevertheless the physical growth record of the Soviet population in the twentieth century remains impressive, particularly because it occurred across all regions of the Soviet Union, including the less developed republics of Central Asia.

The paper proceeds as follows. Section I presents a brief overview of the estimates of economic growth and consumption in the Soviet Union. Section II describes the new data sources used in the paper; Section III discusses the use of anthropometric data as an alternative measure of living standards and analyzes the data on child and adult heights. Section IV examines the trends in infant mortality in this period, Section V tests several hypotheses regarding the causes of changes in height and infant mortality, and Section VI concludes.

I. Previous assessments of economic growth and well-being in the USSR

Economic growth in the Soviet Union was the subject of intense scrutiny for many years by the CIA and western Sovietologists, in part due to the importance of the issue for U.S. national security interests, but also due to the extraordinary effort required to make Soviet economic statistics comparable to U.S. measures and to correct for the deficiencies in the data published by TsSU, the Soviet statistical agency. These deficiencies are well-documented[1] and include incentives to over-report output to fulfill plan targets, the USSR's exclusion of services and interest on capital from its national income accounts, and selective publication of data, in which data considered to be embarrassing were suppressed or definitions changed to suit the purposes of propaganda. The poor quality and questionable reliability of Soviet economic data means that a high degree of uncertainty surrounds the estimates of GNP growth in the country, and underscores the importance of examining alternative measures of well-being.

Keeping these data-quality caveats in mind, the growth record of the Soviet Union is impressive: according to CIA estimates, the annual rate of GNP growth over the 1928 - 1985 period was 4.3 percent (Fischer 1994). Comparing the Soviet growth record with that of the OECD and the United States, the annual average growth rate of GNP per capita in the Soviet Union equaled that of the OECD for the 1950-1980 period and exceeded that of the U.S. by a significant amount, at 3.3 versus 1.9 percent, respectively, from 1950 through 1980 (Table 1). In the last decade of the period, 1970 - 1980, GNP growth per capita was roughly similar in all three regions, averaging about 2 percent annually over those years.[2] While it is clear that Soviet

[1]See Ofer (1987) and Fischer (1994) for more detailed discussions of these problems.

[2]The sources of the slowdown in economic growth in the USSR remain a topic of debate among scholars, with deteriorating productivity growth and poor investment decisions likely the most important contributing factors. See the discussion in Ofer (1987), Easterly and Fischer (1995), and Allen (2001).

growth rates declined after the 1950s, the Soviet growth record in the postwar period nevertheless compares reasonably well with that of the developed market economies.[3]

Household consumption data also support the picture of rising living standards throughout this period; the growth in per capita household consumption met or exceeded the growth rates of household consumption in the OECD and the United States over the entire 1950 - 1980 period (Table 1), as Soviet leaders allowed consumption to grow relatively rapidly until the early 1980s. According to Gur Ofer, this created a "radical change in the quality of life in the Soviet Union" (Ofer 1987, p. 1790), with an increased variety and quality of goods leading to significant improvements in the standard of living. This progress was further enhanced by the massive expansion of the public health care system and educational facilities across the country, with the vast majority of these services provided for free by the government.[4]

While the consumption growth record seems clear, it should be kept in mind that this growth took place in the context of a relatively low initial level of consumption, particularly in comparison with the U.S. and the OECD. As a result, even with rapid growth the absolute level of household consumption remained well below that of the United States throughout the postwar period. Estimates vary widely, but per capita consumption in the USSR likely reached no more than one-third that of the United States in the mid-1970s, and probably declined in subsequent years (see, for example, Schroeder and Edwards (1981), Birman (1983), and Bergson (1991)). Most investigators made herculean efforts to correct Soviet consumption measures for the

[3]See Allen (2003) for a reassessment of Soviet growth performance from 1928 to 1940. Harrison (2003) and Rosefielde (2003) provide further debate on the postwar growth record, and Khanin (2003) focuses on the high-growth decade of the 1950s. Ofer (2005) provides an overview of the new estimates of Soviet growth and the continuing debate among scholars over Soviet growth performance.

[4]Chernichovsky et al. (1996) and Tulchinsky and Varavikova (1996) provide useful overviews of the development of the public health service in the USSR.

important sources of bias – the persistent shortages of consumer goods, the cost of time spent in search, and the poor quality of goods – but it remains likely that the actual level of consumption was even lower than the estimates given here, and the figures remain controversial.

The lack of reliable information on Soviet consumption underscores the benefits of examining alternative indicators of well-being in the USSR, such as anthropometric evidence and mortality, which are more objective measures of well-being than economic growth or consumption, and which are not subject to the data problems inherent in the conventional measures of living standards. Because the Soviet statistical agency ceased publication of infant mortality rates and other demographic data in 1974, these indicators of living standards were unavailable to researchers until the mid-1980s when publication of a limited amount of mortality data resumed. These data revealed that male life expectancy had begun to decline in 1965 and that infant mortality rates started to rise in 1971, both nearly unprecedented developments in industrialized countries and both signals that, despite the continuous improvements in economic growth and consumption in the USSR in the postwar period, a significant deterioration in the health of some groups in the population was underway.

II. New data sources

The opening of the Soviet archives has provided researchers with new opportunities for investigating all aspects of life in the Soviet Union, including changes in health status, mortality, and the standard of living more broadly across the country.[5] The two archives in which the mortality and economic data are housed are the GARF archive (*Gosurdarstvennyi arkhiv*

[5]See Gregory and Harrison (2005) for a comprehensive survey of the new findings on the Soviet economic system that have emerged from archival research.

Rossiiskoi Federatsii (State Archive of the Russian Federation)) and the RGAE archive (*Rossiiskii gosudarstvennyi arkhiv ekonomiki* (Russian State Archive of the Economy)), both in Moscow. The infant mortality data in the archives are tabulated on standardized reporting forms and include data on births, stillbirths, and infant deaths (under 1 year) for urban and rural areas by region (*oblast*') of the Russian Soviet Federal Socialist Republic (RSFSR). Most of the data are hand-written onto the forms and are enumerated simply as the total number of births or deaths in each category. Almost without exception the number of births and infant deaths by region add up to the RSFSR total in the archives and also agree with the published aggregates, indicating that systematic misreporting of deaths did not occur at this level.[6] Births and infant deaths by oblast were collected for 1956 through 1979 from the archives and were used to calculate infant mortality rates (total number of deaths divided by total live births) by region in those years. These data are supplemented by archival data on average monthly wages and published data on health system capacity, urbanization, food consumption, crude birth rates and education levels. Data sources are detailed in Appendix 1.

The anthropometric data used in the paper are the average heights of children and adolescents collected by researchers across the Soviet Union in studies initiated in the 1920s and continuing through the present day. Many of these studies were published in a series of volumes under the auspices of the Semashko Institute of Public Hygiene in Moscow, itself the base of many leading researchers in child anthropometry in the Soviet Union and in Russia today; these volumes (Semashko Institute 1962, 1965, 1977, 1988, 1998) constitute the primary source of the child growth data used in this paper. Most of the studies were conducted in schools by trained

[6]The specific location of each data series by *fond, opis* and *delo* is given in Appendix 1. Infant mortality data for 1969, 1974, and 1976 - 1978 are not in the archives. Other problems with Soviet infant mortality data are discussed in section IV below.

researchers according to a standard methodology;[7] researchers in each region measured at least 100 children of each sex at each age for height and weight. The Semashko data are supplemented by other anthropometric surveys of children in the USSR conducted in schools by researchers and published in Soviet public health journals such as *Sovietskoye zdravookhraneniye* (*Soviet Public Health*) and *Zdravookhraneniye Rossiiskoi Federatsii* (*Public Health in the Russian Federation*); these sources are listed in Appendix 1. The data in these studies appear to be comparable to the Semashko data in terms of methodology, particularly in the standards used for measurement of children. All studies give the average height attained at each age in centimeters; most also give the number of observations in each age group and the standard deviation of average heights. To enable comparisons across ages of children, the average height data have been converted into percentiles of U.S. growth standards. These percentiles were calculated by Richard Steckel (1996) and are derived from the standard U.S. growth charts which are based on nationally representative surveys of well-nourished children in the United States taken in the 1960s and early 1970s.[8] While there is no *a-priori* reason for use of U.S. heights as the standard of comparison, historians have preferred this standard since (as discussed in Steckel 1996) it is based on large samples of a healthy, genetically diverse population. Moreover, these growth charts have been widely used as a standard for evaluating

[7]The methodology is described as follows: "The body length is measured with the child standing with his back to a metal anthropometer, standing in a naturally upright position with hands lowered alongside the body, heels together and toes apart. The child's body should touch the rod at three points: heels, buttocks, and the area between the shoulder blades. The age of the child is determined by birth certificates and by the date of the exam (Seglenietse 1973)."

[8]See U.S. Department of Health, Education and Welfare (1976) for a description of the surveys and methodology for constructing the growth charts. While a new set of growth charts was issued in 2000, this paper uses the earlier growth charts since the period in which they were developed is comparable to that under study in this paper. Note that heights of a well-nourished population are approximately normally distributed (Steckel 1996), so that mean heights at the 50th percentile imply that the population under study has reached the U.S. level.

child growth in many countries, so their use in this context enables one to put the Soviet physical growth record into international perspective.

The Soviet anthropometric data provide a large, relatively untapped resource for examining the biological standard of living across the regions of the Soviet Union. One should recognize, however, that these data are potentially flawed for a number of reasons. First, the data are not representative of the RSFSR or the USSR as a whole. Second, given the long period of time over which these studies have been conducted and the hundreds of researchers involved in these studies, it is unlikely that each study followed the measurement guidelines noted above, possibly resulting in inconsistencies and measurement error in the height reporting. Finally, it is likely that the height data overestimate the average stature of children in the Soviet Union. Researchers sometimes excluded children with "defects," chronic illnesses, or who appeared to be poorly nourished, and this practice was openly acknowledged in the methodological notes (see Sukharev et al. 1965 for an example). In addition, better-off (and therefore taller) children were more likely to go to school and be included in these studies. This is less of an issue in the postwar period as schooling became compulsory in 1958, but may bias the height estimates for the prewar period. To minimize this effect, this study focuses on the heights of urban boys, who had the highest school attendance rates in the prewar period.[9]

The child height data are supplemented with data on adult heights in Russia from the Russian Longitudinal Monitoring Survey (RLMS) and on female adult heights in Armenia, Kazakhstan, the Kyrgyz Republic, Moldova and Uzbekistan from the Demographic and Health

[9]For example, an education census of 1911 found that 60 percent of boys of primary school age were in school on the day of the census, compared with 29 percent of girls; for urban areas these figures were 75 percent and 59 percent, respectively (Dunstan 1997, p. 10).

Surveys.[10] For comparison, data on the heights of adults in southern Europe (Greece, Spain and Italy) are included in the analysis; these data are from Garcia and Quintana-Domeque (2007).

III. Trends in child and adult heights in the Soviet Union

The anthropometric data are used to evaluate the health and nutritional status of the Soviet population over the course of the twentieth century, and, more broadly, to assess the standard of living across regions and in the country as a whole. This use of anthropometric data draws on the pioneering work of researchers such as Robert Fogel and Richard Steckel, which has demonstrated that anthropometric data can provide a wealth of information on the living standards of the past and present, and can be particularly useful when data on traditional measures such as GNP are absent or of questionable quality (Fogel 1986, 1991, 1994; Steckel 1979a, 1979b).[11]

Stature as a measure of living standards has several advantages over more conventional measures. It is a measure of net nutrition in the sense that it takes into account not only the inputs to health – nutrition, health care – but the demands placed on an individual's biological system as well, such as through disease and work intensity in the growing years. Even a mild illness during the growing years will tend to slow growth, and although catch-up growth is possible it will depend on the availability of sufficient caloric and nutrient intake to enable such growth. Child height has an advantage as an indicator of welfare over adult height because child height is sensitive to environmental insults, especially in the years of rapid growth (infancy and

[10]A detailed description of the sampling design and implementation of the RLMS, as well as data access, is available at the RLMS website at http://www.cpc.unc.edu/rlms. The Demographic and Health Surveys are available at http://www.measuredhs.com. The surveys used here are Armenia 2000 and 2005, Kazakhstan 1995 and 1999, Kyrgyz Republic 1997, Moldova 2005, and Uzbekistan 1996.

[11]See Steckel (1995) for a survey of research in this area.

the adolescent years, i.e. age 10 to 14). Indeed it appears that adult height is largely determined by age 3 to 4, and is affected even by nutritional inputs during the fetal growth period (Bogin 1999). While genetic influences in part determine individual height, at the population level nearly all differences in average height are the result of environmental influences, enabling one to compare stature across countries and over time. In other words, well-nourished populations tend to follow the same growth curves, whether the population is European, African, or North American in origin (Martorell and Habicht 1986). Because of the comparability of heights across populations and over time, and due to the clear link between height and nutritional status, stature is viewed as a useful index of the biological standard of living. A further advantage of anthropometric indicators is that they take into account that some economic activity is non-monetized and therefore unmeasured by conventional indicators of living standards. This is particularly beneficial for the Soviet Union, because, as is well-known, increasing shares of economic activity took place in the "second economy" of the USSR as macroeconomic imbalances intensified in the 1970s and 1980s.

Child height in the prewar period and during World War II

The child height data are presented in a series of graphs beginning with Figures 1 through 3b. The city with the most abundant child height data is Moscow; children in Moscow were likely to be the most well-nourished in the Soviet Union with access to the best health care in the country. The average height in centimeters by year of birth of 8-, 10-, 12-, and 14-year old boys in Moscow is shown in Figure 1; these same data converted into percentiles of U.S. growth standards are shown in Figure 2. Figure 2 illustrates that in the prewar period Moscow boys were remarkably short in stature, and their growth trajectories were sensitive to some of the

cataclysmic events experienced in Russia and the Soviet Union in the twentieth century.[12] Between the Revolution of 1905, the October Revolution, World War I and the Civil War (1914 - 1921), children in Moscow reached only the 1st to 5th percentile on U.S. growth charts. These extremely low measures of the stature of children suggest that net nutrition was inadequate to support childhood and adolescent growth during this period, which is consistent with the conclusion of historians that the average Russian diet deteriorated in both quality and quantity in the first two decades of the twentieth century (Mironov 1995; Wheatcroft 1999).

Similar conditions characterized other cities of the Russian republic and the Soviet Union: in St. Petersburg, Nizhni Novgorod and Penza (Russia), Kiev and Kharkov (Ukraine), and Minsk (Belarus), children on average achieved no more than the 7th percentile of growth and in some cases much less in the pre-1925 period (Figures 3a and 3b). These low heights are corroborated by several other sources of stature information for children and adult men born in the early years of the twentieth century; these other indicators are shown in Table 2. For example, the average stature of male military recruits born in 1906 - 1910 was 167.5 cm (Mironov 1999), which is roughly the 8th percentile of the height standard for 18-year-old boys. The average terminal height of Russian men born in 1898 was approximately 166 cm (Wheatcroft 1999[13]); men in the United States had reached a height of 172.1 cm by 1910 (Costa and Steckel 1997). Czech children reached similarly low growth percentiles: based on an 1895 survey of approximately 100,000 children in the Czech region, 7-year-old boys attained an

[12]Data on the heights of girls indicate a nearly identical trend (not shown). The raw data underlying Figures 1 and 2 for boys and girls are given in Appendix Table 1, along with data for other cities in the USSR. All child height data used in the paper are available at the author's website at www.williams.edu/Economics/faculty/brainerd.shtml [*to be posted*].

[13]These data are based on relatively large surveys of individual height and size conducted by the Soviet clothing industry (see Wheatcroft 1999).

average height of only 114 cm, roughly the 3rd percentile of U.S. growth charts, and 14-year-old boys (146 cm) were at the 1st percentile (Vignerová et al. 2006).

Returning to the child height data, it is of interest to examine child height and well-being during the significant and often cataclysmic events that occurred in the Soviet Union during the twentieth century, particularly the New Economic Policy (NEP) (1921-1928), the period of rapid industrialization (1929-1940), the famine of 1932-1933, and World War II. Data spanning the years of NEP and rapid industrialization are very limited, however, with data available for only Moscow, St. Petersburg, and Kharkov; given the paucity of data one should not regard the conclusions drawn here as definitive. These data are illustrated in Figure 4, which graphs the average height in centimeters of boys by age and year of birth in each city. The trends in Moscow and St. Petersburg indicate that the 1920s were a period of improving child health. For example, 10-year-old boys born in Moscow in 1915 attained an average height of 128 cm, while 10-year-old boys born in 1929 attained an average height of 132 cm. A similar trend is evident in St. Petersburg. This increase in stature is likely attributable to the turbulent conditions of World War I, the 1917 Revolution and subsequent civil war, which likely depressed child heights, and the relative prosperity of the 1920s. Child growth appears to have stagnated in the early years of industrialization in the 1930s, however. In Moscow and Kharkov, the average stature of boys born in the late 1930s was nearly identical to that of boys born ten to twenty years earlier. This experience of stagnant (or declining) physical growth during early industrialization also occurred in the United States and England (Steckel and Floud 1997). As noted in Steckel (2008), while industrialization may have improved the material standard of living, it was accompanied by conditions deleterious to health, such as pollution and crowding. These historical episodes underscore that, while height and national income are often positively correlated, the relationship

is inconsistent, and the possible lags between income growth and stature gains are poorly understood.[14]

The 1930s also encompass the 1932-33 famine, one of the great famines of the twentieth century. The degree to which the famine was a deliberate policy of the Soviet regime or the result of forced collectivization and poor grain harvests is controversial,[15] but there is universal agreement that the famine was severe and extremely costly. New estimates based on painstaking archival research put the population losses due to the famine at 2.6 million people out of a population of approximately 34 million in Ukraine prior to the famine (Vallin et al. 2002). While the famine is most closely associated with Ukraine, it also struck the southern regions of the Russian republic (particularly the lower Volga and North Caucuses regions), Moldova and Kazakhstan. Urban areas were generally less affected than rural areas due to a rationing system that had been implemented in 1928-29 (Livi-Bacci 1993).

Because the famine was intense but brief, one can only assess its effect on child height by analyzing the results of single surveys of heights that span children born immediately before, during and after the famine. This type of data is available for eight regions, two of which were in the regions most affected by the famine: Rostov-on-Don in the North Caucuses and Kharkov, Ukraine. These data are illustrated in Figure 5. As an example of how to read the information provided in Figure 5, the upper left graph shows the height percentiles of boys age 11 to 17 from a survey taken in Murmansk city schools in 1947; these children were born between 1930 and 1936. In most of the regions shown in Figure 5 there was a significant decline in the child height

[14]See Deaton (2007) for further discussion of this point.

[15]See, for example, Davies and Wheatcroft (2004, 2006), Ellman (2005) and Tauger (2006). A discussion of the 1932-33 famine and its place in famine history is given in Ó Gráda (2007). The classic book on the famine is Conquest (1986).

percentiles for children born during the famine years as well as in 1934, when infants would have been *in utero* during the famine. This is consistent with recent findings on the 1959-61 famine in China which indicate that individuals born during the famine attained an adult height approximately 3 cm less than they would have in the absence of the famine (Chen and Zhou 2007). The remarkably short stature of adolescent boys in Kharkov shown in Figure 5 is also noteworthy. Since no information is provided in the source on the number of boys surveyed it is difficult to assess the reliability of the data, but the boys in this age group not only suffered through the 1932-1933 famine in infancy, but their adolescent growth spurt years occurred during the occupation of Ukraine in World War II (1941-1943) which may have eliminated any possibility of catch-up growth for this cohort.

The difficult decade of the 1930s was followed by the invasion of the Soviet Union by Nazi Germany on June 22, 1941. World War II exacted a devastating toll on the Soviet Union: besides the massive losses of population, estimated at 26 to 27 million excess deaths or 13.5 percent of the prewar population (Andreev et al. 1990), the population that survived endured horrific conditions including disease, severe rationing and malnourishment, and dislocation. This toll was distributed unevenly across the country, with the eastern regions suffering the most devastation during the Nazi invasion and occupation. One would expect these conditions to be reflected in lower child stature for children born during the war years, but this is not universally the case. In Moscow in particular, among boys born during the war and surveyed in 1950 (ages 7 - 11), average height increased from the 12^{th} to the 22^{nd} percentile between 1941 and 1943 (Figure 6); a similar increase in relative height occurred for Moscow girls age 15 - 17 (not shown). This is surprising given that rationing was implemented in 1941 and that the average daily number of calories consumed by the urban population fell from 3,370 to 2,810 between

1940 and 1944, reaching a trough at 2,555 calories in 1942.[16] A possible explanation for the increase in child height in Moscow during the war is that rationing led to a more equal distribution of calories across the population, reducing the incidence of malnourishment and stunting during the war years.[17] It is also possible that shorter and weaker children died during the war, so that average heights increased, or that child heights increased after the war due to 'catch-up' growth when food supplies improved. One should note that the experience of increasing child stature during World War II was not unique to Moscow; child height increased in most regions in England and Wales during World War II as well (Floud and Harris 1997).

Children living in cities other than Moscow, however, generally experienced a stagnation or decline in relative heights during the war years. As illustrated in Figure 6 for selected cities, children born in 1942 or 1943 were generally shorter than children born just before or just after the war. Average heights of children in occupied regions appear more sensitive than those in unoccupied regions, with some regions such as Rostov-on-Don and Vilnius recording a significant decline in average heights in the war years. As reported in Moskoff (1990), food rations in the occupied cities were inadequate: for example in Tallinn, Estonia, the basic daily ration in early 1942 provided 877 calories. Given the hardship conditions in the occupied regions one might have expected child heights to decline more, but it should be kept in mind that the children in these cities were surveyed after the war, and may have been evacuated from these cities during the war itself.

The final city to examine is St. Petersburg (then Leningrad). The scale of suffering in this city during the war is perhaps unmatched in modern history, with an estimated 750,000 civilians

[16]Chernyavskii (1964), p. 179, cited in Barber and Harrison (1991), p. 79.

[17]Sen (1998) discusses improved access to food and health care as an explanation for the increase in life expectancy in England and Wales during the war decades of 1911-1921 and 1941-1951.

dying of starvation during the siege of Leningrad between 1941 and 1944; the death toll peaked at 500,000 people during the winter of 1941-1942. During the siege, in which Germany blockaded Leningrad and cut off all food supplies, rations fell to starvation levels: at their lowest, rations provided 707 calories per day for workers and 423 calories per day for dependents (Barber 2005). In January 1945 the Leningrad Bureau of Health Statistics conducted a survey of preschool children attending child care centers and kindergarten; the survey is noteworthy because it distinguished between children who lived in St. Petersburg throughout the blockade and those who were evacuated at some point during the blockade. A total of 3207 children were surveyed, of whom 1533 lived in St. Petersburg throughout the entire blockade. The results of this survey were published in Shnitnikova (1963) along with results of other surveys of St. Petersburg children taken before and after the war; these data are reproduced in Table 3 with the average heights converted into percentiles. The extreme suffering embodied in these data is difficult to overstate. Boys who managed to survive the blockade reached the .4th percentile of height on average; boys who were evacuated fared little better, probably due to the starvation many evacuees were already suffering when evacuated.[18] Compared to the average 7-year-old boy in 1936, a 7-year-old boy who survived the siege of Leningrad was on average 7 cm shorter. The same is true for girls although on average the female height percentiles are slightly higher than those for boys.

Did St. Petersburg children recover from the extreme trauma suffered during the war? The evidence indicates that some 'catch up' growth did occur. A survey of St. Petersburg adolescents conducted in 1959 indicated that, for example, the average 17-year-old boy born in 1942 attained the 7th percentile of height (Semashko 1962), compared with the percentiles below

[18]See the description of the evacuation of Leningrad in Frolov (2005).

1 attained by this birth cohort in 1945 shown in Table 3. And, as indicated in the last column of Table 3, St. Petersburg children born in the early 1950s attained approximately the 20th percentile of height on average.

Child and adult height in the postwar period

It is following World War II that a remarkably rapid and sizable increase in the stature of Soviet children occurred. From approximately 1945 to 1969, the average height of children increased from (roughly) the 10th to the 40th percentile of U.S. growth charts. These large gains in stature occurred across all of the Soviet republics for which data are available (Figure 3b), and also characterized the growth of children in many cities of the Russian republic (Figures 3a and 7). Rural children grew dramatically during this period as well, but the rate of increase was slower and the average percentile attained was lower than that of urban children (not shown).

This rapid increase in the stature of children appeared to slow or possibly regress slightly in the early 1970s. For example, while 13-year-old boys in Moscow had increased in stature from the 15th to the 36th percentile between 1945 and 1956 (by year of birth), by 1978 they had fallen to the 27th percentile. As is evident from Figure 7, several other cities across the RSFSR recorded a stagnation or slowdown in the rate of increase in child heights in this period, including Orel, Perm, Ulyanovsk, and Novosibirsk. Soviet researchers themselves commented on this break in the trend of previous decades, even observing that in some regions the change in average child stature had become negative (Maksimova and Yanina 1988). Note that there is no reason that the stature of well-nourished children could not exceed the 50th percentile of U.S. growth charts: the average adult stature of the U.S. population began to lag behind that of many developed countries in the postwar period and is now 3 - 7 cm below that of countries such as

Germany, Sweden, Norway, the Netherlands, Denmark, and the United Kingdom (Komlos and Baur 2004).

The trends in child height in the postwar period are corroborated by a study of adult heights in Russia taken from the Russian Longitudinal Monitoring Survey. As noted above, adult height is largely determined in early childhood including the fetal period; like child stature adult stature also reflects the cumulative effects of nutrition and exposure to disease in early childhood. Figure 8 illustrates the trend in adult heights by exact date of birth and by sex over the 1945 - 1980 period.[19] This graph supports the evidence from child heights of significant gains in stature among individuals born from the late 1940s through the late 1960s; the increase in stature averaged about 1.8 cm per decade for men and 1.5 cm per decade for women between 1945 and 1970, which is comparable to or exceeds the average rates of increase in stature in countries at a similar level of development in the twentieth century (discussed below). By 1970 men in Russia reached an average height of nearly 177 cm, equal to that of U.S. men, and female height in Russia exceeded that of U.S. women by about one centimeter. The trends in Figure 8 also suggest a break in the secular increase in heights that begins around 1970, particularly for women.[20] The timing of this change in trend is the same as the timing of the stagnation in child heights discussed above, and is nearly identical to the timing of the increase in infant mortality

[19]The samples used are for prime-age adults (age 21 - 50) and contain 5,184 observations for men and 5,449 observations for women. Individuals above age 50 are excluded due to the decline in stature that occurs above this age. The sample uses measured height by exact date of birth for Round 5 (1994) of the RLMS. The sample also includes new entrants to the surveys from rounds 6-13. Reported heights of less than 120 cm or more than 210 cm (2 observations) are excluded from the analysis. The graph illustrates locally weighted smoothing (or lowess) estimates of the relationship between stature and exact date of birth. Lowess is a nonparametric estimator that uses a small amount of data near the point in order to generate smoothed values of height. The procedure is described in Cleveland (1979).

[20]Mironov (2007) also reports an increase in female height for St. Petersburg women born between 1956 and 1972, followed by a slight decline for women born from 1973 through 1985, based on the records of over 15,000 women giving birth in St. Petersburg hospitals between 1980 and 2005.

rates in the Soviet Union (discussed below). As a whole these biological data corroborate the slowdown in GNP and consumption growth in the 1970s discussed earlier; ironically this period in Soviet history is known as *"period zastoya,"* or the period of stagnation, which appears to relate to both economic and physical measures of well-being.

Given the Soviet Union's proclaimed commitment to equality, it is of interest to examine how the gains in health status reflected in the increase in stature were distributed across the population. To investigate this issue, Figure 9 illustrates the results of regressions of individual height on exact date of birth by percentile of the height distribution, converted into annual rates of growth. The figure indicates that the increase in height between 1945 and 1980 was remarkably evenly distributed across the population, with men and women at the 10^{th} percentile of the height distribution gaining approximately .10 cm annually over this period, compared with .13 cm and .11 cm for men and women, respectively, at the 90^{th} percentile. The only notable increase in height inequality occurs above the 97^{th} percentile for men, where gains in height far exceed those at lower percentiles. This may be due to sampling variation, or could reflect the privileged access to food enjoyed by a small strata of elites in the Soviet Union.

A second approach to examining inequality in growth is to assess the changes in stature across the Soviet republics: were the gains in stature distributed equally across the Soviet Union? The child height data presented previously suggest that this is the case, and this is largely corroborated by trends in female adult heights across the former republics. Figure 10 illustrates female heights by year of birth for women in the Soviet republics aged 21 to 49 and born between 1950 and 1980. These data are from the Demographic and Health Surveys and are constructed in a similar fashion to the RLMS data. While stature increased across all the republics for which data are available, both the levels and rates of increase in stature for all of the

republics except Moldova are well below those of the Russian republic. In Uzbekistan, Kazakhstan, the Kyrgyz Republic, and Armenia, the 1950s were a period of physical stagnation, and significant increases in stature only began in the 1960s. The data for most republics also suggest a slowdown in growth in the 1970s, although the data are insufficient to draw clear conclusions on the post-1970 period in these regions.

Table 4 summarizes the adult height data and compares it with that of several European countries which were at a similar level of development to the Soviet Union in 1950.[21] Men in the Russian republic recorded gains in stature at the same rate as Greece, .09 percent per year, only slightly below the rates of growth experienced in Italy and Spain. As discussed in Garcia and Quintana-Domeque (2007), these southern European countries (along with Portugal) had the fastest growth rates of stature in Europe in the 1950 - 1980 period. Northern European countries like Finland and Sweden had annual growth rates of .02 and .03 percent, respectively, although the average heights in these countries remain several centimeters higher than those in the southern European countries. The growth rate of Russian women was slightly faster than that of women in Greece and Turkey, but below that of Russian men and below that of women in Spain and Italy. Overall the growth record appears impressive for Russian men when compared with other countries at a similar level of development, but less impressive for Russian women and for populations in some of the less developed republics of the Soviet Union.

To summarize, the evidence presented above indicates extremely small stature of Russian and Soviet children born in the prewar period; height stagnation or decline during industrialization, the 1932-33 famine and World War II; rapid growth in stature among

[21]In Maddison (2007), the European countries with GDP per capita closest to that of the USSR in 1950 ($2,841) included Greece ($1,915), Italy ($3,502), Spain ($2,189) and Turkey ($1,623).

individuals born in the late 1940s, 1950s and 1960s; and a slowdown or halting of growth for individuals born in the 1970s. These trends are consistent across many of the Soviet republics and Russian regions for which data are available. The substantial and rapid increases in height across most regions and birth cohorts in the USSR in the 1945-1969 period indicate that significant improvements likely occurred in the nutrition, sanitary practices, and public health infrastructure in the country in that period. The increase in heights occurred concurrently with the high economic growth rates of the 1950s and 1960s, but heights failed to increase during the high-growth years of 1929-1940 when the Soviet economy was transformed from a predominantly agricultural to an industrialized economy.

IV. Trends in infant mortality in the USSR

Infant mortality rates supplement the anthropometric data because they are a reasonably good proxy for low birth weight and have been widely used as a measure of the quality of life across countries, and are available across all of Russia's regions for most of the years between 1956 and 1979. Infant mortality rates in the Soviet Union have long attracted the attention of demographers and social scientists, particularly after 1986 when the Soviet statistical agency resumed publication of mortality data (see Anderson and Silver 1990), revealing a large increase in infant mortality rates in the Soviet Union beginning in the early 1970s.[22]

[22]This increase in infant mortality rates is controversial among demographers; some argue that it was an artefact of improved birth and death registration in the less developed regions of the USSR, while others argue that it was real and reflected deteriorating conditions in the public health infrastructure (see, for example, Davis and Feshbach (1980), Jones and Grupp (1983), Anderson and Silver (1986), and Velkoff and Miller (1995)). The archival data cannot resolve this issue, but they shed light on the controversy because they show the trends in infant mortality rates across all regions of Russia. If the increase in infant mortality rates was due only to improved registration of births and infant deaths, one would not expect infant mortality rates to have increased in the more developed regions of Russia which had achieved essentially complete vital event reporting decades earlier. The archival data indicate that infant mortality rates rose in many developed regions of the country, including Moscow which registered

Before the 1970s, however, the infant mortality rate in Russia fell rapidly: between 1940 and 1965 the infant mortality rate fell from over 200 to 26.6 per 1,000 births.[23] This period of significant decline in the infant mortality rate is nearly identical to the period of rapid increase in child heights and adult stature documented in the previous section, just as the period of rising infant mortality rates coincides with the slowdown in the rate of increase of average stature in the population. This period of rising infant mortality is illustrated in Figure 11, which shows urban and rural infant mortality rates for the Russian republic from 1960 to 1990. Infant mortality rates rose in both rural and urban areas between 1971 and 1976, and the entire decade of the 1970s saw virtually no improvement in infant mortality overall. Thus, this evidence also indicates that the health status and living conditions of infants and children in the Soviet Union improved dramatically from approximately 1940 to 1969, and stopped improving or began to deteriorate between 1970 and 1979.

V. What caused the improvement in population health status?

What caused the improvement in population health status in the Soviet Union? The improvement in infant and child health is likely related at least in part to the development of the

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a 14 percent increase in infant mortality between 1971 and 1975. The largest increase in infant mortality was registered in Khabarovskii Krai (in the Far East), at nearly 60 percent, followed by Altaiskii Krai in Western Siberia at almost 50 percent. However there is no obvious regional pattern in the increases in infant mortality rates, with large increases registered in such diverse regions as Moscow, Novgorod and Saratov, and improvements recorded in other areas such as Leningradskaya oblast and Tyumenskaya oblast (in Western Siberia).

[23]Note that Soviet infant mortality rates are not directly comparable to Western infant mortality rates, because the Soviet data exclude live-born infants of less than 28 weeks gestation, less than 1000 grams in weight, and less than 35 centimeters in length who die within 7 days of birth (which are included in the WHO-recommended definition of infant mortality). Anderson and Silver (1986) estimate that Soviet infant mortality rates would be 22 to 25 percent higher if the data were adjusted to include these deaths.

national health care system in the Soviet Union, which expanded significantly in this period and provided free health care in even the remotest regions of the country. While the Soviet health care system eventually earned a well-deserved reputation for poor quality and service, it was particularly effective at controlling infectious diseases which undoubtedly contributed to improved child health. The significant increase in female education levels in this period – the share of women with secondary or more education increased from 9.3 to 34.5 percent between 1939 and 1959 – likely also played a role in improving child health status. Other factors that may have contributed include urbanization, particularly the increase in the population with access to clean water and central heating, and the improvement in the caloric and nutrient content of the food supply.

Table 5 give the results of regressions exploring the relationship between some of these variables and infant mortality and adult height, respectively; means of the variables used in these regressions are given in Appendix Table 2. The left-hand panel of Table 5 shows the results of fixed effects regressions with the (log) infant mortality rate as the dependent variable across Russia's regions over the 1960 - 1990 period, in five-year intervals. All regressions include a time trend to account for the secular improvement in infant mortality over the period. The results indicate that the increase in education is related to falling infant mortality, although this effect is only significant for the population with secondary education. The increase in the capacity of the health care system, as proxied by the number of doctors per capita in each region, is negatively correlated with the decline in infant mortality between 1960 and 1990 but it is not statistically significant in all specifications. Urbanization has a weak negative relationship with infant mortality. The second column tests for a relationship between average monthly wages and infant mortality, but the coefficient is statistically insignificant. This may reflect that in an environment

of growing macroeconomic imbalances and shortages of basic food supplies, along with free health care and education, monetary resources may not have been the primary means of accessing an improved biological standard of living.[24]

The last column in this panel investigates whether alcohol consumption is related to infant mortality in this period.[25] Alcohol consumption nearly doubled between 1960 and 1970, rising from 4.6 liters per capita in 1960 to 8.3 liters in 1970, and peaked at 10.6 liters per capita in 1979 before falling in the mid-1980s due to Mikhail Gorbachev's anti-alcohol campaign. Recent research has shown that the anti-alcohol campaign was associated with significant improvements in child health in Russia (Balan-Cohen 2007), so the failure of child (and adult) health to improve in the 1970s may be related in part to rising alcohol consumption. The results in Table 5 imply a nonlinear relationship between regional infant mortality rates and alcohol consumption: at low levels of alcohol consumption the relationship is negative – possibly reflecting an income or wealth effect not captured in the wage variable – but at levels of alcohol consumption greater than 9.7 liters the relationship turns positive and is statistically significant. Given the data quality problems inherent in the alcohol consumption measure these results are not definitive, but are suggestive that alcohol consumption may have contributed to deteriorating population health in the Soviet Union in the 1970s. It is likely that other factors, such as increasing environmental degradation and the growing macroeconomic imbalances that led to

[24]A number of other variables were tested in these regressions but attracted insignificant coefficients. These variables include the number of hospitals per capita, average monthly income, the employment to population ratio, and the share of the population with running water and central heating (the latter for 1985 and 1990 only).

[25]The alcohol consumption data measure state alcohol sales per capita in liters of pure alcohol; these data are available only for selected regions in 1960 and are unavailable for 1965 and 1975. This alcohol consumption measure excludes home-produced alcohol (*samogon*) and therefore underestimates true alcohol consumption.

shortages of consumer goods (including medicines), contributed to the disappointing record of population health in this period; however data are unavailable to test these hypotheses.

A further test of the factors explaining the changes in population health status is to investigate the correlates of the stature of adults from the Russian Longitudinal Monitoring Survey. This survey asked respondents whether they currently live in the place they were born; for individuals who did not move, their adult height can be related to measures of urbanization, health system capacity, and so on for the region in which they were born in the year in which they were born. The results of these regressions are presented in the right-hand panel of Table 5.

The results are similar to those of the infant mortality regressions: (higher) education and the expansion of the health network (the latter for women only) are positively correlated with adult stature. Men born in regions with higher infant mortality rates also tend to be shorter on average, which is consistent with other studies showing a strong negative relationship between infant mortality rates and adult height across countries (Akachi and Canning 2007; Bozzoli et al. 2007). This relationship does not hold for women, however, suggesting that women are less sensitive to conditions in early life than are men. There is again no evidence of a relationship between regional wages or urbanization and health status in these regressions.

A final issue to explore regarding the improvement in infant and child health in the USSR is the role of increased food and nutrient supply. Unfortunately few data are available on the caloric or nutrient content of food by regions for this period, and data on food consumption is limited as well. Regarding the latter, data on per capita consumption of broad categories of food (e.g. meat, milk, eggs) are available by region for 1965, 1970, 1980 and 1990. Including any of these measures of food consumption in the regressions on infant mortality for these years shows little support for the hypothesis that food consumption (by this measure) mattered: all of the

coefficients on food are statistically insignificant. However, it is possible that improvements in the food and nutrient supply explain (in part) the earlier period of improvement in population health. Time-series evidence on available calories indicate that child height increased as calories increased, and that the relationship between changes in calories from animal sources and child growth is particularly strong. For example, available calories from animal sources increased from approximately 351 per capita in 1940 to 672 in 1965; over this period boys in Moscow increased in height from approximately the 10^{th} to the 35^{th} percentile on average. Unfortunately it is impossible to test this hypothesis more extensively given the limited data available, so any conclusions on the role of calories in the improvement in child health status are speculative.

Finally, it is of interest to note that the changes in life expectancy in Russia mirror the changes in infant and child health status discussed previously. Male and female life expectancy increased substantially between 1940 and the early 1960s (at least in part due to falling infant mortality); by 1965 female life expectancy nearly equaled that of U.S. women and male life expectancy fell below that of U.S. men by only 2.5 years. Around 1965, however, male life expectancy began to decline and female life expectancy failed to improve, resulting in a gap of nearly 8.5 years in life expectancy between Russian and U.S. men by 1980, and a gap of 4.3 years for women in that same year. The decline in male life expectancy was largest in the Russian republic, but a similar pattern of deterioration occurred in the other republics as well. The unfavorable trends in mortality and life expectancy in the Soviet Union in this period have long been known and, some have argued (e.g., Eberstadt 1993), should have been taken as the first signal that the impressive rates of economic growth in the USSR either were exaggerated or failed to translate into an improved standard of living for the population in the 1970s and 1980s.

VI. Conclusion

Did the standard of living rise or fall in the Soviet Union over the twentieth century? The conventional measures of GNP growth and household consumption indicate a long, uninterrupted upward climb in the Soviet standard of living from 1928 to 1985; even Western estimates of these measures support this view, albeit at a slower rate of growth than the Soviet measures. The alternative measures of well-being examined in this paper largely support the evidence of improving population welfare throughout much of the twentieth century, despite the many cataclysmic events that marked this period. Three different measures of population health show a consistent and large improvement between approximately 1945 and 1969: child height, adult height and infant mortality all improved significantly during this period. These three biological measures of the standard of living also corroborate the evidence of some deterioration in living conditions beginning around 1970, when infant and adult mortality were rising and child and adult height stopped increasing and in some regions began to decline. The gains in height in the postwar period occurred across many regions of the Soviet Union, although growth was most impressive for men in the Russian republic. The significant improvements in population well-being before 1970 may in part be related to the expansion of the national health care system, public education, and improved caloric and protein supply during this period. While the Soviet experiment of the twentieth century clearly failed and in countless ways harmed the lives of Soviet citizens, the record of Soviet health achievement prior to 1970 remains impressive.

References

Akachi, Yoko and David Canning, "The Height of Women in Sub-Saharan Africa: the Role of Health, Nutrition and Income in Childhood," *Annals of Human Biology*, 34:4 (July 1, 2007), 397 - 410.

Allen, Robert C., "The Rise and Decline of the Soviet Economy," *Canadian Journal of Economics*, Vol. 34, No. 4 (November 2001), 859 - 881.

Allen, Robert C., *Farm to Factory: A Reinterpretation of the Soviet Industrial Revolution* (Princeton and Oxford: Princeton University Press, 2003).

Anderson, Barbara A. and Brian D. Silver, "Infant Mortality in the Soviet Union: Regional Differences and Measurement Issues," *Population and Development Review* Vol. 12, no. 4 (December 1986), 705 - 738.

Anderson, Barbara A. and Brian D. Silver, "Trends in Mortality of the Soviet Population," *Soviet Economy* Vol. 6, No. 3 (1990), 191 - 251.

Andreev, E., L. Darskii and T. Kharkova, "Otsenka lyudskikh poter' v period Velikoi Otechestvennoi voiny," *Vestnik statistiki* 1990, 10, 25-27.

Balan-Cohen, Andreea, "Sobering Up: The Impact of the 1985-1988 Russian Anti-Alcohol Campaign on Child Health," unpublished paper, Tufts University, 2007.

Barber, John, "Introduction: Leningrad's Place in the History of Famine," in John Barber and Andrei Dzeniskevich, eds., *Life and Death in Besieged Leningrad, 1941 - 44* (Houndmills, Basingstoke, Hampshire; New York: Palgrave Macmillan 2005), 1 - 12.

Barber, John and Mark Harrison, *The Soviet Home Front, 1941-1945: A Social and Economic History of the USSR in World War II* (London and New York: Longman Group, 1991).

Bergson, Abram, "The USSR Before the Fall: How Poor and Why?" *Journal of Economic Perspectives*, Vol. 5 No. 4 (Fall 1991), 29 - 44.

Birman, Igor, "Comparison of Soviet and American Consumption," *Russia*, July-Aug. 1983, 100 - 108.

Bogin, Barry, *Pattern of Human Growth,* 2nd edition (Cambridge: Cambridge University Press, 1999).

Bozzoli, Carlos, Angus S. Deaton and Climent Quintana-Domeque, "Child Mortality, Income and Adult Height," NBER Working Paper 12966, March 2007.

Chen, Yuyu and Li-An Zhou, "The Long-term Health and Economic Consequences of the 1959 - 1961 Famine in China," *Journal of Health Economics*, Vol. 26 (2007), 659 - 681.

Chernichovsky, Dov, Gur Ofer and Elena Potapchik, "Health Sector Reform in Russia: The Heritage and the Private/Public Mix," *MOCT-MOST* Vol. 6 (1996), 125-152.

Chernyavskii, U. G., *Voina i prodovl'stvie. Snabzhenie gorodskogo naseleniya v Velikuyu Otechestvennuyu voinu* (1941-1945 gg).

Cleveland, W.S., "Robust Locally Weighted Regression and Smoothing Scatterplots," *Journal of the American Statistical Association*, Vol. 74 (1979), 829 - 836.

Conquest, Robert, *The Harvest of Sorrow* (New York: Oxford University Press, 1986).

Costa, Dora L. and Richard H. Steckel, "Long-Term Trends in Health, Welfare, and Economic Growth in the United States," in Richard H. Steckel and Roderick Floud, *Health and Welfare During Industrialization* (Chicago: University of Chicago Press, 1997), 47 - 89.

Davies, R. W. and Stephen G. Wheatcroft, *The Years of Hunger: Soviet Agriculture, 1931 - 1933* (London: Palgrave Macmillan, 2004).

Davies, R. W. and Stephen G. Wheatcroft, "Stalin and the Soviet Famine of 1932-33: A Reply to Ellman," *Europe-Asia Studies*, Vol. 58 No. 4 , 625 - 33.

Davis, Christopher and Murray Feshbach, *Rising Infant Mortality in the USSR in the 1970s* (Washington, D.C.: U.S. Dept. of Commerce, 1980).

Deaton, Angus, "Height, Health, and Development," *Proceedings of the National Academy of Sciences*, vol. 104 No. 33 (August 14, 2007), 13232 - 13237.

Dunstan, John, *Soviet Schooling in the Second World War* (London: Macmillan Press, 1997).

Ellman, Michael, "The Role of Leadership Perceptions and of Intent in the Soviet Famine of 1931 - 1934," *Europe-Asia Studies*, Vol. 57, No. 6 (September 2005), 823 - 841.

Easterly, William and Stanley Fischer, "The Soviet Economic Decline," *World Bank Economic Review* 1995, Vol. 9, 341 - 371.

Eberstadt, Nicholas,"Mortality and the Fate of Communist States," *Communist Economies & Economic Transformation* 5:4 (1993), 499 - 517.

Fischer, Stanley, "Russia and the Soviet Union: Then and Now," in Olivier Jean Blanchard, Kenneth A. Froot and Jeffrey D. Sachs, editors, *The Transition in Eastern Europe, Vol. I: Country Studies* (Chicago and London: University of Chicago Press, 1994), 221 - 252.

Floud, Roderick and Bernard Harris, "Health, Height and Welfare: Britain, 1700-1980," in Richard H. Steckel and Roderick Floud, eds., *Health and Welfare During Industrialization* (Chicago, Ill.: University of Chicago Press, 1997), 91 - 126.

Fogel, Robert William, "New Sources and New Techniques for the Study of Secular Trends in Nutritional Status, Health, Mortality, and the Process of Aging," *Historical Methods* Vol. 26, no. 1 (Winter 1993), 5 - 43.

Fogel, Robert W., "Nutrition and the Decline in Mortality since 1700: Some Preliminary Findings," in *Long-Term Factors in American Economic Growth*, edited by Stanley L. Engerman and Robert E. Gallman (Chicago: Univ. of Chicago Press, 1986), 439 - 555.

Fogel, Robert W., "Economic Growth, Population Theory, and Physiology: The Bearing of Long-Term Processes on the Making of Economic Policy," *American Economic Review* Vol. 84 No. 3 (June 1994), pp. 369 - 395.

Frolov, Mikhail, "Evacuation from Leningrad to Kostroma in 1941-42," in John Barber and Andrei Dzeniskevich, eds., *Life and Death in Besieged Leningrad, 1941 - 44* (Houndmills, Basingstoke, Hampshire; New York: Palgrave Macmillan 2005), 71 - 85.

Garcia, Jaume and Climent Quintana-Domeque, "The Evolution of Adult Height in Europe: A Brief Note," *Economics and Human Biology* 5 (2007), 340 - 349.

Giguz TL, Polilakov Ala, Bogachanov ND, "Dinamika fizicheskogo razvitiya uchashchikhsya shkol goroda Novosibirska," *Gigiena i sanitariia*. Vol. 3, May-Jun 2003, 50-52.

Glushchenko, A.G. and I.I. Slepushkina, "Fizicheskoe razvitie doshkol'nikov, uchashchikhsya obshcheobrazovatel'nykh shkol i remeslennykh uchilishch Kieva," *Gigiena i sanitariia* no. 24, September 1959, 64 - 69.

Godina, Elena Z., "Secular Changes in Russia and the Former Soviet Union," in Bodzsár, B. É. and Susanne, C., editors, *Secular Growth Changes in Europe* (Budapest: Eötvös Univ. Press, 1998), 351 - 367.

Godina, E.Z., Khomiakova, IA; Zadorozhnaia, LV et al., "Moskovskie deti: osnovnye tendentsii rosta i razvitiya na rubezhe stoletii. Chast' 1.," *Voprosy antropologii,* Vol. 91 2003, 42 - 60.

Goppe, D. I, "Nekotoroye pokazateli fizicheskogo razvitiya shkol'nikov Kemerovo," *Zdravookhraneniye rossiiskoi federatsii*, Vol 5 1972, 27 - 29.

Goskomstat RSFSR, *Narodnoye khozyaistvo RSFSR v 1989 g.* (Moscow 1990).

Goskomstat SSSR, *Narodnoe khoziastvo SSSR v 1960 gody* (Moscow 1961).

Goskomstat SSSR, *Naselenie SSSR 1973* (Moscow 1975).

Goskomstat SSSR, *Zhenshchini i deti v SSSR* (Moscow 1961).

Gregory, Paul and Mark Harrison, "Allocation under Dictatorship: Research in Stalin's

Archives," *Journal of Economic Literature*, Vol. 43, No. 3 (September 2005), 721 - 761.

Harrison, Mark, "Post-war Russian Economic Growth: Not a Riddle," *Europe-Asia Studies*, Vol. 55, No. 8 (December 2003), 1323 - 1329.

Iampol'skaia IuA; Iurko GP; Veremkovich LV; Uzhvi VG, "Izmeneniya v fizicheskom razvitii detei doshkol'novo i mladshevo shkol'nogo vozrasta Moskvy za poslednie 20 let," *Gigiena i sanitariia*, August 1991 (no. 8), 41-44.

Iampol'skaia IuA and Mikhailova, SA, "Sravneniye parametrov fizicheskogo razvitiya sovremennykh shkol'nikov Moskvy i Gorno-Altaiska," *Gigiena i sanitariia* November 1993 (no. 11), pp. 35-7.

Jones, Ellen and Fred W. Grupp, "Infant Mortality Trends in the Soviet Union," *Population and Development Review* Vol. 9 no. 2 (June 1983), 213 - 246.

Khanin, G.I., "The 1950s – the Triumph of the Soviet Economy," *Europe-Asia Studies*, Vol. 55, No. 8 (December 2003), 1187 - 1212.

Komlos, John, "On the Biological Standard of Living in Russia and the Soviet Union," *Slavic Review*, Vol. 58, Issue 1 (Spring 1999), 71 - 79.

Komlos, John and Marieluise Baur, "From the Tallest in the World to (One of) the Fattest: The Enigmatic Fate of the Size of the American Population in the Twentieth Century," *Economics and Human Biology*, March 2004, vol. 2, no. 1, 57 - 74.

Kosarev, A.V. and Kraval', I.A., *Molodezh' SSSR: Statisticheskii sbornik* (Moscow: v/o Soiuzorguchet, 1936).

Krasik, L. B. et al., "Fizicheskoye razvitiye vospitannikov shkol-internatov Permi (po dannym obsledovaniya 1962 g.)," *Zdravookhraneniye rossiiskoi federatsii*, Vol. 6 (June), 1963, 22 - 26.

Lapitskii, F. G., M. P. Nemzer, and V Ya. Belogorskii, "Nekotorye pokazateli fizicheskogo razvitiya shkol'nikov Kirovska," *Zdravookhraneniye rossiiskoi federatsii*, Vol. 5 1969, 11 - 13.

Livi-Bacci, Massimo, "On the Human Costs of Collectivization in the Soviet Union," *Population and Development Review*, Vol. 19, No. 4 (December 1993), 743 - 766.

Maddison, Angus, *World Population, GDP and Per Capita GDP, 1 - 2003 AD*, March 2007 version, http://www.ggdc.net/maddison, accessed June 18, 2007.

Martorell, Reynaldo and Jean-Pierre Habicht, "Growth in Early Childhood in Developing Countries," in Frank Falkner and James M. Tanner, editors, *Human Growth: A Comprehensive Treatise, Vol. 3* (New York: Plenum Press, 1986), 241 - 262.

Maksimova, T. M. and Yanina, V. I, "Sovremennye problemy izucheniya i otsenki fizicheskogo razvitiya detei i podrostkov," in Semashko Institute of Public Hygiene, *Fizicheskoe razvitie detei i podrostkov gorodikh i sel'skikh mestnostei SSSR, Vypusk IV, Chast' II* (Moscow 1988), 19 - 35.

Matveeva, NA, Kuzmichev, IuG, Bogomova, EC, Kabanets, OL and Kotova, HV, "Dinamika fizicheskogo razvitiya shkol'nikov Nizhnego Novgoroda," *Gigiena i sanitariia* Mar-April 1997 (no. 2), 26 - 28.

Millere RK, "Dinamika fizicheskogo razvitiya shkol'nikov Rigi," *Sovetskoe zdravookhranenie* Vol. 21 no. 5, 1962, 40-42.

Mironov, Boris N., "Diet, Health and Stature of the Russian Population from the Mid-Nineteenth to the Beginning of the Twentieth Century," in John Komlos, ed., *The Biological Standard of Living on Three Continents: Further Explorations in Anthropometric History* (Boulder and Oxford: Westview Press, 1995), 59 - 79.

Mironov, Boris N., "New Approaches to Old Problems: The Well-Being of the Population of Russia from 1821 to 1910 as Measured by Physical Stature," *Slavic Review*, Vol. 58, no. 1 (Spring 1999), 1 - 26.

Mironov, Boris, "Birth Weight and Physical Stature in St. Petersburg: Living Standards of Women in Russia, 1980 - 2005," *Economics and Human Biology* 5 (2007), 123 - 143.

Moskoff, William, *The Bread of Affliction: The Food Supply in the USSR During World War II* (Cambridge: Cambridge University Press, 1990).

Mostovaya, L. A., "Sdvigi v fizicheskom razvitii shkol'nikov Kieva," *Sovietskoe zdravookhraneniye* Vol. 11 1979, 41 - 44

Ofer, Gur, "Soviet Economic Growth: 1928 - 1985," *Journal of Economic Literature*, Vol. 25 No. 4 (December 1987), 1767 - 1833.

Ofer, Gur, "The Soviet Growth Record Revisited," unpublished manuscript, December 2005.

Ó Gráda, Cormac, "Making Famine History," *Journal of Economic Literature*, Vol. 45, No. 1 (March 2007), 5 - 38.

Orlik, I. M., "Dinamika fizichekogo razvitiya podrostkov Kharkhova za 40 let (1923 - 1964), *Gigiena i sanitariia* Vol. 7 1967, 35 - 39.

Romenskii, A. A., T. M. Maksimova, and V. N. Yanina, "Fizicheskoye razvitiye naseleniya po materialam kompleksnogo izucheniya sostoyaniya zdorov'ya naseleniya v svyazi s perepisyu 1970 g.," *Sovietskoe zdravookhraneniye* 11, 1978, 35 - 43.

Rosefielde, Steven, "The Riddle of Post-war Russian Economic Growth: Statistics Lied and

Were Misconstrued," *Europe-Asia Studies*, Vol. 55, No. 3 (2003), 469 - 481.

Schroeder, Gertrude E. and Imogene Edwards, *Consumption in the USSR: An International Comparison* (Washington, D.C.: Joint Economic Committee, United States Congress), 1981.

Seglenietse, K. B., *Fizicheskoye razvitiye detei doshkol'nogo vozrasta goroda Rigi* (Riga, 1973).

Semashko Institute of Public Hygiene, *Fizicheskoe razvitie detei i podrostkov gorodikh i sel'skikh mestnostei SSSR, Vypusk IV, Chast' II* (Moscow 1988).

Semashko Institute of Public Hygiene, *Materiali po fizicheskomy razvitiyu detei i podrostkov gorodov is sel'skikh mestnostei Rossiskoi Federatsii, Vypusk 5* (Moscow 1998)

Semashko Institute of Public Hygiene, *Materiali po fizicheskomy razvitiyu detei i podrostkov gorodov i sel'skikh mestnostei SSSR, Vypusk I* (Moscow: Meditsina, 1962)

Semashko Institute of Public Hygiene, *Materiali po fizicheskomy razvitiyu detei i podrostkov gorodov i sel'skikh mestnostei SSSR, Vypusk II* (Moscow: Meditsina, 1965)

Semashko Institute of Public Hygiene, *Materiali po fizicheskomy razvitiyu detei i podrostkov gorodov i sel'skikh mestnostei SSSR, Vypusk III* (Moscow: Meditsina, 1977)

Sen, Amartya, "Mortality as an Indicator of Economic Success and Failure," *The Economic Journal* 108 (January 1998), 1 - 25.

Shnitnikova, Z. Z., "Fizicheskoye razvitiye detei doshkol'nogo vozrasta Leningrada," *Zdravookhraneniye rossiiskoi federatsii* Vol. 12 1963, 12 - 15.

Sifman, R. I., *Statistika zdorovya i meditskinskogo obsluzhivaniya detei* (Moscow, 1960), p. 80.

Steckel, Richard H., "Slave Height Profiles from Coastwise Manifests," *Explorations in Economic History* 16 (1979a), 363 - 80.

Steckel, Richard H., "Slave Mortality: Analysis of Evidence form Plantation Records," *Social Science History* 3 (1979b), 86 - 114.

Steckel, Richard H., "Stature and the Standard of Living," *Journal of Economic Literature* Vol. 33, no. 4 (December 1995), 1903-1940.

Steckel, Richard H., "Percentiles of Modern Height Standards for Use in Historical Research," *Historical Methods* Vol. 29 No. 4 (Fall 1996), 157 - 166.

Steckel, Richard H., "Biological Measures of the Standard of Living," *Journal of Economic Perspectives*, Vol. 22 No. 1 (Winter 2008), 129 - 152.

Steckel, Richard H. and Roderick Floud, *Health and Welfare During Industrialization* (Chicago: University of Chicago Press), 1997.

Sukharev, A. G., H. P. Maslova, and V. N. Kazachuk, "Sostoyaniye zdorov'ya i fizicheskoye razvitiye detei shkol'nogo vozrasta Noril'ska," *Gigiena i sanitaria* Vol. 8 (August) 1965, 51 - 54.

Tarasov, L. A., Lapitskii, F. G., and Pogorelyi, Iu. A., Fizicheskoe razvitie shkol'nikov Murmanska v 1961 g., *Zdravookhranenie Rossiiskoi Federatsii* No. 10 1966, 18 - 21.

Treml, Vladimir and Michael Alexeev, "The Second Economy and the Destabilizing Effect of Its Growth on the State Economy in the Soviet Union: 1965 - 1989," Berkeley-Duke Occasional Papers on the Second Economy in the USSR, No. 36, November 1993.

Tulchinsky, Theodore H. and Elena A. Varavikova, "Addressing the Epidemiologic Transition in the Former Soviet Union: Strategies for Health System and Public Health Reform in Russia," *American Journal of Public Health* Vol. 86 (3), March 1996, 313-320.

U.S. Department of Health, Education and Welfare, Public Health Service, "NCHS Growth Charts, 1976," *Monthly Vital Statistics Report*, Vol. 25, No. 3 Supplement, June 22, 1976.

Vallin, Jacques; France Meslé; Serguei Adamets; Serhii Pyrozhkov, "A New Estimate of Ukrainian Population Losses during the Crises of the 1930s and 1940s," *Population Studies*, Vol. 56, No. 3 (Nov. 2002), 249 - 264.

van den Berg, Gerard J., Maarten Lindeboom, and France Portrait, "Economic Conditions Early in Life and Individual Mortality," *American Economic Review* Vol. 96, No.1 (March 2006), 290 - 302.

Velkoff, Victoria A. and Jane E. Miller, "Trends and Differentials in Infant Mortality in the Soviet Union, 1970 - 1990: How Much Is Due to Misreporting?" *Population Studies* Vol. 49 no. 2 (July 1995), 241 - 258.

Vignerová, J., M. Brabec and P. Bláha, "Two Centuries of Growth Among Czech Children and Youth," *Economics and Human Biology 4* (2006), 237 - 252.

Wheatcroft, Stephen G., "The Great Leap Upwards: Anthropometric Data and Indicators of Crises and Secular Change in Soviet Welfare Levels, 1880 - 1960," *Slavic Review*, Vol. 58, Issue 1 (Spring 1999), 27 - 60.

Appendix 1: Data sources

Archival data:

Births and infant deaths by RSFSR oblast:

1956: RGAE, F. 1562, op. 27, d. 209
1957: RGAE, F. 1562, op. 27, d. 352
1958: RGAE, F. 1562, op. 46, d. 1561; d. 489
1959: RGAE, F. 1562, op. 27, d. 813; d. 826
1960: RGAE, F. 1562, op. 27, d. 1005; GARF F. A-374, op. 31, d. 7851
1961: RGAE, F. 1562, op. 27, d. 1170; GARF F. A-374, op. 32, d. 3034
1962: RGAE, F. 1562, op. 27, d. 1311; GARF F. A-374, op. 32a (vol. 2), d.7013, 7014
1963: RGAE, F. 1562, op. 27, d. 1445; GARF F. A-374, op. 32a, d. 11512
1964: RGAE, F. 1562, op. 37, d. 2610; GARF F. A-374, op. 35 (vol. 1), d. 3141
1965: RGAE, F. 1562, op. 44, d. 2603
1966: GARF F. A-374, op. 36, d. 3740
1967: RGAE F. 1562, op. 45, d. 5855
1968: RGAE F. 1562, op. 45, d. 9712
1970: RGAE, F. 1562, op. 47, d. 1399; d. 1421
1971: RGAE, F. 1562, op. 48, d. 1267; d. 1281
1972: RGAE, F. 1562, op. 49, d. 1833, 1834
1973: RGAE, F. 1562, op. 50, d. 1729, 1730
1975: RGAE, F. 1562, op. 56, d. 1928
1979: RGAE, F. 1562, op. 62, d. 1672

Average daily calories and average daily calories from animal sources (RSFSR): RGAE F. 1562, op. 44, d. 135 (1965); RGAE F. 1562, op. 47, d. 1949 (1970).

Wages, average monthly: GARF, F. A-374, op. 30, d. 7087 (1956); GARF F. A-374, op. 30, d. 10.407 (1957); GARF, F. A-374, op. 31, d. 2779 (1959); GARF, F. A-374, op. 31, d. 5814 (1960); RGAE F. 1562, op. 37, d. 3287 (1964); GARF F. A-374, op. 35, d. 6508 (1965); GARF F. A-374, op. 36, d. 2626 (1966); GARF F. A-374, op. 36, d. 6547 (1967); GARF F. A-374, op. 36, d. 10091 (1968); RGAE F. 1562, op. 48, d. 1668 (1971); RGAE F. 1562, op. 50, d. 2175 (1973).

Other data sources:

Alcohol consumption (liters of pure alcohol per capita): 1960: GARF F. 374, op. 31, d. 5299. 1970: Treml, Vladimir and Michael Alexeev, "The Second Economy and the Destabilizing Effect of Its Growth on the State Economy in the Soviet Union: 1965 - 1989," Berkeley-Duke Occasional Papers on the Second Economy in the USSR, No. 36, November 1993. 1980, 1985, 1990: *Pokazateli sotsial'nogo razvitiya respublik, kraev i oblastei Rossiiskoi Federatsii*, Moscow

1992, pp. 145-6.

Calories (per capita daily calorie supply, total and from animal sources, 1910 - 1960): Wheatcroft 1999, p. 51.

Education variables: Tsentral'noye statisticheskoe upravleniye, *Itogi vsesoyuznoi perepisi naseleniya 1979 goda Tom III chast' I* (Moscow 1989), 190 - 287. Education levels are interpolated between census years.

Doctors per 10,000 pop; hospitals per 10,000 pop.: Tsentral'noye statisticheskoe upravleniye, *Narodnoye khozyaistvo RSFSR*, various issues 1958 - 1985.

Life expectancy, Russian republic: estimated: Andreev, E. M., L. E. Darskii and T. L. Kharkova, *Demograficheskaya historiya Rossii: 1927 - 1959* (Moscow: Informatika, 1998), 164-5; official: Goskomstat Rossii, *Demograficheskii ezhegodnik Rossii 2002* (Moscow, 2002), 105.

Meat consumption, kilos per capita; milk consumption, liters per capita; egg consumption (1965, 1970): Treml, Vladimir and Michael Alexeev, "The Second Economy and the Destabilizing Effect of Its Growth on the State Economy in the Soviet Union: 1965 - 1989," Berkeley-Duke Occasional Papers on the Second Economy in the USSR, No. 36, November 1993.

Urban population: Goskomstat RSFSR, *Narodnoye khozyaistvo RSFSR*, various issues 1958 - 1985.

<u>Child height data:</u>

The year indicated after each city is the year in which the study was conducted.

Giguz et al. 2001:	Novosibirsk 2001.
Godina et al. 2003:	Moscow 1998.
Goppe 1972:	Kemerovo 1962, 1969.
Iampol'skaia et al. 1991:	Moscow 1961, 1974.
Iampol'skaia et al. 1993:	Moscow 1991.
Krasik et al. 1963:	Perm 1962; Novosibirsk 1962.
Lapitskii et al. 1969:	Murmansk 1965.
Matveeva et al. 1997:	Nizhni Novgorod 1937, 1946, 1970.
Millere 1962:	Murmansk 1951.
Mostovaya 1979:	Kiev 1927, 1955, 1960, 1967, 1972, 1977.
Narodnoe khoziastvo SSSR v 1960 gody:	Moscow 1925, 1938.
Naselenie SSSR 1973:	Minsk 1934; Moscow oblast 1938, Murmansk 1947, 1957; St. Petersburg 1928; Tblisi 1936
Orlik 1967:	Kharkov, 1923, 1926, 1946, 1950, 1955, 1959, 1964
Romenskii et al 1978:	Perm 1970.
Semashko 1962:	Blagoveshchenski 1958; Kharkov 1959; Kopeisk 1958; Moscow

	1958, Minsk 1955, Novosibirsk 1958; Odessa 1956; Orel 1959; Penza 1956; Rostov-on-Don 1958; Rostov rural areas 1958; St. Petersburg 1959; Tula 1957.
Semashko 1965:	Nizhny Novgorod 1959, St. Petersburg 1961, Riga 1960, Baku 1959, Ulyanovsk 1962, Novosibirsk 1959; Vilnius 1958.
Semashko 1977:	Moscow 1969, Murmansk 1970, Minsk 1970, Novosibirsk 1970, Ulyanovsk 1965, Nizhni Novgorod 1966, St. Petersburg 1972, Kemerovo 1969
Semashko 1988:	Riga 1970, 1985, Baku 1974
Semashko 1998:	Nizhny Novgorod 1991, Kemerovo 1991, Orel 1991, Perm 1993, Ulyanovsk 1992
Shnitnikova 1963:	St. Petersburg 1936, 1945.
Sifman 1960:	Moscow 1950.
Tarasov 1966:	Murmansk 1961.

Zhenshchini i deti v SSSR (Moscow 1961): Rostov-on-Don 1946.

Table 1. Comparisons of Soviet and Western economic performance, 1950 - 1980 (annual rates of growth)

	Soviet Union			E-OECD		United States	
	1950-80	1960-80	1970-80	1950-80	1970-80	1950-80	1970-80
GNP per capita	3.3	3.1	2.1	3.3	2.3	1.9	2.0
Household consumption per capita	3.7	3.2	2.6	3.2	2.6	2.1	2.3

Notes: Soviet data are Western estimates. Data for E-OECD and the U.S. are GDP rather than GNP. Household consumption is at established prices for the Soviet Union, at factor cost for E-OECD and the United States.

Source: Ofer (1987), Table 2.

Fig. 1 Height of boys in Moscow by age and year of birth, cm

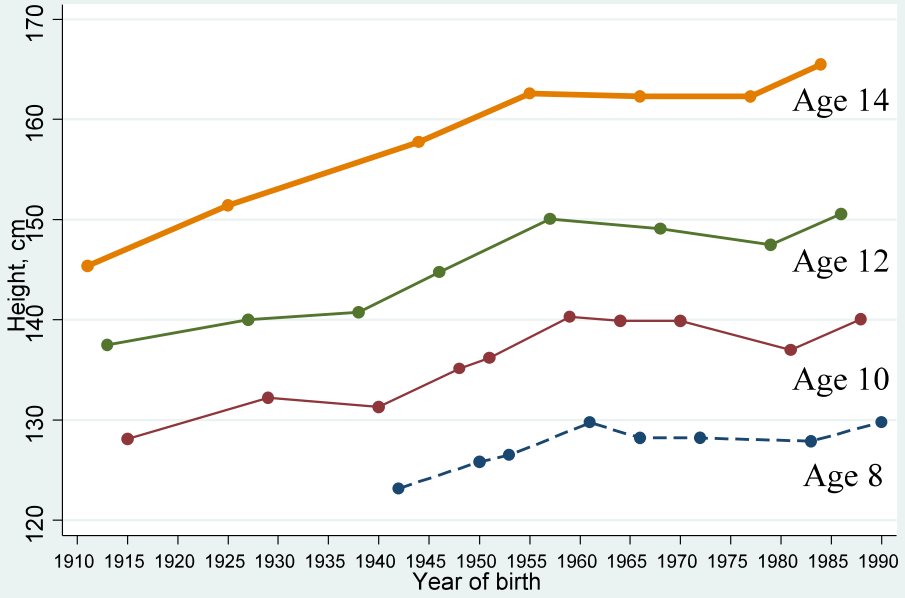


Fig. 2 Height of boys in Moscow by age and year of birth, in percentiles of US growth standard

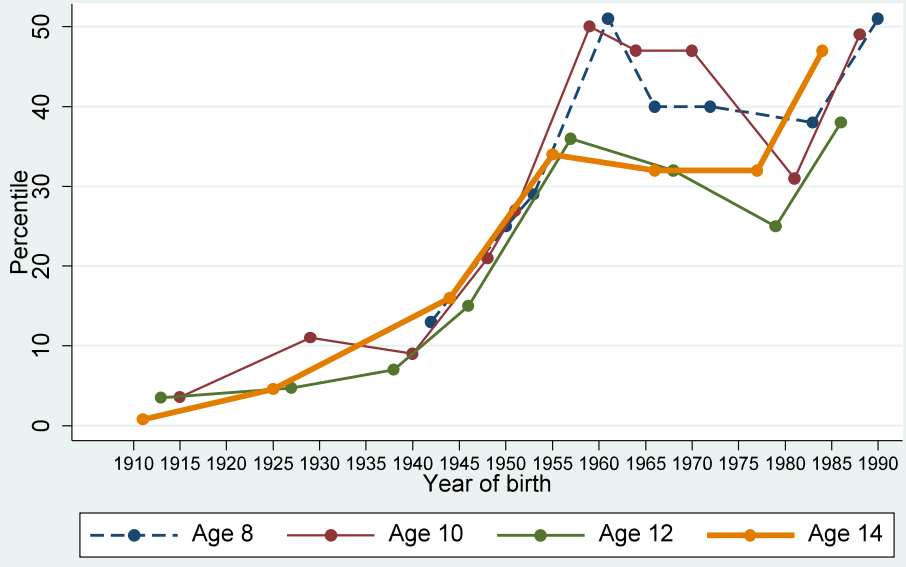


Fig. 3a Height of 13-year-old boys in RSFSR cities, in percentiles of US growth standard

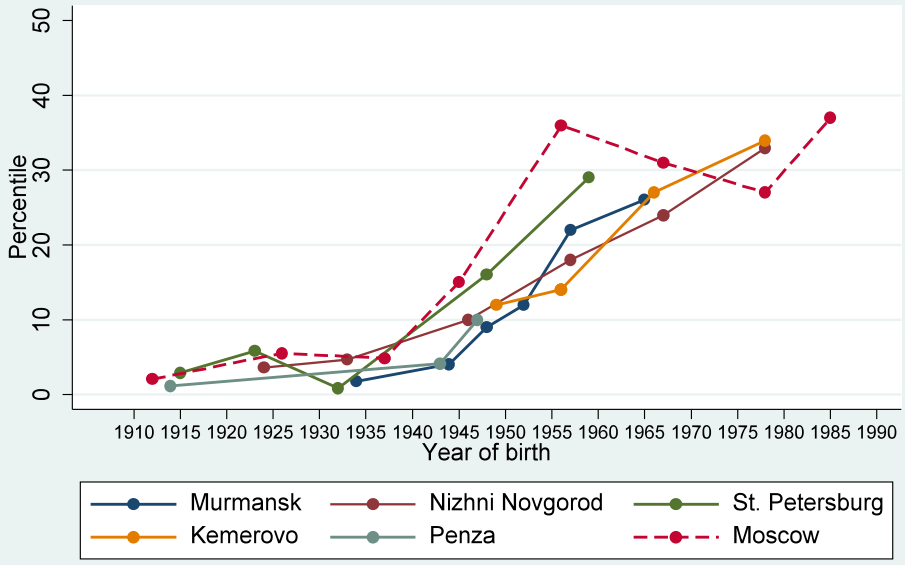


Fig. 3b Height of 12- to 15-year-old boys in USSR cities in percentiles of US growth standard

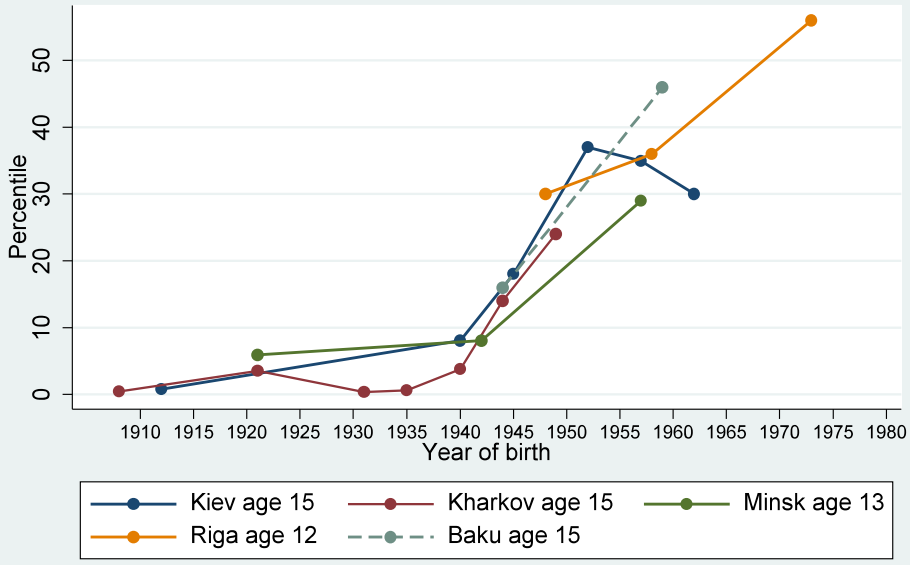
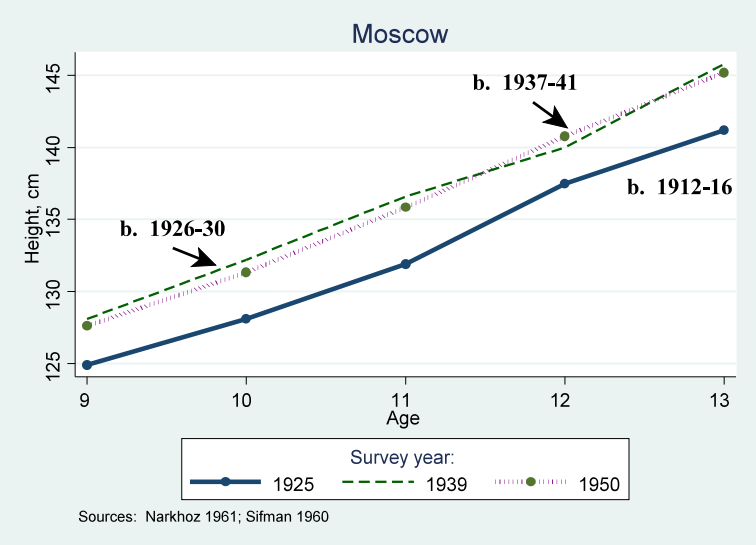


Table 2. Evidence on Soviet and East European heights from other sources

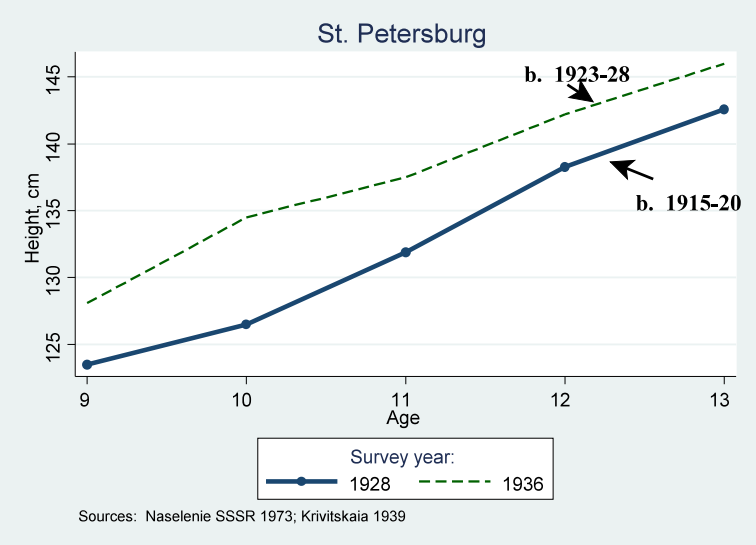
Population	Year of birth	Height in cm
1. Moscow men aged 20-29	1891 - 1909	168.2
2. Adult men in central regions of Russia, age 22 and over	1898	166
3. Russian military recruits	1906 - 1910	167.5
Moscow male workers age 25	1901 - 1905	167.3
Moscow male workers age 25	1906 - 1910	167.8
4. Moscow working youths age 18	1905	161.5
5. Moscow military recruits	1906	167.3
St. Petersburg military recruits	1906	167.0
Ukraine military recruits	1906	169.1
6. Kiev boys age 8 years old	1918	120
Kiev boys age 17 years old	1910	162
7. Czech boys age 7 years old	1888	114
Czech boys age 14 years old	1881	146
Czech boys age 14 years old	1937	159.5

Sources by line:
1. Zhdanov and Nikityuk 1964, cited in Godina 1998 p. 358.
2. Wheatcroft 1999, p. 43.
3. Mironov 1999, p. 16.
4. *Naselenie SSSR 1973*, p. 194.
5. Kosarev and Kraval', *Molodezh' SSSR* pp. 308 - 309.
6. Glushchenko and Slepushkina 1959. p. 67.
7. Vignerová et al. 2006, p. 240, 243.

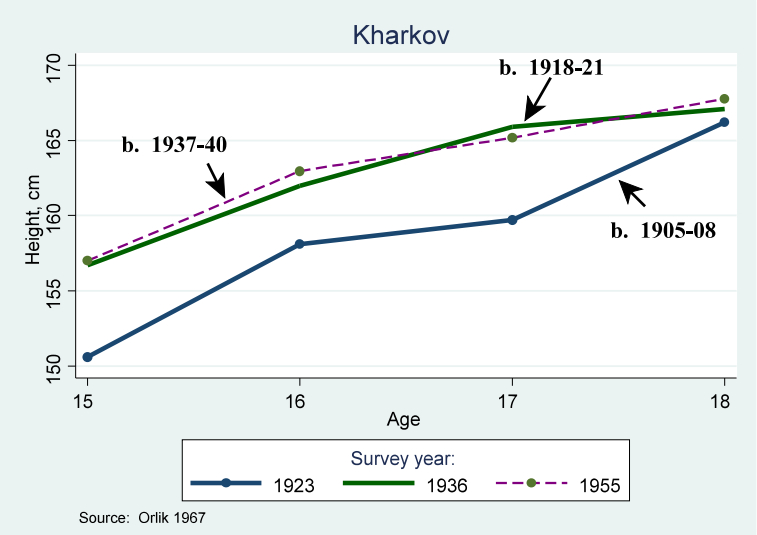
Figure 4. Average heights during NEP and industrialization



Sources: Narkhoz 1961; Sifman 1960

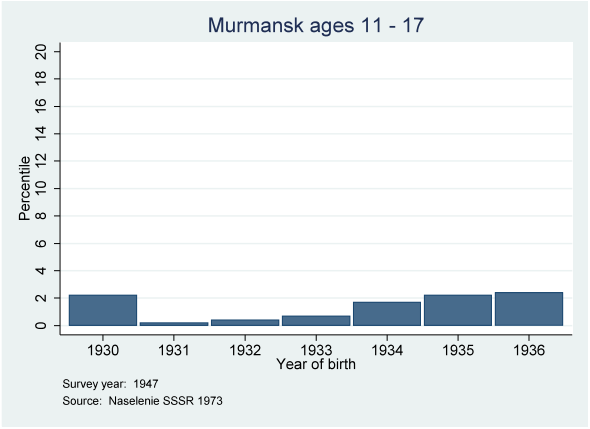


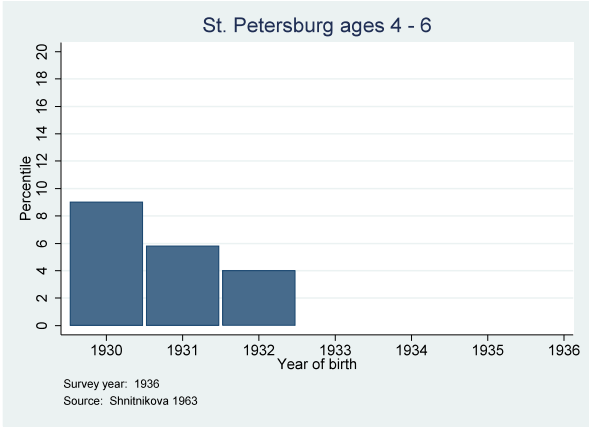
Sources: Naselenie SSSR 1973; Krivitskaia 1939

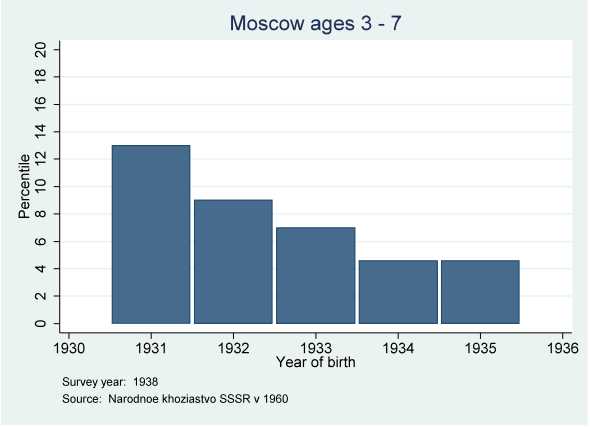


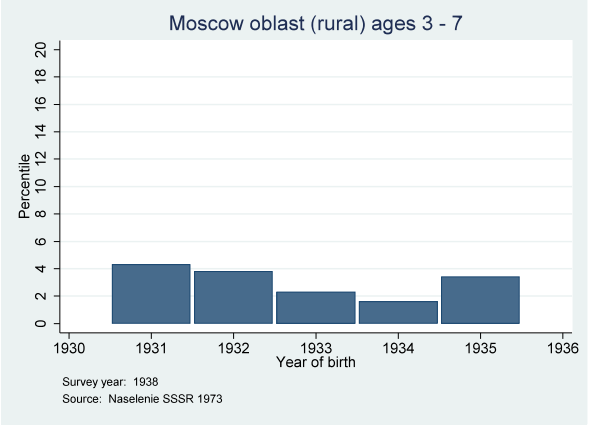
Source: Orlik 1967

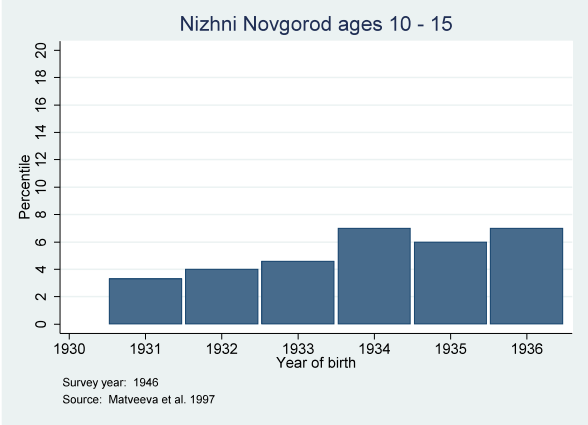
Figure 5. Height percentiles in the famine years, boys

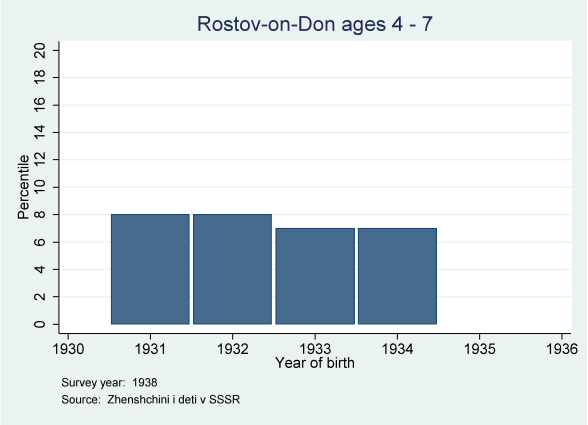












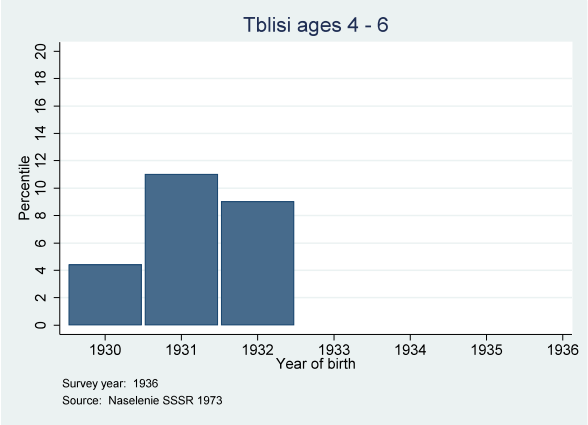
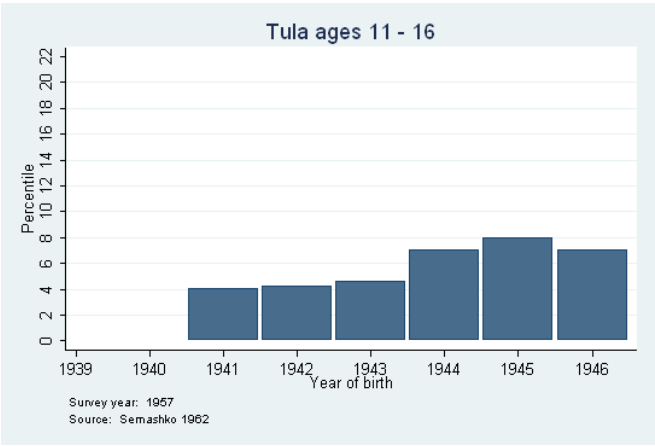
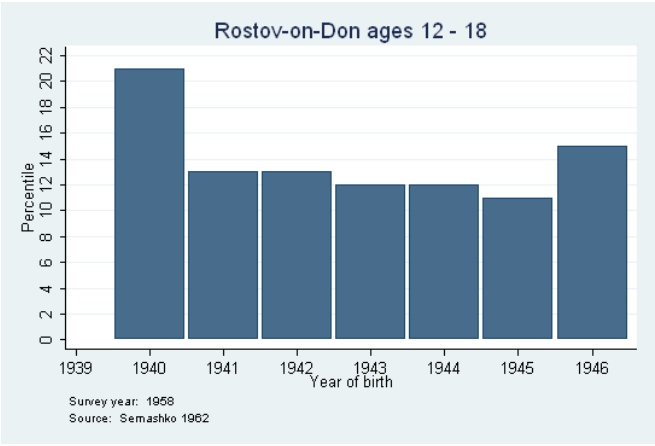


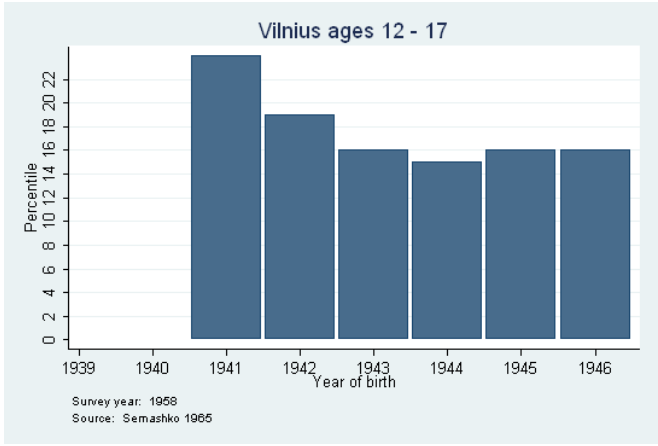
Figure 6. Height percentiles during World War II, selected cities, boys

Unoccupied cities:



Occupied cities:





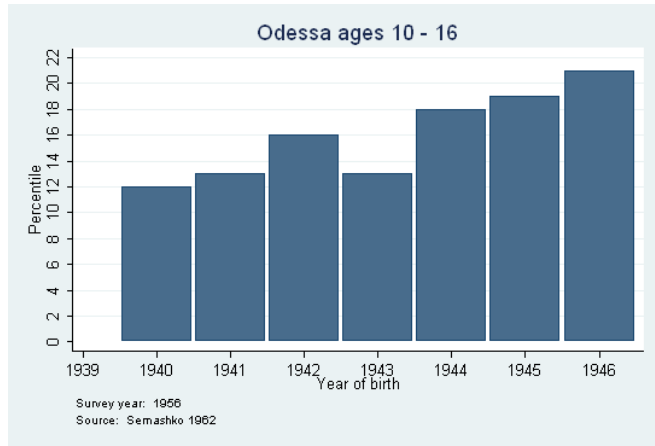


Table 3. Average heights of children in St. Petersburg by age and year of survey

Age	1936-37		1945						1958	
			All children		Blockade children		Evacuated children			
Boys	Height, cm	Percentile	Height, cm	Percentile	Height, cm	Percentile	Height, cm	Percentile	Height, cm	Percentile
4	97.8	4	94.8	.8	95.0	.9	94.7	.8	102.2	18
5	105.1	6	100.7	.7	99.8	.4	101.6	1.2	108.3	17
6	111.9	9	105.3	.4	104.8	.4	106.0	.6	115.0	22
7	117.2	9	109.7	.4	109.6	.4	109.8	.4	120.7	24
							3.7			
Girls										
4	96.3	4	94.1	.9	94.8	1.5	93.7	.7	101.6	23
5	103.7	6	99.5	.8	98.6	.5	100.3	1.2	107.8	22
6	112.5	18	105.4	1.4	104.6	.9	106.5	2.3	113.3	22
7	117.1	14	109.7	1.1	109.7	1.1	110.0	1.4	119.4	25

Source: Shnitnikova 1963.

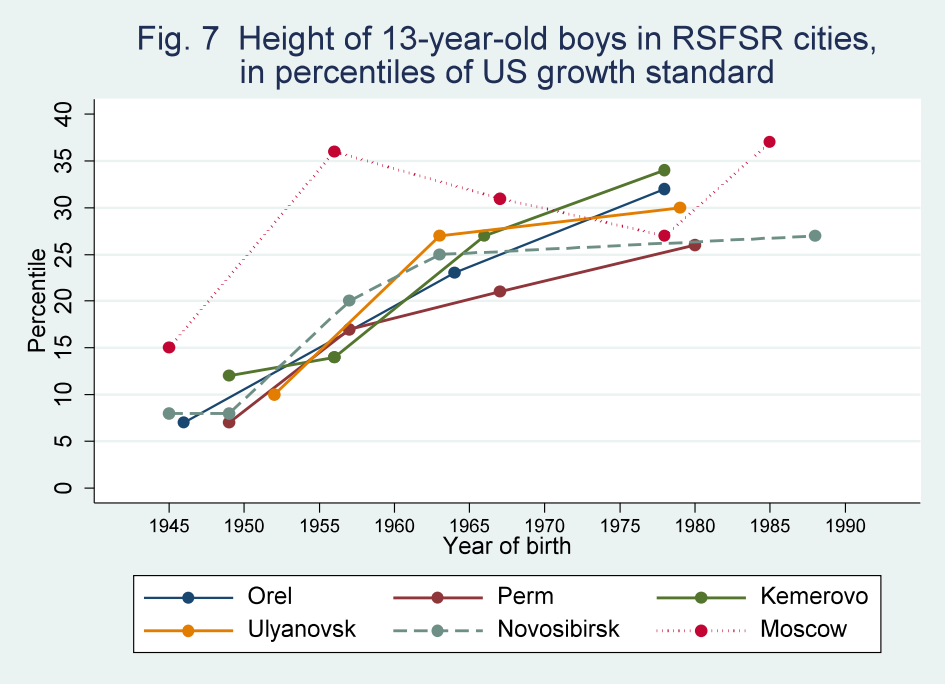
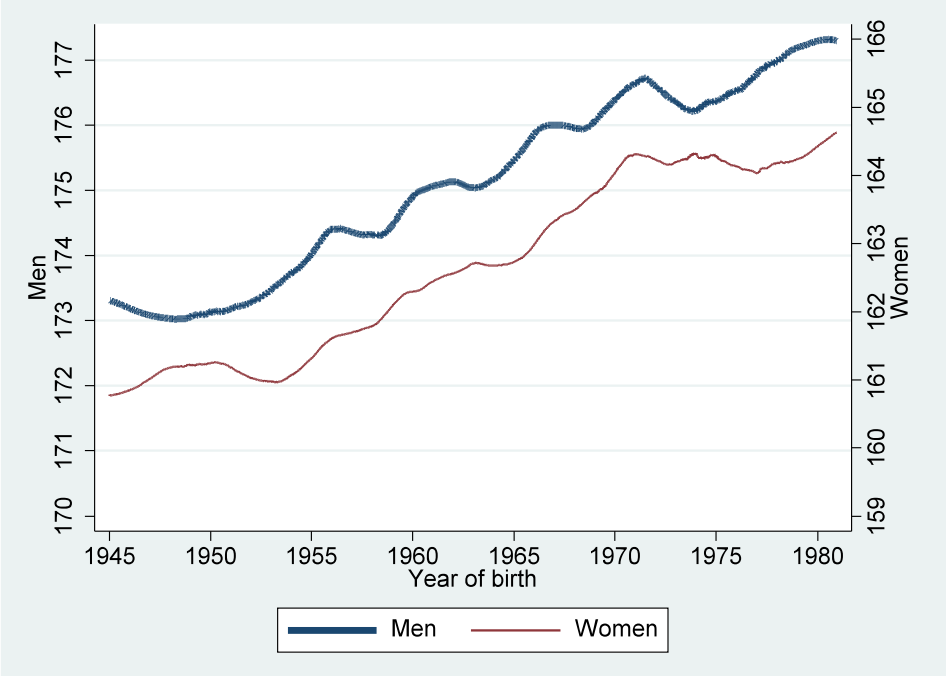
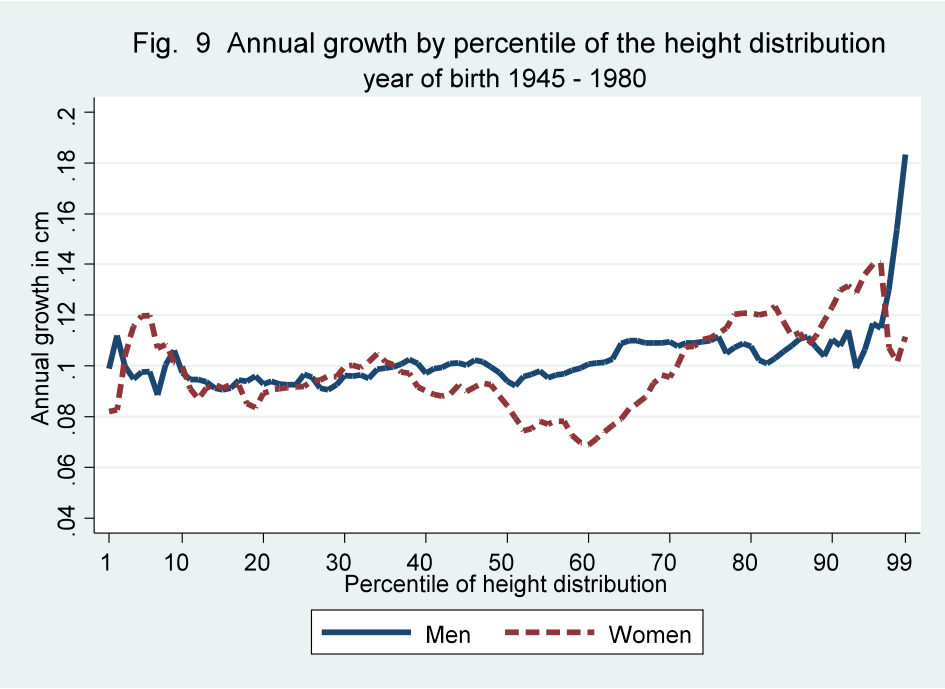


Figure 8. Male and female adult heights by exact date of birth, Russia, ages 21 - 50





Coefficients from regressions of height of men and women aged 21 - 50 on exact date of birth by percentile of the height distribution using Rounds 5 - 13 of the Russian Longitudinal Monitoring Survey, converted into annual rates of growth. Regressions include controls for the year in which the survey was taken.

Figure 10. Female adult heights by year of birth, USSR republics, ages 21 - 49

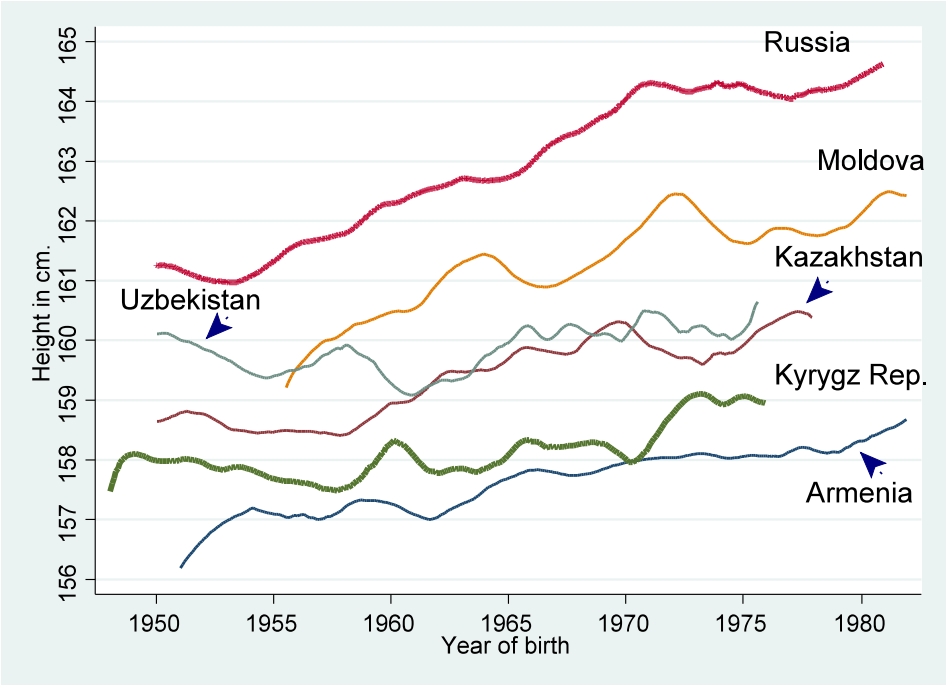


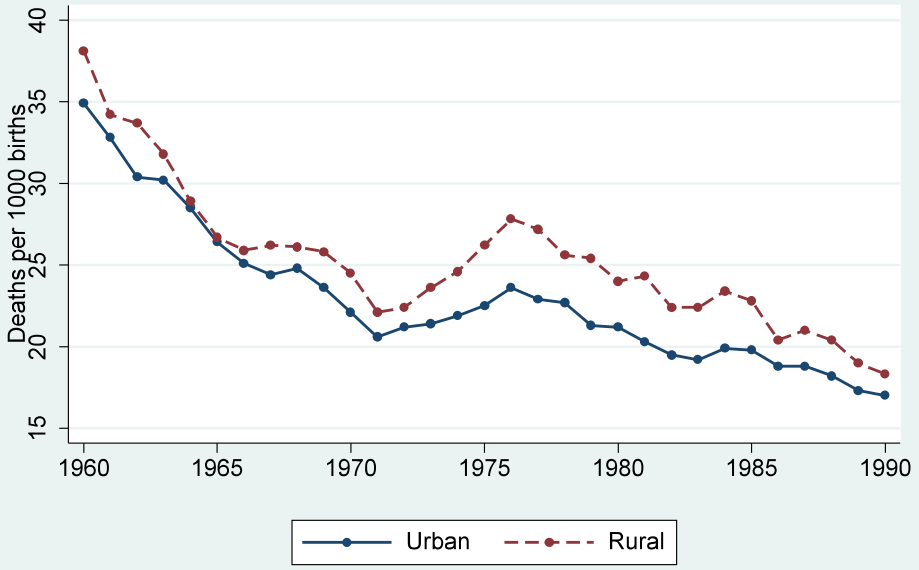
Table 4. Average heights and growth rates by year of birth, Soviet Union and Southern Europe, individuals aged 21 - 50

Country	Men			Women		
	Average height, cm		Annual growth rate, %	Average height, cm		Annual growth rate, %
	1950-1954	1976-1980		1950-1954	1976-1980	
Russia	173.3 (6.51) [N = 632]	177.2 (6.44) [N = 465]	.09	161.0 (6.18) [N = 719]	164.1 (6.57) [N = 525]	.07
Armenia	na	na	na	157.0* (6.06) [N = 608)	158.2 (5.83) [N = 1614]	.03
Kazakhstan	na	na	na	158.7 (6.31) [N = 752]	160.4+ (5.79) [N = 185]	.04
Kyrgyz Rep.	na	na	na	157.9 (5.98) [N = 375]	158.9^ (6.11) [N = 239]	.03
Moldova	na	na	na	159.6# (6.08) [N = 295]	162.0 (6.14) [N = 924]	.07
Uzbekistan	na	na	na	159.7 (6.31) [N = 396]	160.0** (5.79) [N = 264]	.01
Greece	174.7	178.6	.09	163.3	165.9	.06
Italy	172.5	177.1	.10	161.4	166.5	.12
Spain	171.3	176.1	.11	160.4	165.5	.12
Turkey	na	na	na	154.4 (5.94) [N = 125]	156.5++ (5.36) [N = 215]	.06

* 1951 - 1954; + 1975 - 1977; ^ 1975 - 1976; # 1955 - 1956; ** 1974 - 1975; ++ 1976 - 1977.

Sources: Russia: Russian Longitudinal Monitoring Survey; Armenia, Kazakhstan, Kyrgyz Republic, Moldova, Uzbekistan, and Turkey: Demographic and Health Surveys; Greece, Italy, and Spain: Garcia and Quintana-Domeque 2007. The annual growth rate is calculated (as in Garcia and Quintana-Domeque 2007) as $(((h_2 - h_1)/h_1)/n) \times 100$, where h_2 is the average height in the later period, h_1 is the average height in the earlier period, and n is the number of years between the midpoints of the cohort intervals.

Figure 11. Urban and Rural Infant Mortality Rates, RSFSR



Source: see Appendix 1.

Table 5. Correlates of infant mortality rates and adult height

Dependent variable:	**Regional infant mortality rate** (in logs), fixed effects 1960 - 1990 (5-year intervals)			**Adult height in cm** (non-movers born 1956-1980, age 21-48, RLMS)			
				Men		Women	
Crude birth rate	**.026** (.004)	**.023** (.006)	**.026** (.006)	–	–	–	–
Infant mortality rate	–	–	–	–	**-.146** (.041)	–	-.066 (.046)
Doctors per capita	**-.0052** (.0030)	-.0048 (.0033)	-.0035 (.0040)	.051 (.066)	-.002 (.065)	**.097** (.049)	.085 (.052)
% urban population	-.003 (.002)	-.003 (.002)	.0001 (.0032)	-.027 (.035)	-.042 (.032)	-.006 (.033)	-.010 (.033)
Log(average monthly wage)	–	.120 (.191)	.249 (.210)	-.255 (3.48)	.630 (3.01)	1.46 (2.65)	1.62 (2.67)
Alcohol sales per capita, liters	–	–	**-.035** (.020)	–	–	–	–
Alcohol sales squared	–	–	**.0018** (.0009)	–	–	–	–
Share of pop with: Higher education	.008 (.015)	.010 (.018)	-.013 (.020)	-.037 (.184)	**.285** (.168)	.246 (.162)	**.329** (.184)
Incomplete higher ed.	.073 (.074)	.108 (.087)	.209 (.111)	**.083** (.046)	**.091** (.042)	-.084 (.080)	-.076 (.078)
Specialized secondary ed.	.016 (.010)	.008 (.014)	-.010 (.015)	.051 (.039)	.035 (.034)	-.003 (.018)	.005 (.018)
Secondary ed.	**-.017** (.006)	**-.020** (.007)	**-.028** (.006)	-.029 (.035)	-.028 (.030)	-.007 (.022)	-.017 (.022)
Incomplete sec-ondary ed.	.007 (.007)	.004 (.010)	**-.022** (.010)	.007 (.014)	.012 (.012)	.009 (.012)	.010 (.013)
N	567	547	330	1,667	1,658	1,677	1,665
R2	.70	.72	.76	.05	.06	.08	.08

Bold: statistically significant at $\leq$ 10%. IMR regressions include year dummy variables; robust standard errors clustered by region in parentheses. Adult height regressions: independent variables are for the year of birth of the individual; regressions include dummy variables for year of birth, survey year, and large-region dummies. Education variables are for the share of male or female population over 15 with each level of education; omitted variable is the share of the population with primary or less education. Robust standard errors corrected for clustering at the PSU level in parentheses.

Appendix Table 1. Average heights and percentiles of growth by U.S. standards, USSR schoolchildren by age and year of birth

Moscow							
Boys age 8				**Girls age 8**			
Year of birth	N	Height, cm	Percentile	Year of birth	N	Height, cm	Percentile
1942	438	123.2	13	1942	440	122.5	15
1950	479	125.8	25	1950	478	125.1	26
1953	302	126.5	29	1953	288	125.7	29
1961	203	129.7	51	1961	198	129.0	48
1966	164	128.2	40	1966	157	127.3	38
1983	169	127.9	38	1983	165	128.0	42
Boys age 10				**Girls age 10**			
1915	na	128.1	4	1915	na	128.2	4
1929	na	132.2	11	1929	na	131.6	9
1940	889	131.3	9	1940	831	131.1	8
1948	595	135.1	21	1948	571	134.7	18
1951	321	136.2	27	1951	287	136.5	25
1959	179	140.3	50	1959	183	140.3	43
1964	185	139.9	47	1964	190	138.4	34
1981	121	137.0	31	1981	110	137.0	27
Boys age 12				**Girls age 12**			
1913	na	137.5	4	1913	na	137.0	0.6
1927	na	140.0	5	1927	na	141.3	4
1938	1074	140.8	7	1938	819	141.4	4
1946	695	144.8	15	1946	801	146.6	13
1957	109	150.1	36	1957	140	152.8	40
1964	230	149.0	31	1964	216	151.4	33
1979	151	147.5	25	1979	108	150.0	26
Boys age 14				**Girls age 14**			
1911	na	145.4	1	1911	na	147.8	3
1925	na	151.4	5	1925	na	152.0	9
1944	352	157.7	16	1944	388	156.6	25
1955	160	162.6	34	1955	153	160.9	48
1962	242	162.3	33	1962	229	159.2	38
1977	121	162.3	33	1977	123	160.0	43

Appendix Table 1. Average heights and percentiles of growth by U.S. standards, USSR schoolchildren by age and year of birth, continued

Kiev (Ukraine)							
Boys age 15				**Girls age 15**			
Year of birth	N	Height, cm	Percentile	Year of birth	N	Height, cm	Percentile
1912	na	152.3	0.7	1912	na	152.0	7
1940	na	160.3	8	1940	na	159.8	37
1945	na	164.3	18	1945	na	157.8	26
1952	na	168.9	37	1952	na	159.7	36
1957	na	168.4	35	1957	na	161.4	46
1962	na	167.3	30	1962	na	160.5	41
Kharkov (Ukraine)							
Boys age 15				**Girls age 15**			
1908	na	150.6	0.4	1908	na	na	na
1921	na	156.7	4	1921	na	na	na
1931	na	149.9	0.3	1931	na	na	na
1935	na	152	0.6	1935	na	na	na
1940	na	157	4	1940	na	na	na
1944	na	163	14	1944	na	na	na
1949	na	166	24	1949	na	na	na
Minsk (Belarus)							
Boys age 13				**Girls age 13**			
1921	na	146.1	6	1921	na	147.9	5
1942	97	147.2	8	1942	141	150.1	10
1957	113	155.1	29	1957	140	157.3	40
Riga (Latvia)							
Boys age 12				**Girls age 12**			
1948	103	148.8	30	1948	100	148.5	19
1957	92	150.1	36	1957	139	150.1	26
1973	na	154.2	56	1973	na	154.1	47
Baku (Azerbaijan)							
Boys age 15				**Girls age 15**			
1944	104	163.9	16	1944	108	158.5	29
1959	103	170.6	46	1959	104	160.9	43

Appendix Table 2. Means of variables for fixed effects and RLMS regressions
(standard deviations in parentheses)

	Fixed effects regressions, 1960 - 1990	RLMS regressions on individual heights
Dependent variables:		
Infant mortality rate	25.32 (8.40)	–
Height in cm: Men, all	–	175.78 (6.77)
Men, non-movers	–	175.92 (6.91)
Women, all	–	163.28 (6.12)
Women, non-movers	–	163.85 (6.06)
Independent variables:		
Crude birth rate	7.82 (5.12)	–
Doctors per 10,000 pop.	30.89 (13.6)	33.46 (21.40)
% urban pop.	59.00 (18.1)	64.87 (21.50)
Log(average monthly wage)	5.03 (0.50)	4.71 (0.30)
Infant mortality rate	–	27.08 (8.29)
Share of population with:		
Higher education	5.45 (3.45)	5.39 (4.53)
Incomplete higher	1.20 (0.53)	1.60 (1.06)
Specialized secondary education	11.10 (5.43)	7.79 (2.53)
Secondary ed.	15.56 (8.34)	11.48 (4.77)
Incomplete secondary	23.63 (3.04)	23.93 (2.47)