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The Development and Inequality of Heights in North, West and East India 1915-44

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Abstract

In this study, we trace the development of height and its distribution in India during 1915-1944. Heights of Indian males of the North, West and East grew very slowly.

It has been argued that income inequality declined, but we reject our working hypothesis that height inequality declined in parallel. Rather, height differences were low during the influenza/famine period of 1918-20, and the Great Depression. With the growing openness of the late 1920s we observe a temporary rise in height inequality. The overall level of height inequality is lower than could be expected in a society influenced by a rigid caste-system.

Keywords: Stature; Heights; Biological Welfare; India; Great depression; Inequality; Influenza; Caste; Real wages

Introduction

The economic historiography of India has long been dominated by studies on the relations to the British colonial power, and although this remains an essential topic, the economic history of this South Asian giant opens many more important questions to be addressed. One such issue is the inequality of living conditions: Was inequality much higher than elsewhere, given the peculiar caste system that stirs up debates until today (Deshpande, 2000)? How did inequality develop, both between social groups and between regions? Did the crucial events of the interwar period influence the history of Indian inequality?

We assessed those questions with anthropometric techniques, measuring inequality with (a) the height differential between social groups and regions, and (b) with the coefficient of height variation (those measures will be explained below). We created a sample of 26,154 observations that covers the large parts of North, West and East India. We compared the results with our expectations generated from the existing literature. For example, Williamson (2000) found that the inequality of purchasing power probably declined in the interwar years, because real wages of unskilled workers rose, while average income fell. Ceteris paribus we would expect that height inequality of the cohorts born in this period should also decline. However, Williamson formulated some important caveats about his estimates: his real wage estimates were based on urban wages only, and the cost of living is based on a mere wheat/rice price proxy and hence contains no information about other important components such as rents and protein-rich foods. A counter-checking with anthropometric evidence can yield crucial additional evidence.

Heights are mainly determined by nutritional intake and by disease environment. While the inequality of food intake is strongly correlated with the social gaps of purchasing power, this is less the case for the latter factor, the disease environment. Especially in societies with a poorly or modestly developed public health system, morbity crises also affected the middle and upper strata, especially those who were in frequent contact with other

people (such as traders). We therefore assessed the social height differences of the most important event during this period, the influenza and famine period 1918-20. This article will be structured around the following four working hypotheses:

Hypothesis 1: Income inequality was declining significantly in the inter-war period, and this should be reflected in declining inequality of heights.

Hypothesis 2: During the influenza period, height inequality was particularly low as the disease also affected some middle and upper class groups, especially those with frequent contact with other, potentially infected people (such as traders). Large landowners lost some of their purchasing power based advantages they enjoyed during other periods.

Hypothesis 3: The Indian caste system created particularly large inequality between social and economic groups.

Hypothesis 4: In terms of height development over time, declining average income and slightly increasing public health and medical knowledge outweighed each other, hence heights were stagnant during this period. This hypothesis was constructed, but rejected for South India by Brennan, McDonald, and Shlomowitz (1994). The background of this hypothesis is given by the famous deviations between height and income development (for example, in the antebellum U.S., see Margo and Steckel 1983).

In the following, we first reviewed the quantitative literature on Indian inequality and height development, followed by a discussion regarding the main data sources of this study. Section 4 provides an overview of potential height determinants (real wages, GDP per capita, food production, disease and famine), which we then compare with the empirically observed height development. Section 5 discusses social and caste differences in the cross-sectional view, and traces its changes over time. Section 6 discusses inequalities among regions. Our section 7 analyzes the overall inequality within the three regions (using the coefficient of height variation), and explores its potential determinants. The last section of this paper

focuses on the influenza period to understand the relation between disease environment and biological welfare.

1. Methods of anthropometric inequality assessments

The study of trends and inequalities of both income and height has attracted an enormous attention during the last decades. However, it is appalling to see the limitations imposed by the available datasets on inequality of purchasing power. Gini coefficients of income and wealth have been estimated very infrequently for the Less Developed Countries (LDCs) before the 1980s and this hinders research as the long run perspective is particularly important in this field. One attempt to fill the gap was to compare the real wage index of unskilled urban workers (considered representative for the poorest part of the society) with an index of real GDP per capita (Williamson, 2000). Even though this method yielded interesting insights, it is important to complement it with additional techniques that take into account not only the wage earners, but also groups such as farm-hands, industrialists, housewives, and peasants practising subsistence agriculture.[1] In this context, various methods were proposed to make use of anthropometric measures such as human stature for extending the inequality database. Two methods based on height data were employed in this study. The first one is to use the height difference between occupational and social groups as an inequality measure, which was used successfully before by many anthropometric historians. Even though this measure depends on the availability and quality of (parental) occupational and other classifications that serve as income and education proxies, we employed this in our paper to understand inequality. As height of adults is, to the largest part, determined in the first three

[1] The question is whether urban and rural labour markets were sufficiently integrated or not. Otherwise one might argue that for our study that is dominated by the rural population (but also includes urban areas), this indicator might be of less importance. Nevertheless, it gives us an understanding regarding urban poor.

years of life, their own occupation can only be used under the strong assumption of very low social mobility (not so unlikely in the Indian case).

Another measure that was recently explored is the coefficient of variation of height for both children and adults (Baten, 1999; 2000a, Pradhan, Sahn, and Younger, 2001; Baten and Fraunholz, 2003; Boix and Rosenbluth 2004; Moradi and Baten 2005). In the case of adult height, CVs can be organized by birth cohort to understand changes over time. Moradi (2002) showed that the height variation over time is strongly correlated with Gini coefficients of purchasing power. These two measures of height inequality - height difference by occupation and social group, and coefficient of variation of height - were employed to describe the development of inequality in India during the early 20th century.

2. Views of the literature: Indian inequality and theoretical expectations

Many scholars explored Indian inequality especially in the recent years. More comprehensive and recent studies of the early 20th century found heterogeneous results about trends of height and income inequality: Brennan, McDonald and Shlomowitz (2003) argued that inequality between major castes increased by observing height from the late 19th century to the 1960s. Trends in income inequality might have been different. Williamson (2000) observed that until 1914 the urban real wage declined relative to GDP per capita (i.e., rising inequality), and after 1914 there was a decrease in inequality until the 1940s. We compared these studies with our results below.

Williamson's trends of the wage-to-GDP equality measure for India move in concordance with Bourguignon and Morrison's (2002) estimates of world inequality within and between countries. They found that inequality between all countries in the world rose over the last two centuries (in the "deglobalization" period 1914-45 perhaps slightly faster), whereas inequality within countries declined during 1914-45, but rose slightly before and after this. The reasons behind this development are not yet entirely clear, especially for the

land scarce countries in Europe. If political ideas were driving this development world-wide, then this would make our working hypothesis (1) more likely to be true.

Which theoretical views on inequality determinants can be formulated from the existing literature? Globalization and economic integration can be important driving forces of inequality, if the initial land-labor and capital-labor ratios are quite different in the previously non-integrated economies. For example, in Punjab during the 1870s there was much more land per capita than in Britain. The economic integration of the 1870-1913 period (brought about by the transport revolution) led to strong increases in agricultural exports of Punjab and the non-agricultural products of Britain. *Ceteris paribus* and assuming perfect competition, this trade boom should have made British workers better off (relative to British land-owners), and Punjab landowners richer (relative to Punjabi workers). On the other hand, after the breakdown of the first globalization movement around 1914 the reverse tendency of an equality trend in Punjab and growing inequality in Britain were expected. There is some evidence for the first in both countries, but the second development did not take place in Britain, probably because of political counter forces.[2] We answer the question below whether this had the expected impact on Indian height inequality, differentiating between deglobalisation periods, and the slight recovery of globalisation in the late 1920s.

Baten and Fraunholz (2003) found that for seven Latin American countries during the period 1950-2000, height inequality was higher in periods of greater openness, whereas closed economies had lower inequality. Apart from the influence of globalization on inequality, there is a variety of other factors that influence widening or narrowing gaps between social groups. Among the other determinants, demographic variables such as the share of the mature population (aged 40-59) relative to the total population in the age groups 15-69 (working age) was featured prominently in the work of Higgins and Williamson (1999).

[2] Whether all India can be considered a "land abundant" economy as Williamson (2000) did for Punjab and Burma (also Egypt) is a disputable issue.

Their reasoning was that an excess supply of younger workers who typically have lower wages competed the wages in their age-group down, so that inequality increased. This idea was emphasized in studies about the U.S. baby boom of the 1960s. They also considered Kuznets curve effects (growing inequality during the first phase of rapid income growth and decreasing in the second), structural change with lagging agricultural productivity, political and other factors. The implications of those latter two factors for Indian inequality dynamics were probably small, because the age composition changed in the opposite direction (see below), and there was no rapid income growth phase.

The literature on height trends in India has mainly focused on the 19th and 20th century for which the Australian research team - Brennan, McDonald and Shlomowitz - provided a variety of rich anthropometric studies. As an example, we want to highlight their result that North Indian heights increased very slowly until the second half of the 19th century, but during the last decades they started to stagnate or decline. For the 20th century, trends of heights were less clear. There was no secular trend from the late 19th century to the 1960s (Brennan et al., 1994, 1997, 2000). Earlier work by Ganguly (1979) hypothesized that during the first six decades of the 20th century, there was no significant height increase. Brennan et al. (1994) reported the following main working hypothesis of their project: There was no long term change in Indian stature under British rule, because income and disease environment before and after 1920 were offsetting each other, albeit in opposite directions. Before 1920, GDP per capita grew slightly, but the disease environment worsened. Just the opposite took place after 1920: GDP per capita declined, perhaps due to rapid population growth pressing on resources, whereas the disease environment in India improved, caused by improving knowledge about public health. Klein (1989; 1900) explains similar phenomena, but stresses other determinants. He argues that the population that had survived the influenza pandemic after 1918 had greater immunological resistance, because the more vulnerable groups had died. For South India, Brennan et al. (1994) reject their working hypothesis. They arrive at the

result that before 1920, it was mainly climatic volatility on the dry plains (and inappropriate legislation against draft animal grazing), and inequality in the irrigated areas that kept heights stagnant. The GDP growth before 1920 might have come with a more unequal distribution of income, as Kumar (1965) argues for declining real wage rates before 1900 in South India. This was intensively debated in the literature. But even an optimist would accept that at best there was a stagnation of real wages, and some increase after 1900 (Morris 1966).

In the four decades after 1920, Brennan et al. (1994) find only modest improvements in the disease environment, whereas the lower food production per capita was partly offset by unusually cheap rice imports from Southeast Asia. If those developments were main driving forces, we would expect improving living standards for market-dependent workers, and stagnant or decling welfare for rural independent producers. In the analysis described below, we found this confirmed by purchasing power trends, but not by height development.

While the development over time was modest, cross-sectional differences were remarkable. Brennan et al. (1995) found important interstate differences in height. Intercaste differences in stature were also observed in all their studies for the early 20th century (Brennan et al., 1995, 1997, 2000, 2003). Sahn (2003) explored health inequality in late 20th century India using height of pre-school age children with a special emphasis on spatial analysis. He found that inequality was low in Kerala state when compared to other states of India and health of children in Kerala was relatively equally distributed.

We extended all these previous contributions by considering the short-term variation of height, the development over time for each region, caste group, and occupation. Moreover, we also measured intra-group variation over time, and considered determinants of inequality such as integration into the world market, and the impact of the influenza pandemic.

3. Data

Figure 1 and 2 about here

The anthropometric data used in this paper were taken from the All India Anthropometric Survey (AIAS) that was done in 1960s. The anthropometric survey of the "North Zone" was initiated in December 1962. It covered the states of Assam, Bihar, Orissa, Maharashtra, Gujarat, Rajasthan (only two districts), Jammu and Kashmir, Himachal Pradesh, Punjab, Haryana, Madhya Pradesh and Uttar Pradesh (for the location of states, see Fig. 1). The survey was carried out in different phases between the years 1963 and 1971 (mostly in the mid-1960s). Many of the state surveys were taken in one year so that we could calculate the year of birth using the age information. We analyzed the data by birth cohorts in the following. In those surveys that lasted for two or three years, we took the middle year to minimize the measurement error. We assume this measurement error to be uncorrelated with our explanatory variable, but we need to keep in mind that individual year events might turn out insignificant, simply because the birth year cannot be exactly ascertained. From the 12 Northern states of India we had access only to 10 states (Madhya Pradesh and Rajasthan were unavailable), and after removing extreme ages and heights (<120 cm, >200 cm), we obtained a database of 26,154 cases. The frequency distribution of the sample is appoximately normal, as our kernel density estimates showed (Fig. 2). Tests for normal distribution also indicated that there was no normality problem with our data (not shown).

How were the surveys conducted? It seems as if the research teams measured randomly 50 individuals in general for each group in each district. A "group" consists of, as per the definition, a caste, tribe, or religious group (such as Jains, Sikhs and Muslims) in a district. Males from both urban and rural areas were selected in the sample and rural men were probably overrepresented in the sample. The measurements neither took place in special places (such as in schools), nor in social gatherings, which helped in avoiding bias. The subjects were not chosen on the basis of their bodily structure and proportion (as, for example, Risley [1891] did). The authors concluded that "the sample were free from any selection bias," although this sentence might just be relatively realistic. The principle was that if a

"group" had a substantial representation in a district, 50 individuals were selected. Groups that have small shares but lived in all districts (such as Muslims in Orissa) were somewhat oversampled. Very large groups (such as the Keota or Nulia in case of Orissa) were sampled with N=100. Brahmins and Kshatriyas were also oversampled due to the fact that they are present in all regions of India. In the following estimates, we weighted their impact on the overall mean by assigning them population weights. The authors of the AIAS survey selected males aged 18-70, but very few were in the age group 55-70. We restricted the height data to the ages 20-49 in order to avoid potential shrinking biases. Late adolescence growth beyond age 20 was tested with regression techniques, but turned out to be insignificant.

This data set contains as many as 101 population groups from 134 districts. Each caste group had a typical occupation that was described in the survey documentation. We employed this "typical occupation" as an explanatory variable, aside with the caste status. Nevertheless, we need to keep in mind that not all caste members performed the "typical" occupation of their caste in a specific region. In a few cases there were remarks about changes in the dominant occupation of a caste over time. But in general, the early 20th century can be characterized by widespread immobility among castes and their typical occupations (see appendix). However, the exact quantitative extent of social mobility between castes in the first decades of the 20th century is a desideratum of Indian economic history. More focus on this topic can be found in later sections.

Table 1 and 2 about here

The regional composition by state is as expected (Table 1). Large states such as Maharashtra and Uttar Pradesh account for many cases in our sample, the opposite is true for the small states. Over time, the geographical composition is relatively stable (Table 2). Among the "Northern" states (Jammu and Kashmir, Punjab, Haryana, Himachal Pradesh, Uttar Pradesh), some surveys were taken relatively late, so that the earliest five year birth

cohort contains only about 500 cases even though it is almost as well-documented as the West (Maharashtra, Gujarat) for the later birth cohorts. In general the distribution is relatively even, which implies that sufficient height measurements are available after 1915 for all regions. As by far the most measurements were taken in the mid-1960s, the birth cohorts closely reflect the age structure. Those born 1915-19 were mostly aged 45-49, those born 1940-44 mostly aged 20-24. Hence the slow increase in birth cohort size until 1935-39 describes an age pyramid as it is typical of LDCs during the 1960s (many young adults, fewer older ones). Only the age group 20-24 (born 1940-44) is smaller, perhaps due to the Bengal famine. This is supported by the fact this phenomenon concentrated on East India, where the famine was most severe. Hence, the age composition of the sample does not show indications for substantial bias.

The composition of "typical occupations" in the sample covers a wide range of relevant Indian occupations of the time (Table 3). One particular source of concern here is the large number of professionals (mostly Brahmins). We had to weigh the following estimations accordingly with population weights to remove this source of bias.

In order to address questions of survivor bias, the social structure by birth cohort needs to be assessed. If selectively higher mortality of poorer population segments is significant, we would expect an under-representation of poorer strata at the beginning of the period, and the opposite at the end. We consider the share of caste hierarchy and religious groups that falls into each birth quinquennial (Fig. 3). We distinguish groups with above-average social status (such as Jains, and middle/upper Hindu castes) from those below average (the scheduled castes and tribes). In between, there were muslims and sikhs with mixed social status. We find that the share of all the caste and religious groups stayed constant over time. If mortality would have caused a very strong selectivity, we should have observed a higher share of jains and upper/middle hindu castes in the first cohort, and a lower share of scheduled castes and tribes. As this is not the case, we conclude that selective mortality had only a modest

importance on the overall shares of survivors. Moreover, the share of these status groups in our sample is more or less representative in terms of their share in total population (except Brahmins, as noted above).

Figure 3 about here

4. Developments in Indian GDP, real wages, and heights

Before describing the development of Indian heights, we consider the question: which development over time would we expect, based on income and production data, if height and income would be perfectly correlated? It is clear that Indian national income during the early 20th century was extremely low and stagnant, even if it grew modestly during the "first era of globalization" 1870-1913 (but very little in comparison with the West). Maddison's (1995) estimates of GDP per capita were very pessimistic, not only in terms of level, but also regarding the development over time (Fig. 4). Except for the World Wars (!) Indian real national income declined from about 680 $ (in 1990 Geary-Khamis $) to a meager level of some 640 $ after the Great Depression. Even though those inter-war years were not a successful period for many countries around the globe, India was particularly unsuccessful during those last decades of British reign (afterwards, Indian GDP growth continued to be slow relative to many other nations, until the early 1990s).

Figures 4 and 5 about here

Scattered agricultural production data moved with a similar pessimistic trend, which is not astonishing given the dominance of the agricultural sector in the Indian economy. We constructed per capita wheat production series in two of the major wheat-growing states, Uttar Pradesh and Punjab (Fig. 5, data from Narain 1965). Those series were built with fairly good

data about the area sown with wheat (this causes most of the variation), somewhat weaker land productivity data, and interpolated population data (between the censuses that were taken every decade). We can see that wheat production did not grow as fast as population did in Uttar Pradesh (population: +7% in the 1920s and +14% in the 1930s). The per capita level was much lower in Uttar Pradesh (right x-axis in this two-axis diagram) then in Pubjab (left x-axis). The years of WWI saw some relatively successful harvests on large areas, but during the famine period of 1918-20 first the volatility increased, and then the levels started to fall (on a per capita basis) during the 1920s. Except for a production peak in 1930, the levels of 1913 and 1914-17 were not reached again during the 1920s and 1930s. Punjab had a population that was six times smaller than Uttar Pradesh due to which its greater stability (on a higher level) did not influence the general Indian development with the same weight. In this state, wheat production per capita in 1922-24 was slightly higher than the pre-war and WWI levels. Later it declined some 15-20% (except, again, in 1930).

Overall, income and agricultural production trends (in the North) would lead us to expect a height stagnation or slight decline in India, if the medical and hygienic progress during the early 20th century can be assumed to act as a counter-balancing force, as it probably did to a certain extent. Hence, hypothesis (4), the one on height stagnation, would be confirmed. However, another series of income estimates offered a different view: The real wage estimates of urban unskilled workers performed by Williamson (2000) were much more optimistic (Fig. 6). Especially the Western metropolis of Bombay and Ahmedabad experienced an increase of 60% and more between the 1910s and 1920s. Real wages have doubled there between WWI and the 1930s, even when the astonishingly low food prices of the early 1930s were dismissed as a temporary phenomenon. Real wages in Calcutta, the largest city of India and the giant of the East, increased modestly only after the 1930s (perhaps partly because they had grown exceptionally before 1900, the year on which the index is based). Inspite of high wages during WWI, Delhi participated in the later wage boom.

We should however note that those "real" wage estimates are only based on wheat and rice prices (and nominal wages). It is likely that other (untradable or less transportable) cost-of-living components, such as rents, milk and other protein-rich food, became much more expensive in booming cities like Calcutta (+138% inhabitants in the 1930s), Bombay (+46%) and the others. If we nonetheless trust the general tendency of those real wage estimates, we would expect a more favorable height development. This would lead to rejection of hypothesis (4) of a height stagnation, because it is unlikely that the disease environment worsened during this period of at least modest progress in medical technology. Williamson assumed that this wage series meant not only gains for urban unskilled workers, but that it could serve also as an indicator (assuming sufficient labor mobility) for a general decline of Indian inequality.

Fig. 6 about here

Does the development of purchasing power and biological components such as longevity, health and quality of nutrition always correlate? In fact, some important deviations were found, especially during the early phases of Modern Economic Growth in the 19th century. The highest deviation occurred during rapid economic growth in the Antebellum US, as Margo and Steckel found (1983) [for an overview, see Komlos (1996) and Steckel and Floud (1997)].

How did Indian heights develop in the interwar period and the Second World War? Our strategy to assess these developments is based on multiple regression with control for regional composition (using state dummies), caste and religion, to interpret the birth year dummy variable coefficients (Table 4). Height of Indian men during this period increased in an extremely slow pace. In Figure 7 the coefficients of our annual dummy variables are shown. We adjusted the height development by adding the year dummy coefficients to the

constant that is adjusted with the state dummy coefficients, population share of these states, and the caste shares (see Table 3, Fig. 1).

Table 4 and Figure 7 about here

We weighted the state coefficients by the population weight of each state (and not with the sample weight), so that the level of height is more or less representative of the ten Northern, Eastern and Western states of our sample. We found that the male height level around 1915 was 163.5 cm, which fitted together with Brennan et al.'s (2003) estimates of 162.8 cm (lower castes) to 164.0 cm (higher castes) for indentured workers of Uttar Pradesh measured during 1870-1900. Neither the pessimistic development of declining GDP *per capita* nor the optimistic views based on urban real wages corresponds exactly with our results. The anthropometric evidence takes the middle position between the optimistic and the pessimistic view, perhaps a bit closer to the pessimistic one. One possible reason that the real wage series does not correspond with the height developments is the deflator being only grain price. In addition, the real wage refers to cities only, whereas heights are both urban and rural, with a strong representation of rural. One considerable aspect of the low grain prices during the 1930s might be a shift from protein to starches that might have slowed down height increase.[3] A slight increase in average height after about 1932 matches up well with the potentially strong increase in urban unskilled real wages.

After the crisis years of 1918-20 that meant a decline of height, stature of Indian male started a slow and volatile growth during the 1920s, reaching a first peak in the year after the production peak of 1930 and exceptionally low grain prices. In the high-income years of WWII, heights reached their maximum around 164.0 to 164.3 cm. In 1944, the year after the

[3] Thanks to Sevket Pamuk for this suggestion.

Bengal famine, heights fell back to 163.6 cm, even though Bengal and Calcutta were not included in our sample. In sum we can say that Indian heights increased, but very modestly (around 0.7 cm), and at a very low level. The fact that we often find a height effect in the year after an event might either be explained by birth year measurement error (see above) or by the fact the maternal nutrition during pregnancy impacted particularly strongly in the Indian cases (particularly strong gender discrimination). Summing up, Indian heights grew only modestly during this period. Therefore, we can confirm the first part of hypothesis 4 posed in the introduction: height did not change very much during this period.

Four caveats of our time series estimates need to be mentioned. We also report the degree to which we could control them.

1. Selective mortality problems of cohort studies: Shorter people had a higher risk of dying at younger ages compared to the older ages (Waaler, 1984). Those that survived might have been from a slightly taller selection, although many direct comparisons did not yet gain conclusive results. In our case, the influenza and famine period of 1918-20 and the Bengal famine 1943 are events that might have caused special selective mortality. But our discussion of survivors by caste and religion did not yield strong evidence of selective mortality, therefore the effect might be small (see Fig. 3).

2. The influence of environmental conditions during the years after infancy and early childhood is also important, especially for short-term deviations from the growth path. But we rely on the study of Baten (2000b) that found the effect of environmental conditions during the first three years to be so overwhelmingly strong that later influences on growth had only a very modest impact on final adult height.

3. Age heaping: Especially people from less educated social strata did not know their exact age and they tended to round their age to the nearest number, generally a number that ended with zero or five. Those who were not able to report their exact age are considered to be less educated and of lower social status (and also perhaps lower height). Therefore, age heaping

had the consequence that average height might be lower on round years and there might be less cases documenting height in the numbers that do not end with five or zero. We adjusted age heaping by assigning dummy variables to the "preferred" round and the neglected ages. The age heaping effect on ages ending with zero was strong enough to decrease the heights significantly (Table 4).

4. We could not control for migration, and this leads us to avoid all comparisons between urban and rural welfare, or between individual states. However, migration across the borders of our three large regions (North, East, and West) was relatively limited. Somebody born in rural Maharashtra (West) might have preferred to migrate to Mumbai instead of migrating to Delhi (North) or Madras (South). We would therefore argue that an interpretation of height developments of these three regions is legitimate.

5. Did the caste system create abnormally large inequality? How did social inequality develop?

Figure 8 about here

We will now shift to study the differences in anthropometric development among different Indian social groups and to various regions. We will test whether the egalitarian trend suggested by the unskilled real wage vs. GDP/c. data can be confirmed by height data (hypothesis 1). We will also consider whether the more open period during the late 1920s increased height inequality, and the Great Depression and influenza epidemic decreased social differences.

Before we discuss height differences by caste, it is revealing to have a general view on the caste system in India. From a religious point of view Indian society during pre-independence time was mainly divided into two categories viz., the Hindu and Muslim

society, whereas Sikhs, Jains and others were smaller religious groups. The division of Hindu society can be explained in terms of the so-called Varna system from the Brahmin point of view, the Brahmin on the top, followed by Kshatriya, and the Vaishya. Sudras were at the bottom of this social hierarchy. In a village different castes lived separately from one another and the so-called untouchables suffered greatest disabilities. There was a restriction on occupational mobility and caste mobility. Every Hindu was born in a caste and could not leave it unless he or she was made an outcaste or decided to become a Sanyasi (Yogi) who completely abstracts from all worldly objects to acquire superhuman faculties.

Caste was characterized by endogamy and caste status was fixed for all the castes. There was a network of socio-economic relationships often termed as Jajmani system that does not exist now, but was still influential during the early 20th century. Anthropologists and sociologists in general define it as the reciprocal social and economic arrangement between families of different castes within a village community of India, by which one family exclusively performs certain services for the other. These relations continued from one generation to another, and payment was normally made in the form of grain, clothing, and money. It added to low occupational mobility of the castes and did not create incentives for productivity and quality improvement (Desai, 1968).

The Brahmin was a temple priest, teacher, doctor and cook of a rich landlord. Rajputs were cultivators, landowners or so-called Zamindars (i.e., the feudal lord of the village). Sometimes they worked in the army or police. Vaishyas' were generally involved in trade and business. Other social groups were oil processors (Teli) and carpenters who repaired ploughs, agricultural implements and made furniture for every village. Blacksmiths made iron instruments and utensils and some castes performed occupations like leatherwork, washing, pottery, barbering and scavenging. There were also castes for those who made sweets and liquor. There were pastoral castes, flower and vegetable growing castes, entertaining castes, a fishery caste, an accountant caste, a prostitute caste, a watchmen caste, and other groups.

Summing up, Indian caste system created hierarchy in the society where certain castes enjoyed privileges and the remaining castes were discriminated. From all those factors, we would expect that height differences between social groups were abnormally large in India, which referes to our initial working hypothesis (3). But there were also other factors that might modify this view: For example, the Dravid movement (1920), Justice movement (1916), self-respect movement (1926) and few other similar movements played a significant role as anti-Brahmin and anti caste movements. Along with these movements modern education, industrialization, means of communication, new legal machinery provided by the British government (like punishing criminals of all castes in equal way), legalization of inter-caste marriages and abolition of untouchability might have contributed to changes in the caste system in British India. Later on, independent India guaranteed right of equality and abolished utouchability in a constitutional way. These factors might lead to the rejection of hypothesis (3), hence it is an empirical question whether this is true or not.

This study classified the castes of the total sample into seven major categories: High, middle, and low castes, tribes, Muslims, Sikhs and Jains. People from ‘high castes’ had access to land and education. Middle castes included artisans, fishermen, and oil pressing specialists, agricultural laborers and many others. Low caste people were those who were assigned various menial jobs and ritually polluting jobs like cleaning, leather working, butchering, and serving. Low caste people were so-called ‘Untouchables’ and currently they are referred as “Scheduled Castes” (as they are now under governmental protection for rights). High caste people belong to the "twice born" group that distinguishes them from the other caste groups. The typical characteristics of tribes were simplicity of technology, geographical isolation, distinct culture, shyness to contact with the rest of the society and economic backwardness. In summary, high caste people were the ones that belonged mostly to priestly, warrior and trading caste. The castes that were neither lowest castes (scheduled caste and tribe) nor upper castes were classified as middle caste.

We will now shift our focus to the discussion regarding height differences in a cross-sectional perspective before tracing the development of inter-group differences over time. Men belonging to the Sikh religion were the tallest and they were followed by the men belonging to upper caste (Table 4, Fig. 8). Jains and Muslims were shorter than Sikhs and Upper caste men, but they were taller then other Hindu groups. Within the Hindu religion, upper caste men were taller than the middle and low caste men. Scheduled Tribe and Scheduled Caste men were in the most disadvantageous position in terms of stature. From this we can conclude that social hierarchy played an important role in determining height of individuals. Higher caste people who were taller had better access to food, health and education compared to the lower castes. In contrast, the religious groups of Sikhs and Jains had a relatively egalitarian society with no caste hierarchy. In addition, most of the Sikh men were residing in Punjab and Haryana where agricultural productivity and protein supply was high. Jains were mostly in trade occupation that yielded high incomes which reflected in their height.

However, while social height differences were remarkable, this was no Indian specialty. Everywhere in the world, higher income groups tend to be taller. The interesting question is rather: Did the Indian caste system with its low occupational mobility lead to abnormally large height differences? Comparing our differentials with the literature on other countries, the answer is negative. Height differences elsewhere were I a similar range, and sometimes even larger. For example, in the late 19th century U.S. farmers were the tallest group, whereas laborers were the shortest, with a difference of about 3.1 cm (Haines 2005). Height differences in Argentina were about 2.5 cm between unskilled workers and students/teachers/professors (Salvatore 2004). In 1875, Belgian students were even 5.3 cm taller than woolworkers, who were the shortest group there (Alter, Neven, and Oris 2004). In this case, some of the 20-year-old Belgian recruits might not yet have reached their final adult height. Therefore this difference might translate into slightly lower adult height differences,

because both growth velocity and final height differential are both affected by worse net nutritional status of the poorer groups. The growth velocity part of the differential might later disappear due to catch-up growth. This explains also the truly enormous height differential between English school boys, which were far more than 10 cm around 1800 (Floud, Gregory, and Wachter 1990). To sum up, caste inequality was definitely important in India for the period 1915-1944, but in international comparison it was not as abnormally large as we would have expected, hence we falsify hypothesis (3). Religious rules might have played a role here that contrained the protein (especially beef) consumption of Indian upper classes, whereas the lowest classes were not hindered by those rules.

In our next step, we focus on the typical occupations of the groups, which is a refinement to the classification we used before. Now we consider 14 typical occupations of population groups. Interestingly, pastoral men were taller in many states despite of their typically low caste status (Table 5). For example, the tallest men in the state of Himachal Pradesh were the men belonging to the Scheduled Tribe group of the Gujjars (Appendix Fig. A1). Brahmins and Rajputs were shorter than this Scheduled Tribe that might have had good access to protein (given their pastoral occupation). On average in all states, and controlling for regional composition, landholders, professionals, pastorals, writers, and traders were relatively tall (Table 5). A middle group consisted of skilled craftsmen, cultivators, agriculturists, fishermen, weavers and leather workers. They were doing relatively better than agricultural laborers, men doing menial jobs, potters, and mixed occupations.

Figures 9, 10 and Table 5 about here

How did height of the seven religious and caste groups' change during the period 1915 to 1944 (Fig. 8)? In short, the differences did not change very much, except for the Sikhs. This relatively well-educated religious group might have benefited from the "open period"

during the late 1920s, and from the very low grain prices during the early 1930s; two advantages, that were lost in the following period. However, we would not over-emphasize this result, because our sample size for Sikhs is relatively small. Other groups moved very similar to the general development. Slight increases in the height of upper caste men and Muslims can be observed, whereas Jains and Scheduled Caste men gained no real increase in height. The biological welfare of Scheduled Tribe groups converged somewhat. Overall, among men belonging to Hindu caste height disparities did not decrease much from the period 1915 to 1944. Our working hypothesis (1) of an egalitarian development must be rejected for caste groups, although we will consider below whether this was also true for the development between occupational groups, and within groups.

Finally, we consider the development of the 14 typical occupations over time (Fig. 9). In general, the movement of those time series is quite similar. Fishermen had a high volatility (probably due to relatively small sample size). Interestingsly, traders might have benefited most from the "open" period of the late 1920s, but their heights fell dramatically during the Great Depression. Poor and less market-integrated groups (cultivators, perhaps fishermen) did relatively better during this economic downturn. In sum, this component of inequality between occupational groups again confirmed that between-group differences did not change much, except perhaps modestly for the early 1930s.

6. Height differential by region

Regional differences are often an important element in overall inequality, as it is certainly the case in today's China. Within our sample, they were clearly noticeable. Men from the Northern region were the tallest over the period 1915-44 (Fig. 10). Eastern men were the shortest and they experienced only a very slight increase (about half a centimeter) over the time period. Northern male heights remained most of the time within a band between 166 and 167 cm, except for the crisis period around 1920. The North and the West did not show much

upward trend in height. The disparity between East and North/West declined slightly. In sum, we find that regional inequality did only decline very modestly during this period, as East Indians converged to a limited extent from below. Hence, this is partial evidence favour of our first working hypothesis.

It is also interesting that the most urbanized West suffered the most from the 1918-20 influenza and famine crisis. The variability of Western heights decreased – as one can expect during the 20th century market integration process – whereas the variability of Eastern heights increased over time. This is not caused by small sample size. It might be a hint that food markets in the East with its rapidly growing population did not develop fast enough. This observation could be helpful in subsequent studies on the Bengal famine.

7. CV of height inequality

The overall height inequality can be assessed with the coefficient of variation of height (Baten, 1999; Baten, 2000; Pradhan, Sahn, and Younger, 2001). After we found above that height differences between groups and regions did change only modestly, this measure of overall inequality might have determined mainly by intra-group and intra-regional inequality. The height inequality coefficients had no clear trend in the three Indian major regions for the period as whole (Fig. 11). But we found that 1915-29 was a period of increasing inequality for all the three regions. The Northern region experienced highest increase during this period and had decreasing inequality till 1944. The Eastern region experienced their highest peak slightly later, in 1935-39. In contrast, the early 1930s with their particular low food prices were a period of falling inequalities for west and north, and stable values in the East.

Figure 11 about here

What could explain this development? The influence of openness on inequality could be one point. Baten and Fraunholz (2004) have argued that openness increased height inequality in another less-developed region of the world, in Latin America 1950-79. Firstly, there were growing height differences between the well-educated and the uneducated during the more "open" periods. Secondly, foreign investment was more dynamic in high-income metropolitan regions (thus, capital and labor markets worked imperfectly). O'Rourke and Williamson (1999) found that especially in land-rich countries income inequality increased during globalisation, and they classified India as such. While the whole period of 1914-45 was characterised world-wide by deglobaliation tendencies, during the 1920s some recovery of international integration took place. In the late 1920s India's trade shares ([Import + Export] divided by GDP) reached their highest values during this whole period (Mitchell, 1998). In contrast, the decrease of international integration during WWI and the Great Depression might have had the opposite effect of reducing height inequality. Apart from the openness, the particularly low food prices during the early 1930s could have also decreased inequality.

What about other determinants of inequality? The demographic theory that the share of mature people in the labor force was not likely eplanation here, as India experienced a decline in the share of mature people between 1911, 1921 and 1931 that would lead us to expect a constant increase in inequality. Kuznet's inverse U theory of growing inequality during the first phase of rapid economic growth does not apply because there was no rapid growth. In sum, we reject our working hypothesis (1) of a continuous equality trend during the interwar period. We would rather argue that there were two periods of low inequality, the late 1910s, and the early 1930s, and an increasing inequality during the 1920s.

8. Height inequalities during the influenza period

To find out whether influenza did hit the poorer population relatively harder or not, we took height deviations of occupational groups from mean height for the pre-influenza pandemic and famine period (1915-17), influenza pandemic and famine period (1918-20) and post-influenza pandemic and famine period (1921-24). This allowed us to understand the impact of influenza and famine on different occupational groups. Three hypotheses are mentioned in the literature that can be considered as refinement to our hypothesis (2). What could have lead to the lower height inequality during the influenza and famine period? (2A) During a major wave of epidemic disease, the infection is less determined by income, especially if the health system is less-developed. Compared with food consumption, which is directly determined by income, social differences of height might decline (compare McKeowns # arguments about disease). (2B) The Indian religious constraints about food consumption kept the upper Hindu castes, especially the Brahmins, from going to soup-kitchens and other food distribution institutions, because they would have felt polluted. Higher castes aimed at never sharing cooking, eating and drinking vessels with other castes. Apart from this, Brahmins never accepted food and water from any other castes other than their own. Moreover they never ate with persons of other castes during ceremonies such as marriage or food distribution programs. Even if economists typically do not like “irrational” behaviour, religious taboos could have played a role in this special case. (2C) The closing of the economy during WWI and the decline in world trade continued, and created less additional income for the well-educated groups (such as traders, Sikhs etc), and for the inhabitants of vibrant metropoles, so that their income advantage over the uneducated and over those living in economically depressed regions vanished. To a certain extent, this might been reflected in heigths (Baten and Fraunholz 2004).

Figure 12 about here

In fact, disaggregating by typical occupations, we find that traders and landholders who did well under other circumstances, did badly during the influenza and famine crisis (Fig. 12). In contrast, the professionals (mostly Brahmins) kept almost entirely their heigh biological standard of living. Among the lower and middle height groups, the development was heterogeneous. Menial workers and agriculturists who were already below mean height in other periods were hit hard during influenza peiod. Weavers and leather-workers, mixed occupational men, potters and cultivators who did not fare well under normal situation were doing better during the the famine and influemza epidemic. Pastoralists who were already doing well also kept their anthopometric values during the influenza and famine period. In general, the influenza pandemic had egalitarian effects, as landholders and traders (rich and educated) were among the suffering strata. At the same time menial workers were severely affected due to their contact with diseased people due to their cleaning and scavenging occupation.

Which conclusion can we draw about our hypotheses? Factor 2A, the egalitarian spreading of disease, was definitely at work, given that so many high-income Indians were affected. Brahmins were less affected, but they might have used their high education to isolated themselves sufficiently to be less infected. Traders also had a good education, but it was of a more commercial character. The second hypothesis 2B (religious contraints not allowing to share food aid) is somewhat less supported in our cross-section, because we would have expected the detrimental effects on Brahmins to be strongest, but their anthropometric values only declined modestly. In contrast, traders in early 20th century India might have been less "irrational" about not accepting food aid because of religious rules when their children were hungry. But we find a strong height decline in the traders groups in the core years of the crisis. Hypothesis 2C (egalitarian effects of closing) certainly has some explanatory power, as

we our intertemporal comparison above suggested. But this cannot be the whole story, because then the egalitarian effect should have already affected the cohorts born 1915-17. In sum, we would argue that the egalitarian effects of the influenza pandemic were the driving force between the low inequality of the 1918-20 period, with the other two factors contributing to a smaller extent.

A comparison can be drawn with the second major equality episode, the early 1930s. Around the world, this was the period of the Great Depression, although in India the effects might have been slightly less pronounced. Again, we took the deviation of height of various occupational groups from mean for the period 1926-29 (pre-depression period), 1930-33 (great depression period), and 1934-37 (post-depression period). We found that landholders and traders were particularly affected during the 1930-33 period (Appendix Figure A2 and A3). Traders had the maximum decline of their anthropometric values during this Great Depression period. Contrastingly, most other occupational groups showed only little change, some even small improvements during this period. We can conclude that the occupations that were related to the world market directly suffered most from the Great Depression in relative terms, and this might have contributed to the egalitarian effects of this second major crisis.

9. Conclusion

We structured this study around a set of four interrelated hypotheses about Indian height inequality and height development during the period 1915-1944. We obtained the following results.

Hypothesis (1) In sum, we reject our working hypothesis of a continuous height equality trend during the interwar period that might have been *ceteris paribus* caused by the declining income inequality which Williamson (2000) found. We did not find continuous convergence between castes and religious groups, not between occupational groups. A modest regional convergence between the three large regions did not lead to generally declining height

inequality in India. We would rather argue that there were two periods of low inequality, the late 1910s, and the early 1930s, and an increasing inequality during the 1920s. The inequality increase during the 1920s was partly caused by better incomes for the more educated groups (such as traders and Sikhs). The egalitarian episodes were analyzed more closely under hypothesis 3.

Hypothesis (2) During the influenza and famine period 1918-20, we observe relatively low height inequality in India. Traders and landlords suffered relatively more compared to middle and lower status groups. We have argue that the egalitarian effects of the influenza pandemic were the driving force between the low inequality of the 1918-20 period, with two other factors contributing to a smaller extent: religious taboos, and the lower advantage of well-educated and metropolitan groups during "closed" phases of world trade. We would argue the effects of the 1918-1920 influenza epidemics are one of the most interesting results of the this study.

Hypothesis (3) The caste system clearly played a significant role in determining stature of individuals, but it was only the Indian substitute for income and educational differences that were at work in other countries. Upper caste Indians were about 2.9 cm taller than scheduled tribe men. Sikhs were even taller, but they lived in a region with high protein proximity advantages. In comparison, height differentials in Europe, North and South America were of a similar dimension (between 2.5 and nearly 5 cm between extreme groups). Interestingly, Indian pastoralists who belonged to low caste and social status were taller compared to the higher caste people, because the milk proximity advantage mentioned above, which is also an argument against an omnipotent determinism by caste.

Hypothesis (4) In sum, we confirmed the hypothesis of Brennan, McDonald and Shlomowith (1994) that heights increased modestly during the early 20th century. Between our earliest cohorts and the late 1940, the increase was only about 0.7 cm, which is much lower than in Europe, for example. Comparing Williamson's real wage estimates to the height

development, we find that also their hypothesis supported that cheap rice imports did offset the declining food production in India, and the declining GDP per capita. The slightly improving disease environment over the 20th century might have played an additional role, certainly after the distrastrous influenza pandemix at the beginning of our study period.

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Appendix A: Caste System and occupational mobility

In this paper we have focused on typical occupations of different caste groups and their biological welfare. Data about the typical occupation of the caste groups were taken from the introductory chapters of the survey. One important question that arised in this context is occupational mobility. There is a lack of adequate data especially about changes in individual occupation over time. L.K. Mahapatra (1995) was the only one to use census data of 1911, 1921 and 1931 to describe the change and development of traditional occupations of different castes in Orissa state.

Table A1 Percentage of working population following the traditional occupations as their main or first subsidiary occupation

Caste	Percentage of working people in traditional occupations (1921)	Percentage of working people in traditional occupations (1931)
Brahman	27.2	26.1
Kamar	67.7	57.4
Dhoba	85.6	75.1
Kumbhar	83.4	78.2
Tanti	78.1	71.7
Karan	34.4	50.2
Teli	46.7	32.3
Chasa	88.7	N.A
Barhai	49.9	N.A
Chamar	67.1	N.A
Kewat	82.7	N.A
Goura	69.5	N.A

Note: N.A stands for non availability of the data.

There was no strong occupational mobility in Orissa during this period for most caste groups. In many cases, two-thirds still worked in their traditional occupations, or used it as their first subsidiary occupations. Notable exceptions were elite groups like Brahmins and Karans. Also we should keep in mind that we were talking about low occupational mobility corresponding to the year of birth of the men covered by the AIAS survey. Their height was mainly determined by their parents' occupation and when we move further backward in time

to the fathers of these men whose occupations were determined 2-3 decades before, occupational mobility probably was even lower. Based on this argument we conclude that occupational mobility might not have played a significant role for the late 19th century and the first decades of the 20th century, especially for the rural parts, except for a few elite groups.

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Appendix B

Definition of occupational groups is given in this appendix in detail.

Cultiv: Number of males whose primary job classification is cultivation

Agric: Number of males whose primary job classification is cultivation who rent others land for cultivation

Agriclab: Number of males whose primary job classification is agricultural labor

Profess: Number of males who were priests, doctors, and teachers (these occupations were in the hold of Brahmin caste)

Fisher: Number of males whose primary job classification is fishing

Landhold: Number of males who possess vast size of land and hire labors for cultivation

Menial: Number of males whose primary job classification is scavenging, cleaning, leather production and butchering (This occupation category was considered degrading)

Trade: Number of males whose primary job classification is trading

Pastoral: Number of males whose primary job classification is pastoralism

Writing: Number of males whose primary job classification was writing

Skilledc: Number of males who were oil processors, gold smiths, and black smiths

Potter: Number of males whose primary job classification was pot making

Mixed: Number of males who were in other occupations that were not listed above.

Table 1: Composition of the sample by state

State	Number
Assam	1468
Bihar	3683
Gujarat	3296
Haryana	500
Himachal Pradesh	773
Jammu and Kashmir	559
Maharashtra	5607
Orissa	3789
Punjab	1013
Uttar Pradesh	5498
Total	26186

Table 2: Composition by birth cohort and large region

	1915-19	1920-24	1925-29	1930-34	1935-39	1940-44
EAST	668	1305	1370	1681	2143	1773
NORTH	490	886	1489	1530	2043	1905
WEST	745	1074	1257	1817	2068	1910

Table 3: Composition by occupational groups

Occupation	Frequency
Agriculturist	3163
Agriculture labor	1695
Land holder	2948
Professional	4157
Cultivator	2253
Fisher	602
Menial	1319
Pastoral	1613
Potter	1299
Trade	902
Writer	628
Weaver and leatherworker	2010
Skilled crafts	1420
Mixed	2145
Total	26154

Table 4: Regression of height on state, caste, religion and individual year dummies.

Variable	Coefficient	P-values
Assam	-32.8	0.00
Bihar	-29.5	0.00
Gujarat	-21.3	0.00
Haryana	14.0	0.00
Himachal	-31.6	0.00
Jammu	-22.9	0.00
Maharastra	-23.7	0.00
Orissa	-32.8	0.00
Punjab	14.4	0.00
Rounding 10	-1.9	0.20
Rounding 5	1.5	0.25
Near rounding 10	-0.6	0.70
Near rounding 5	1.6	0.19
Birth year		
1915	-7.3	0.19
1916	-9.9	0.01
1917	-6.0	0.13
1918	-9.7	0.01
1919	-10.1	0.00
1920	-7.3	0.03
1921	-4.8	0.14
1922	-7.0	0.02
1923	-6.2	0.05
1924	-1.5	0.61
1925	-5.8	0.05
1926	-6.8	0.02
1927	-2.0	0.49
1928	-4.2	0.17
1929	-6.8	0.01
1930	-6.0	0.04
1931	-0.6	0.82
1932	-4.5	0.08
1933	-1.4	0.61
1934	-2.4	0.38
1935	-3.3	0.23
1936	-3.0	0.25
1937	-3.2	0.21
1938	-2.9	0.26
1939	-2.2	0.38
1940	-4.1	0.13
1941	-1.1	0.67
1942	-2.8	0.27
1944	-5.9	0.03
Upper Caste	29.8	0.00
Middle Caste	8.6	0.00
Scheduled Caste	2.4	0.09
Sikh	44.6	0.00
Jain	20.2	0.00
Muslim	25.2	0.00
Constant	1642.8	0.00
Adjusted R^2	0.10	
N	26154	

Notes: In the right column, p-values are given. The constant refers to scheduled tribe men measured in Uttar Pradesh, born in 1943, whose age is not on round or next-to-round numbers.

Table 5: Determinants of height: typical occupations

Agriculturist	15.9	0.00
Agriculture labor	4.6	0.03
Land holder	27.0	0.00
Professional	36.0	0.00
Cultivator	20.1	0.00
Fisher	12.8	0.00
Menial	2.7	0.24
Pastoral	35.2	0.00
Potter	5.0	0.03
Trade	29.4	0.00
Writer	31.7	0.00
Weaver and leatherworker	12.8	0.00
Skilled crafts	24.4	0.00
Constant	1639.7	
Adjusted R^2	0.11	
N	26154	

Notes: In the right column, p-values are given. The constant refers to men from mixed occupations born in 1943. The regression also controls for year of birth and age heaping though not reported here.

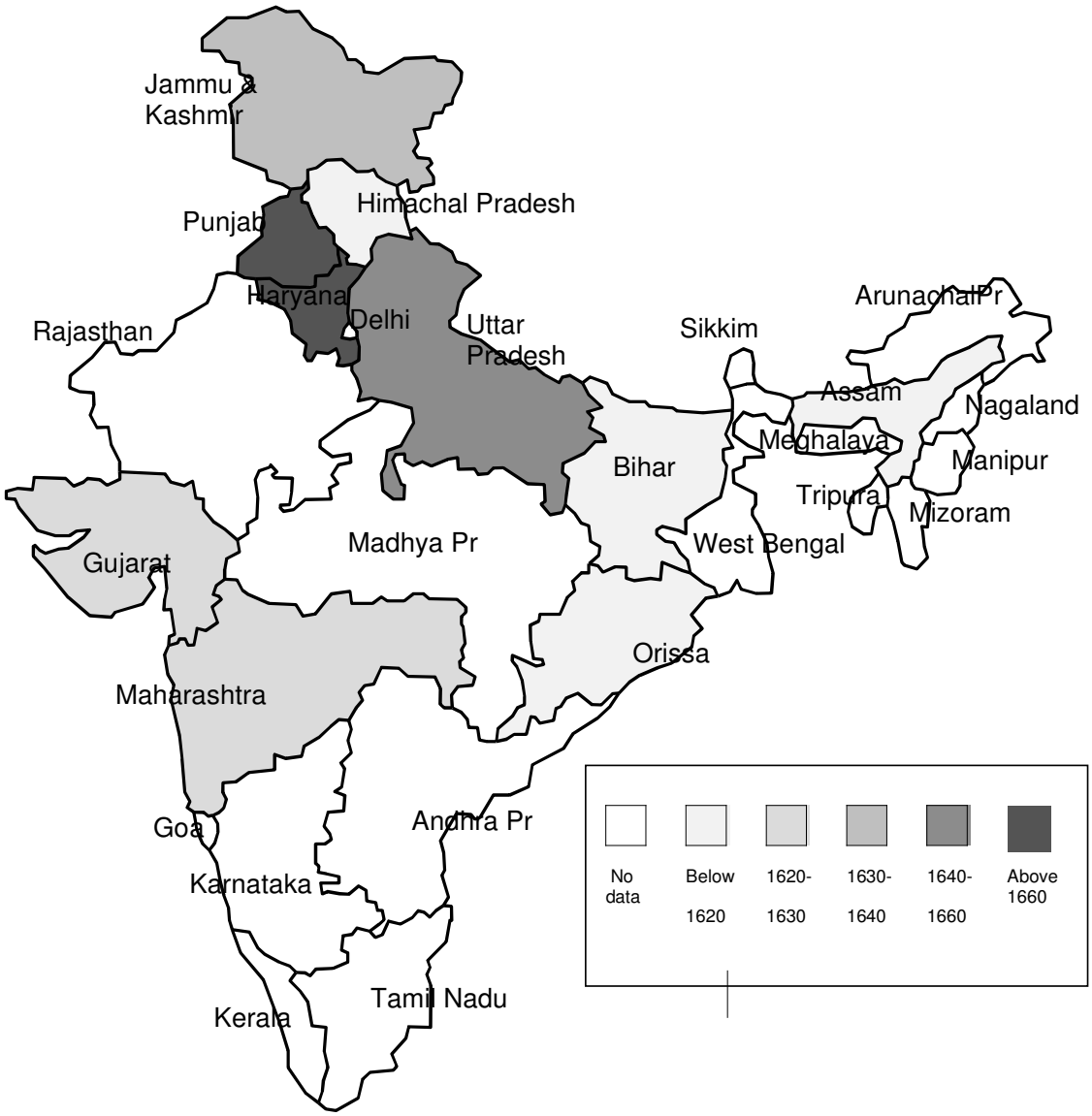


Fig. 1. Map of Indian States with mean height level
Source: State coefficients from Table 4

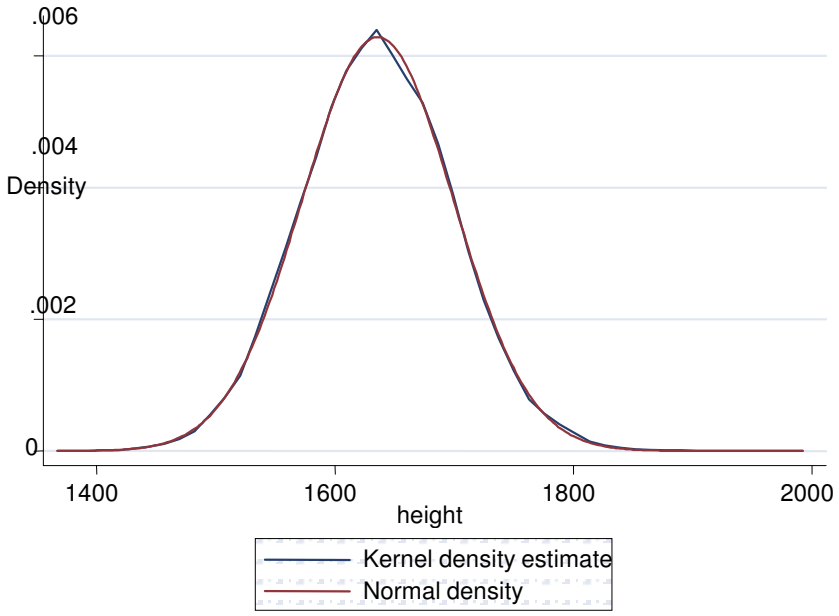


Fig. 2. Test of normal distribution of the sample

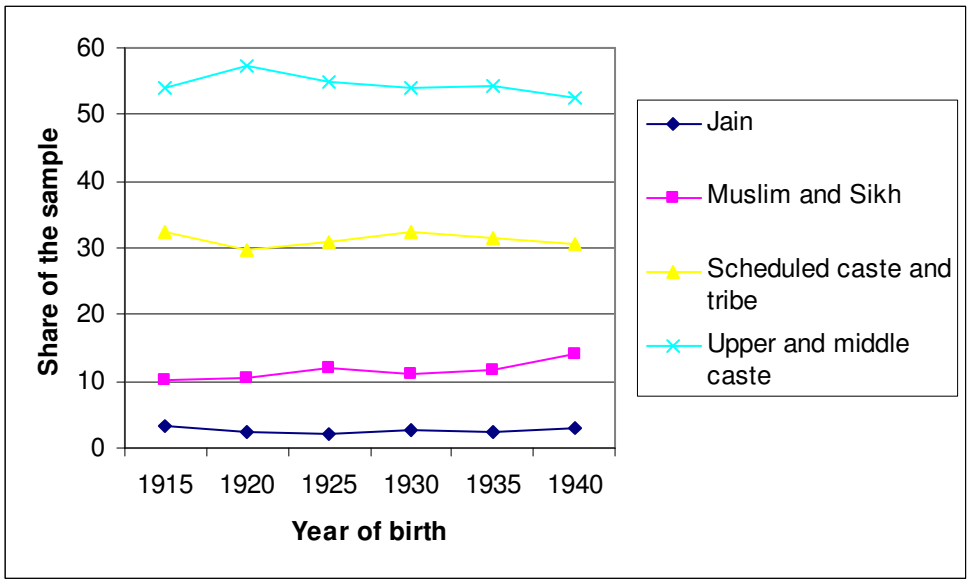


Fig. 3. Composition by religious and caste groups of high and low status over time

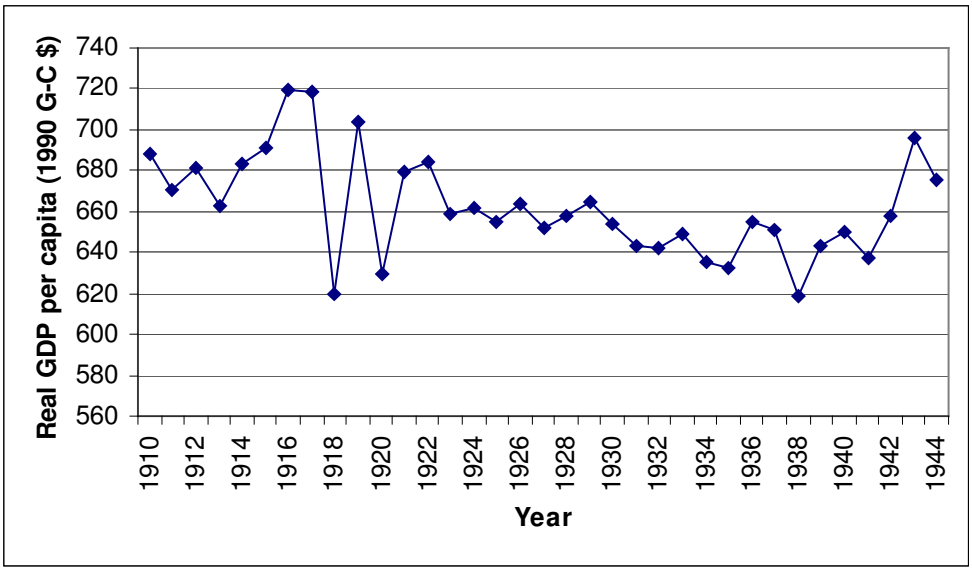


Fig. 4. Real GDP per capita in India from 1910-1944 (in 1990 Geary-Khamis $)

Source: "Maddison 1995, p. 204-5".

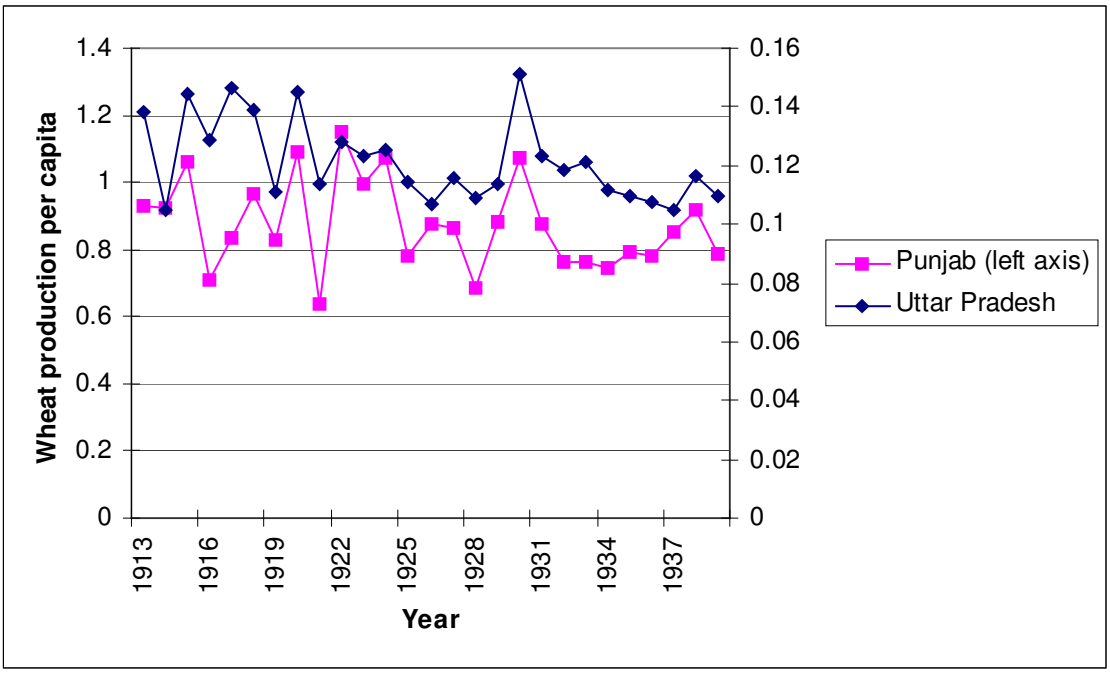


Fig. 5. Two-Axis-diagram: Estimates of wheat production per capita in Punjab (left y-axis) and Uttar Pradesh (right y-axis).

Source: "Narain 1965, pp. 216 and 223".

Wheat production per capita is measured by #

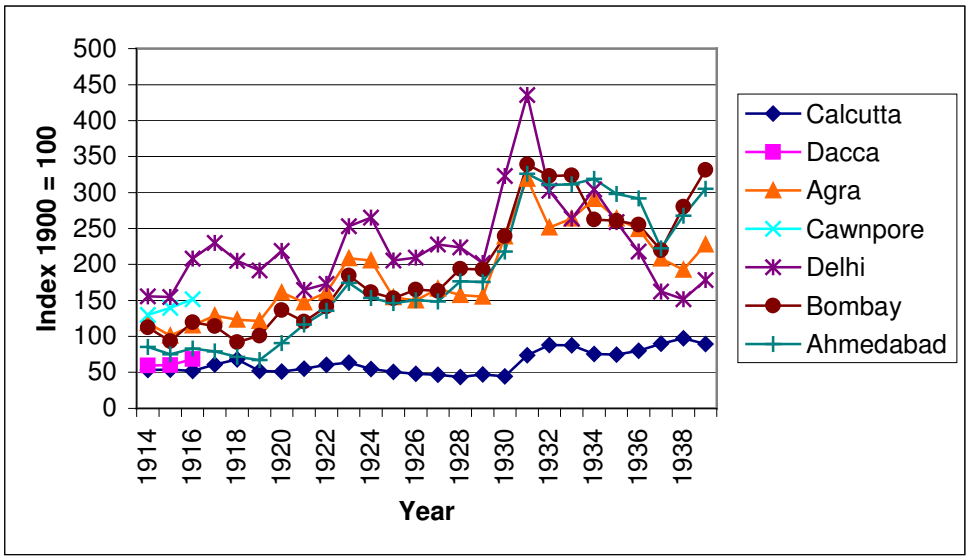


Fig. 6. "Real" (wheat/rice) wages of urban unskilled workers in Indian cities.

(Source: Williamson 2000)

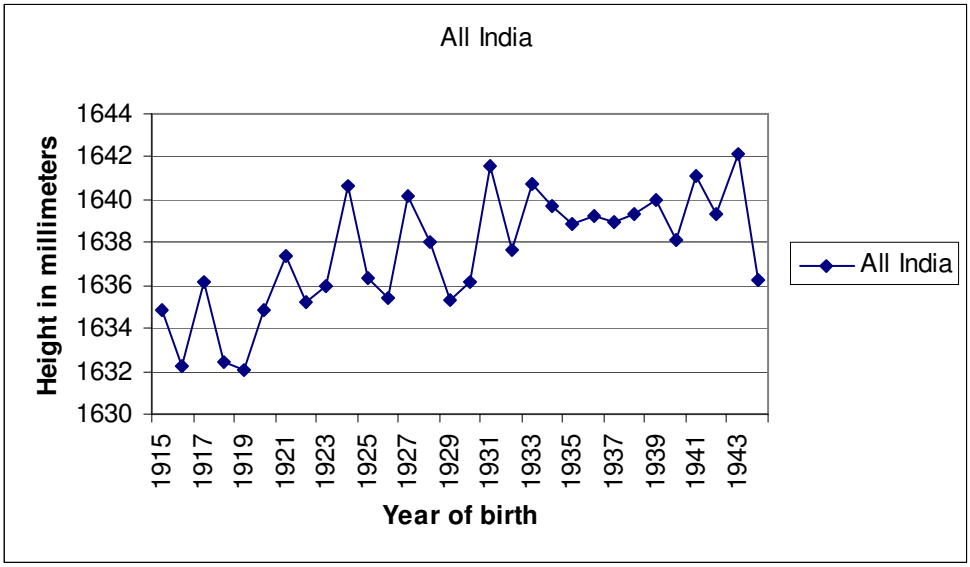


Fig. 7. Height in India, 1910-1944: Adjusted annual average heights. Note: We adjusted for regional composition (using population, not sample weights), and for cate status composition to avoid biases (for example, because of Brahmin overrepresentation).

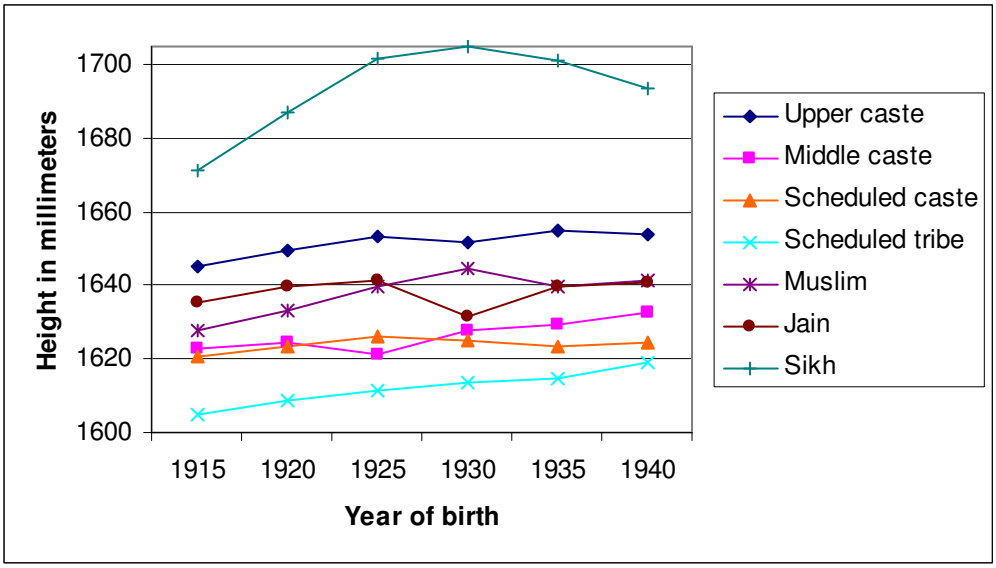
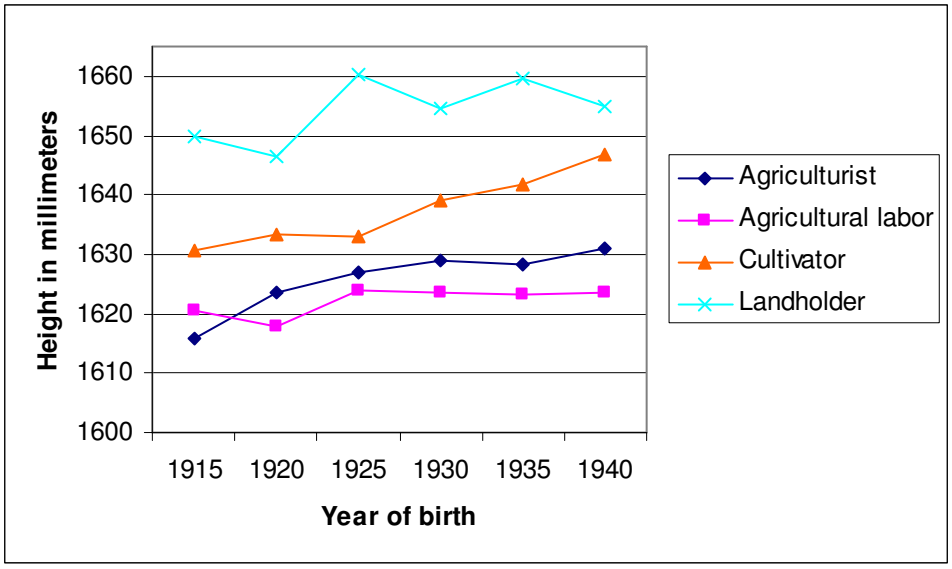
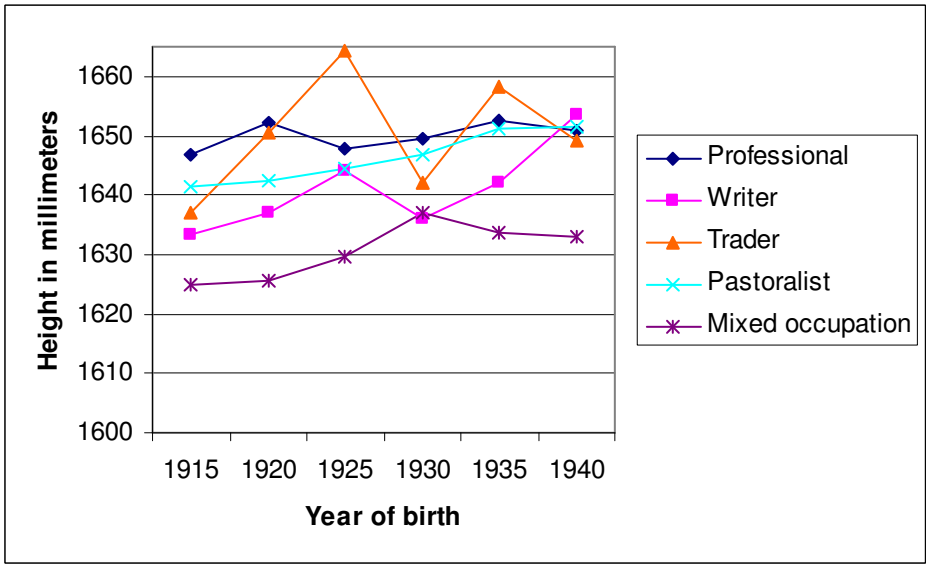


Fig. 8. Height development of various caste and religious groups

Panel A



Panel B



Panel C

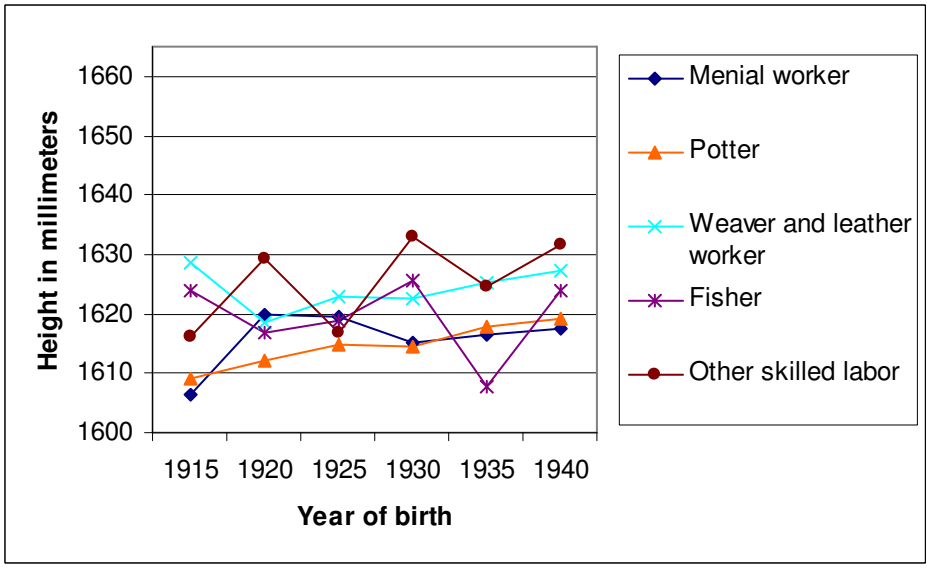


Fig. 9. Height development of various occupational groups

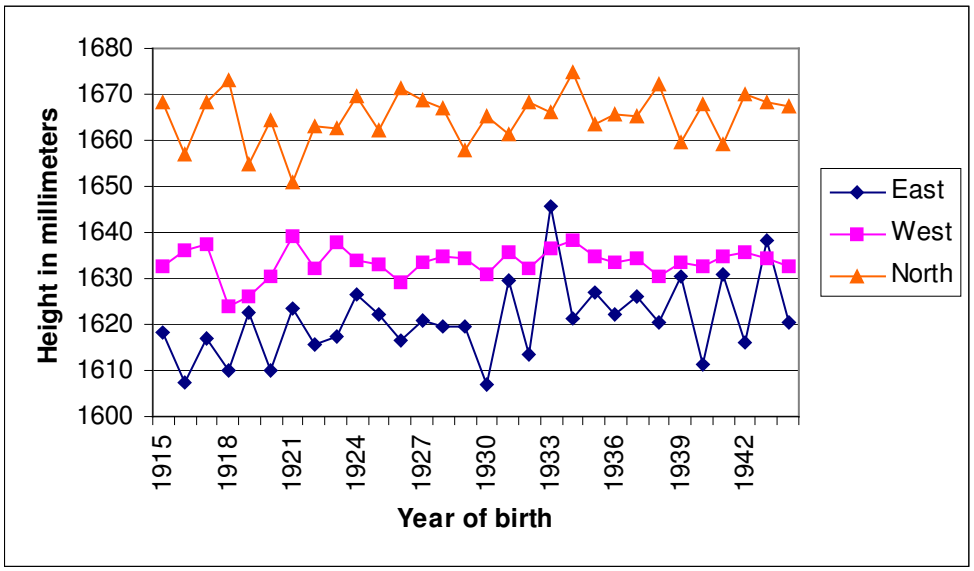


Fig. 10. Regional height development in India, 1910-1944: Adjusted annual average heights

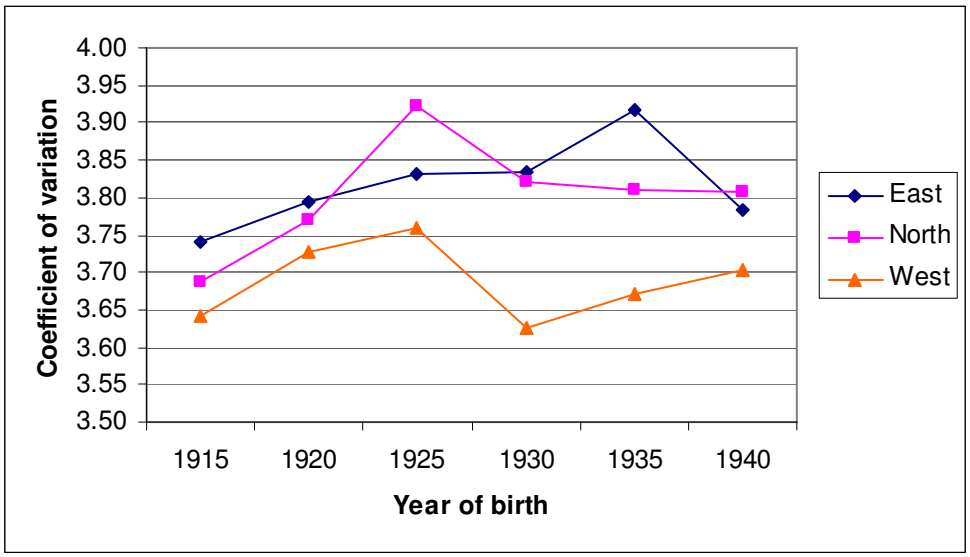
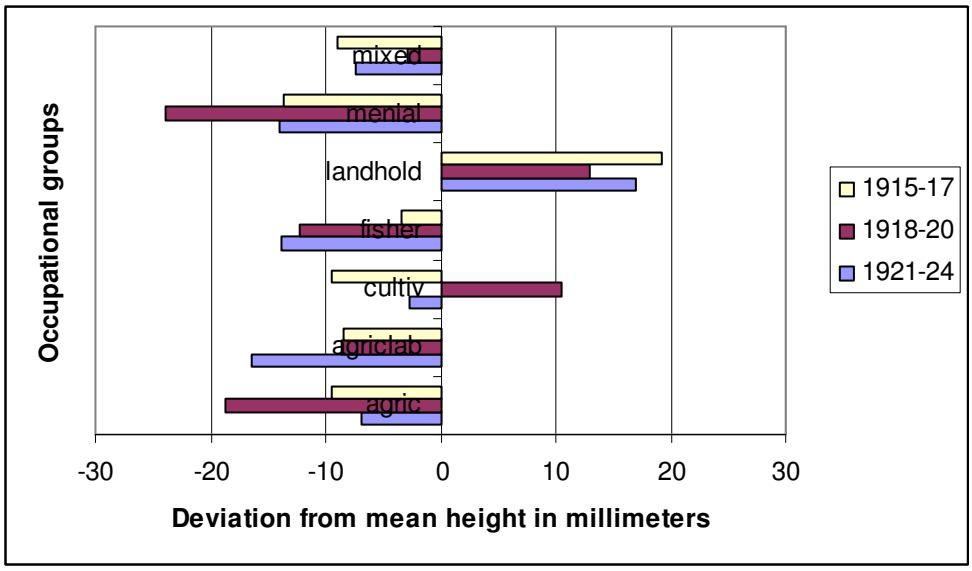


Fig. 11. Height CV by regions

Panel A



Panel B

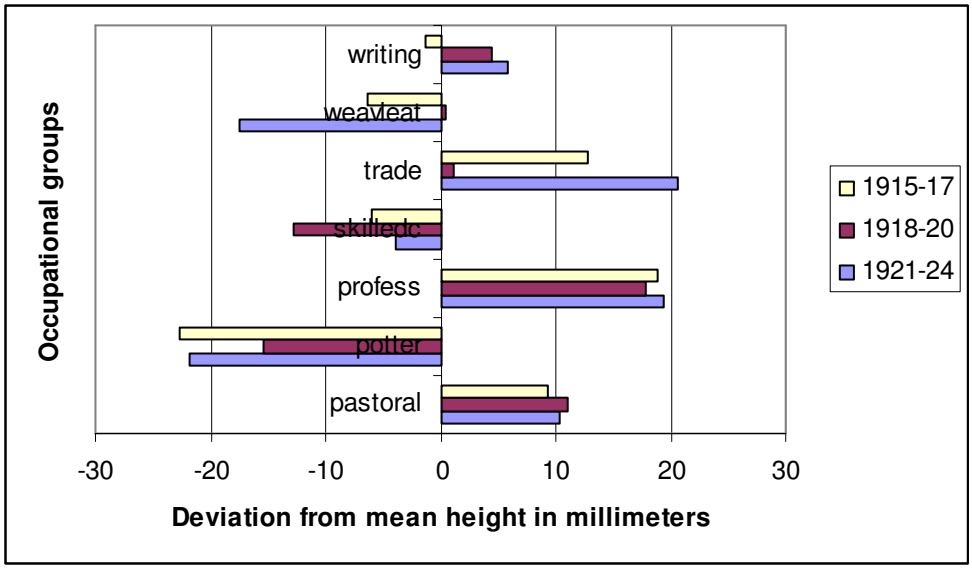


Fig. 12. Height deviation of occupational groups from mean with special focus on influenza/famine period (1918-20)

Note: Definition of the occupational abbreviations in appendix B.

Appendix

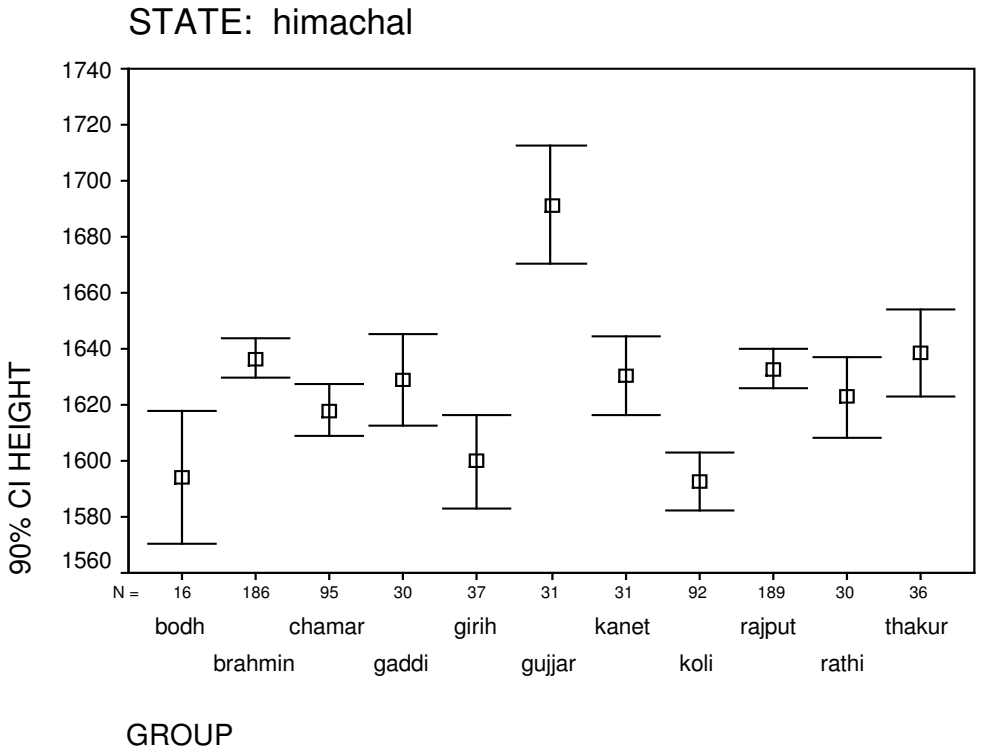


Fig. A1. Height among various caste groups in Himachal Pradesh

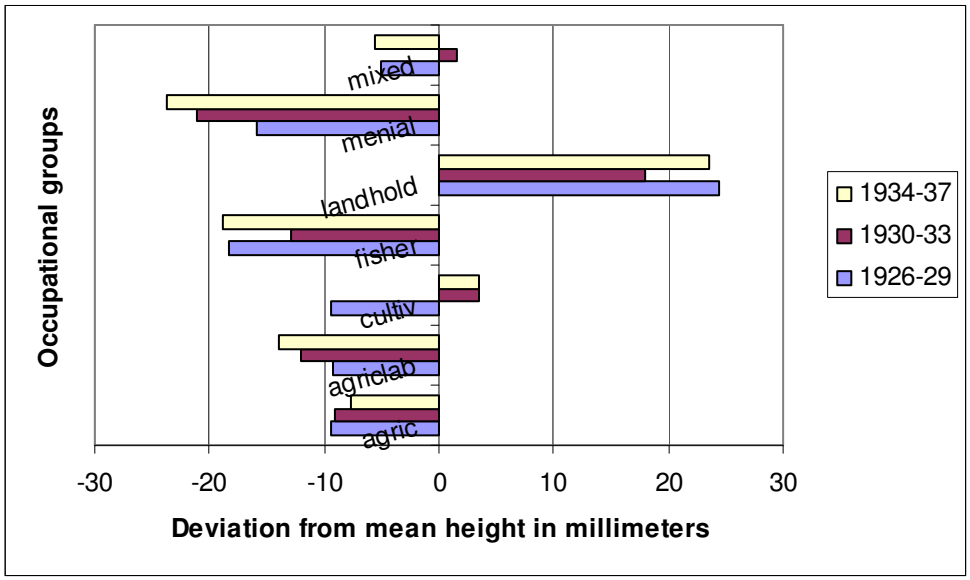


Fig. A2. Height deviation of occupational groups from mean during great depression

Note: Definition of the occupational abbreviations in appendix B.

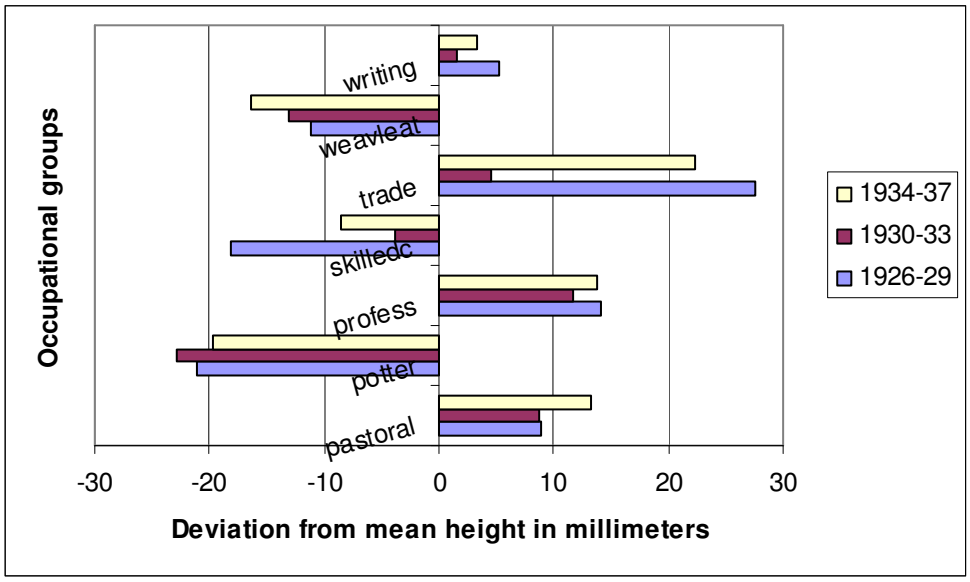


Fig. A3. Height deviation of occupational groups from mean during great depression

Note: Definition of the occupational abbreviations in appendix B.