

The Anthropometric History of Argentina, Brazil and Peru during the 19th and Early 20th Century

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Abstract

This anthropometric study focuses on the histories of three important Latin American countries – Brazil, Peru, and Argentina – during the 19th century, and tests hypotheses concerning their welfare trends. While non-farm Brazil and Lima, Peru, started at relatively low height levels, Brazil made substantial progress in nutritional levels from the 1860s to the 1880s. In contrast, Lima remained at low levels. Argentinean men were tall to begin with, but heights stagnated until 1910. The only exception were farmers and landowners, who benefited from the export boom.

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Background of the Study

Anthropometric evidence can shed light on past trends in living standards, particularly in such countries as Peru and Brazil, where other data are not available for the first half of the 19th century. Maddison (2001) was the first to estimate historical income trends for Latin American countries by making subjective assumptions about certain key variables. For example, he assumed that the growth rate of GDP per capita in Brazil from 1820 to 1850 was similar to the period from 1850 to 1913, for which the first data-based estimates were published by Goldsmith (1986). For Peru, the data available are even less adequate, and Maddison assumed that during the decade before 1913, its development equalled the average growth rate of Brazil and Chile.¹ Yet the economies and populations of these three countries present distinctly different trends. It would be very important to obtain country-specific evidence on welfare trends in Brazil and Peru.

The purpose of our study is to use anthropometric indicators to compare welfare trends in the three countries under study with GDP-based welfare estimates and assumptions. Of course, height and GDP per capita do not measure the same components of welfare. GDP is much more sensitive to urbanisation and industrialisation, whereas height reflects the biological components of the standard of living and tends to correlate with health, longevity, and quality of nutrition (Steckel and Floud, 1997; Komlos and Baten, 1998). But we can still gain insights by studying the extent to which our estimates of height trends correspond to current GDP levels and to the long-term welfare growth.²

[Table 1 about here]

¹ An additional estimate by Seminario and Beltrán (1998) suggests a modest upward trend from 1896-1913, but again does not cover the period which came before it.

² Apart from the conceptual differences between height and GDP measurement of living standards, we should also mention the general doubts about the strategy with which to estimate GDP based on backward interpolation, see Fukao et al. (2007).

Current estimates imply that: (1) Brazil experienced very modest improvements in living standards during the 19th century; (2) and that Peru had a standard of living similar to that of Brazil and Chile; (3) Argentina experienced rapid economic growth during the export boom of 1870 to 1913, which should have resulted in some height increase (Table 1).³

The hypotheses to be tested below are that anthropometric trends were similar to conventional estimates of welfare. We use new anthropometric evidence for all three countries. For Brazil, a smaller data set of the early period has been studied previously (Frank, 2006). Here we test Frank' estimates of height levels for Brazil of the 1850s to 1860s and we shall assess whether the results change when the data set is expanded from 1,142 to 6,771 observations. We also extend the anthropometric history of Brazil into the 1880s. By contributing data on Peru, we fill an important gap in Latin American anthropometric history, as previous studies considered only Mexico, Argentina, Brazil, and Colombia.⁴

The biological components of physique are interesting in themselves, as stature differences have often been found to correlate with health and life expectancy (Komlos, 1985; Steckel, 1995). In his lecture to the Nobel Prize committee, Robert Fogel (1993) stressed that for Norwegian males in the 1960s and 1970s, men who were 17.5 cm shorter than average height had at least a 71 % greater probability of dying in the following decade, clearly a significant difference (based on data by Waaler 1984). In a similar vein, Baten and Komlos (1998) estimated that each centimeter in height increases life expectancy by 1.2 years, with only negligible coefficient changes between birth cohorts of 1860, 1900, and 1950. One centimeter in height creates a meaningful difference, since 1.2 years is a considerable portion of a human's life span. There is mounting evidence that an increase in height correlates with

³ There are GDP estimates for Argentina between 1870 and 1900 (Cortés Conde and Harriague, 1994). But Maddison still assumed the same growth rates as from 1900 to 1913. For a recent GDP estimate, see also della Paolera and Taylor (2003)

⁴ See Lopez-Alonso and Condey (2003), Carson (2005), Meisel and Vega (2007), Frank (2006), Salvatore (1998, 2004a, 2004b, 2007), Salvatore and Baten (1998), Bogin and Keep (1999).

increases in cognitive abilities, physical robustness, and higher wages. Finally, as Arora (2001) argued, it also correlates with GDP growth.

In Sections 1 to 3 we focus separately on each of the three countries, beginning with Argentina, followed by Brazil and Peru, first describing each country's social and economic history, main export goods, and food production. For each country and period of time, anthropometric evidence is discussed, and our new findings presented. Finally we present our conclusions, comparing anthropometric estimates for Brazil, Peru, and Argentina with GDP estimates of Maddison and others.

1. Argentina

Social and Economic History

Between 1870 and 1913, Argentina became a major actor in the world economy. Its 56 million hectares of pampa plains, ideally suited for temperate-zone agriculture and for raising livestock production, but sparsely populated in the mid-19th century, became a magnet for European immigrants and capital (Ferrer, 1967). Argentina's society changed considerably during the 19th century as its population became increasingly dominated by recent European arrivals. They arrived in great numbers in the second half of the century, driven by a desire to escape poor living conditions in Europe and attracted by this vast territory. By 1914, the Argentinean census reported that one-third of the population was composed of immigrants (Republica Argentina, 1916).

Many economists have supported Douglass North's theory that exports increase a nation's productivity, especially in the New World, if world markets demand at least one of its export staples (North, 1966). This availability of export staples, in turn, could have a positive impact on other sectors of the economy, raising the population's standard of living. Argentina had become well-integrated into the world market by 1913 and gained large export revenues. It became well-known for producing export surpluses, mainly in beef and wheat.

During the first decade of the 20th century, Argentina's growing export economy (Diaz Alejandro, 1970) provided its citizens with one of the highest per-capita incomes in the world. This period is considered the "Golden Age" in Argentinean economic history. However, as Salvatore (2007) argued, export-led growth raises the general standard of living only if export revenues also benefit lower-income groups. Whether this actually took place is an empirical question, which Salvatore answered in the negative.

New Anthropometric Evidence on Argentina

To learn more about its male population's military potential, Argentinean authorities measured all men in 1927, recording their heights and other physical data. The study registered both native-born and naturalized men, born between 1820 and 1915. For our study, we consider only those between ages 17 to and 52 (birth cohorts of 1875 to 1910), a total of 6,953 measurements (Table 2).

[Table 2 about here]

Our sample was drawn from a randomly chosen series of registration books preserved in a general register in the military-history archives in Buenos Aires.⁵ We took a convenience sample from the following provinces and cities: Misiones, Tucumán, San Juan, Córdoba, La Pampa, Buenos Aires city, Junín city, Río Negro, and Chubut/Santa Cruz (Figure 1).⁶

⁵ Servicio Histórico del Ejército, Archivo General del Ejército, Calle Defensa (entre C. Mexico y Chile), Capital Federal, Argentina.

⁶ The youngest cohort might have had some growth potential at the time of measurement, but our conclusions would not be affected by this.

Aside from stature and occupation, categories that we found to be most useful for our work, we found additional information about the men under study. They were asked whether they could ride or swim, if they could read, and if they were proficient in telegraphy. They were asked about to describe their driving abilities, and to name the types of vehicles, motorcycles included, that they were able to operate. This information was not used by us but might contribute to future studies.

See Appendix 4 for a facsimile of the source. Unfortunately, the archives in Lima and Rio de Janeiro did not allow to take photos. http://www.wiwi.uni-tuebingen.de/cms/fileadmin/Uploads/Schulung/Schulung5/Paper/Appendix_Baten_Pelger_Twrdek.doc

[Figure 1 about here]

This map also indicates global height averages by province. Average height values in the Argentinean provinces were, as it turned out, quite similar in the various regions, except for the Northwest, especially in Tucumán and to a lesser extent in San Juan, where the male population was shorter. Moreover, those in Río Negro and the city district of Buenos Aires were slightly shorter than those in the other six provinces.⁷ We also included more Southern provinces in the sample because they have not been studied before (Salvatore 2004a, 2004b, 2007 and 2009 concentrated mainly on the Center and North).

How representative is our evidence? Our data for Argentina benefit from the fact that the entire male population was recorded in that country's national data sources. Our data is normally distributed or Gaussian and does not suffer from typical truncation problems (Figure 2).

[Figure 2 about here]

Because the Argentinean military census did not record the country of birth, immigrants had to be included in our study. Previous height estimates by Salvatore (1998, 2004a, 2004b, 2007) excluded immigrants since he was mainly interested in estimating the determinants of heights within Argentina. But we are also interested in long-term trends in heights for the entire Argentinean population (as is done in GDP estimation).⁸

⁷ The city district does not include the rural province of Buenos Aires.

⁸ For this reasons, also in GDP estimation, the contribution migrants that permanently reside in a country are included.

As for the question of survivor bias, we came to the conclusion that it poses no problem for the data assessed here.⁹

How can we classify occupational groups to assess social height differences? We used the Armstrong (1972) scheme of occupations to get a clearer understanding of the social structure of Argentinean society. It was developed for 19th-century censuses, and was designed to capture the skill level and social status level of different occupations during that period. Clearly, some occupations can span several social strata. However, this classification scheme has proved useful for a large number of applications. In anthropometric history, it has been employed in a number of studies (for example, Johnson and Nicholas, 1995).

The first group consists of unskilled workers, including domestic servants and similar low status occupations. The second group includes semiskilled occupations, such as housepainters, which do not feature the lengthy craftsmen-type extended sort of apprenticeship required for skilled crafts. The third group consists mainly of skilled craftsmen and other workers with higher greater craft levels and responsibilities (for example, shop assistants). Category (4) consists of semiprofessionals, such as clerks and telegraphers, whose occupations clearly require a somewhat greater skill level, but not as much as Category (5), that of the professionals. The typical member of the latter group has typically attended high school and in some cases also university (e.g., lawyers and doctors), or has attained success as an entrepreneur, thus acquiring considerable social status. We coded the farmers as a separate group (6) since they might have benefited from direct access to landownership and food production (Komlos, 1987). Most of our sample consists of farmers, unskilled and semiskilled workers (around 74 %). As one might expect, a higher share of skilled persons are found in Buenos Aires than in the rest of the country.

⁹ see Appendix A.3 http://www.wiwi.uni-tuebingen.de/cms/fileadmin/Uploads/Schulung/Schulung5/Paper/Appendix_Baten_Pelger_Twrdek.doc

The regression results for Argentina indicate that average heights remained nearly constant in Argentina during the 19th century (Table 3, column 1 and 2). Such insignificant time coefficients indicate that the increase compared to the 1870s constant was close to zero.¹⁰

[Table 3 about here]

The absent growth of average heights confirms, in the main, Salvatore's findings (Salvatore, 2007). In Figure 3, we graph the impressive amount of different data sets Salvatore collected, plus our own. Earlier historians, states Salvatore, who described this period as the "Golden Age" of Argentina, did not take into account the fact that the standard of living of lower-income groups did not improve during the country's so-called Golden Age, and that heights in fact stagnated.

[Figure 3 about here]

Modest height gaps existed between social groups. The difference between unskilled and semiskilled persons was relatively large in Argentina. Farmers were 2.04 cm taller than the unskilled group represented by the constant, and professionals were even taller.¹¹

As a result, Argentinean height levels were quite impressive during the turn of the 20th century, compared with other Latin American or with European populations. However, they did not increase during the GDP boom, as we would have expected. This finding confirms earlier studies of Salvatore (1998, 2004a, 2004b, 2007), whose estimates for average heights of prisoners and soldiers indicated a stagnation of average stature during the period when

¹⁰ The R-squares are generally low, which is quite common in individual height regressions – we know that we cannot capture individual genetic height variation, which thus accounts for a large share of the unexplained part (as soon as heights are averaged, for instance by regions, and the genetic component averages out, R-squares increase dramatically, see Baten, 1999).

¹¹ Thanks to one of our referees who noted the latter point.

exports were growing the fastest. Salvatore (2004a, 2004b) argues that the influx of large numbers of immigrants during this period contributed to the nutritional stress. Native workers competed in the labour markets with European immigrants, who were often more highly skilled. Hence Salvatore concludes that labour supply increased so rapidly that native Argentinean workers had difficulties to keep their real wage, and that social protection was insignificant. He also notes that the share of protein provided to infants and toddlers may have been relatively low during this period. At the same time, rising food and rent prices diminished real wages. In general, wages rose from 60% to 80% during the 1880s and 1890s (of the British level in 1905), and from 90 to 100% during the 1900s (Williamson, 1995).¹² But real wage increases may have been lower actually, since higher costs of rent and non-tradable products often bias purchasing-power estimates, especially during periods of rapid urban growth. We can safely conclude that GDP per capita increased much more than did real wages, and that disparities in income increased as well (Table 1).

Argentina, and especially its Pampas region, was successfully integrated into the world market thanks to the international trade in beef and grain, and to the influx of immigrants (Salvatore, 2007).¹³ At the same time its population suffered from marked social inequality. Unregulated child labour and crowded housing conditions in the cities mitigated against an increase in living standards, and spread of infection and disease.¹⁴

We find that farmers benefited from the export boom slightly more than did unskilled workers. From an initial height gap during the 1870s of 1.5 cm between farmers and unskilled people, the height difference between these two groups increased by more than one centimetre

¹² see our appendix Figure A.1 http://www.wiwi.uni-tuebingen.de/cms/fileadmin/Uploads/Schulung/Schulung5/Paper/Appendix_Baten_Pelger_Twrdek.doc

¹³ We must keep in mind that some Patagonians, for example those in the province of Santa Cruz, were recent arrivals from within or outside Argentina.

¹⁴ During the period studied in this paper, life expectancy at birth in Argentina rose from around 33 years in 1883 to 40 years in 1905 (Somoza, 1973), and mortality rates were declining from 24 per 1000 inhabitants during the years 1881 to 1890, and to 18 per 1000 inhabitants during 1901-1910 (Elizaga, 1973). But this can also be viewed as a convergence to the more favorable levels of other countries with similar incomes at the time. For instance, life expectancy in Paris was already 47 years in 1880 and mortality rates in Paris and London were 6 to 8 per 1000 inhabitants accordingly (López-Alonso, 2002).

in height until the 1890s, which is statistically significant (Table 3, Column 2). At the same time the heights of unskilled workers stagnated (Figure 4).

[Figure 4 about here]

Obviously, the notable growth of wealth in Argentina from 1870 until the First World War did not equally benefit all sectors of the population equally. While landowners and farmers made some gains, workers did not enjoy a proportionate growth in their income (Cortés Conde, 1986). As the big height gap in Argentina was between unskilled workers and more skilled occupational groups, we find that a strong middle class represented by the latter groups had already emerged by the late 19th century. These results for Argentina are somewhat similar to those of Cranfield and Inwood (2007) on physical well-being in Canada. They found that during the 19th century the physical stature of Canadian-born men stagnated or declined slightly in spite of a substantial increase in income. Similar findings were recorded in the U.S. during the 1860s to the 1890s, when the agricultural-exports boom began (Komlos 1998). This divergence between height and GDP seems to be the pattern for food-exporting New World countries which initially had small populations.

2. Brazil

Social and Economic History

Throughout the 18th century, Brazil's economy was agrarian and monocultural. In 1815, Brazil became a monarchy with equal rights for its citizens, and it remained a monarchy after having gained independence from Portugal in 1822. Furthermore, Brazil made a fairly peaceful transition to independence and despite repeated efforts by secessionists (Bernecker et al., 2000). Though political conditions were stable, the Brazilian economy is often assumed to have grown too slowly or even to have stagnated on account of low agricultural productivity

and a lack of capital, infrastructure, and financial institutions. A slow transition to industrialization did not begin until the end of the 19th century. Latin American economic history has traditionally held that newly independent Brazil fell under the economic control of Great Britain. In fact, Brazilian trade with Great Britain was based on special treaties. Haber and Klein (1994) argue that “Brazilian policy makers were not British puppets” and that it is not clear whether this trade resulted from Brazil’s independence or from its prior close relationship with Great Britain.

Slavery still played a vital role. Although the importation of slaves had been prohibited since 1850, Brazil did not abolish slavery until 1888, and then only because of British pressure, and was the last country in the world to do so. As a consequence, prosperous coffee plantations in the south soon found themselves short of workers, as a vast southward migration of former slaves, from stagnating sugar plantations in the northeast, began. Meanwhile, European immigrants began arriving in large numbers. Coffee planters pressed Brazil’s central government and the province of São Paulo to pay the transportation costs of immigrants from southern Europe (Leff, 1994), who might otherwise have sought higher wages in the United States or Argentina. Coffee planters were more willing to finance immigration from Europe than migration within Brazil, as they preferred “hardworking white people” to black Brazilian workers (Vainer and Brito, 2001). This preference was in line with the prevailing intention of “whitening” the Brazilian population, a policy that the government acknowledged in the second half of the 19th century (Skidmore, 1990).

Brazil was an agricultural economy both before and after independence. Sugar exports led the world market until 1815, but then stagnated on account of growing competition from other Latin American countries and later from European sugar-beet producers. As a result, coffee soon overtook sugar as Brazil's most important export staple. Northeastern sugar and cotton exports declined, and per-capita income fell below that of the boom region in the southeast (Leff, 1994).

Johnson and Frank (2006) point out that focusing on aggregate economic performance tends to obscure the level of wealth and economic dynamism in southeast Brazil. Moreover, Frank (2006) discovered that mean wealth in Rio de Janeiro in the first half of the 19th century was surprisingly large and growing steadily, although the period was marked by a high level of economic inequality.¹⁵

What can be said about the nutrition of Brazilians? As the concentration on cattle raising might suggest (Bauer, 1986), the amount of animal protein per capita was potentially higher in inland Brazil. Meat and especially milk have a positive effect on human height (Baten, 2009); however, meat was consumed both in fresh and in dried forms, which had different health implications (Kiple, 1989). In the northeast in the 19th century the basic diet was nothing but dried meat and manioc flour. The diet in Rio de Janeiro and São Paulo consisted of fresh meat and beans for the rich, and dried meat and cornmeal or manioc flour for the poor. In Minas Gerais both rich and poor consumed a great deal of pork, cornmeal, and beans, while in Rio Grande do Sul the diet featured fresh meat, cereals, and vegetables. Kiple (1989) pointed out that the diet of dried meat and manioc was seriously deficient in thiamine, and that beriberi, the disease caused by this lack, was a serious health problem in Brazil during the latter half of the 19th century.¹⁶ High consumption of beans helped overcome some of the health problems, and bean soup with offal, feijoda, became an indispensable national dish (Fish, 1978). High in protein, feijoada improved the diet of many Brazilians.

New Anthropometric Evidence on Brazil

Our Brazilian sample consists of 6,771 male prisoners from the Rio de Janeiro city jail, measured between 1861 and 1903.¹⁷ Data include height, origin, occupation, birthplace, age,

¹⁵ They calculated a Gini coefficient of 0.87 for the 1820s and 1850s in Rio de Janeiro and estimated a top decile share of 77 to 78 percent.

¹⁶ The process of salting and drying destroys the thiamine and mostly also the fat in the meat.

¹⁷ Rio de Janeiro/Brazil: Arquivo Público do Estado do Rio de Janeiro – APERJ – Depositum Casa de Detenção do Rio de Janeiro.

and skin color. Until 1879, height was measured in Portuguese feet, and from then on in meters. One Portuguese inch equals 2.75 centimeters; however, Frank (2006) found that on account of measurement error in the Rio prison, it is more accurate to calculate 2.73 centimeters to the inch. Prison records recorded the heights of some individuals in both centimeters and feet, and an analysis of the double measurements led to this correction. We have followed Frank's reasoning and have adopted this approach.¹⁸

The prisoners came from many regions of Brazil, and from other countries as well.¹⁹ We have information on migrant and immigrant status and therefore can control for it. We pooled the information on skin color into three categories -- white, black, and other or brown -- because the description of skin color varied for mixed-race individuals, and terms used at the time could not be accurately defined.²⁰

The number of individuals in the sample pertains to the birth cohorts of the 1810s to the 1880s (Table 2). Standard deviations of the height distributions are relatively high, as we would expect for a country with pronounced social inequality.²¹

How representative is our evidence? In prison samples, there might be height bias and occupational bias, with height bias defined as the gap between heights of prisoners and heights of the total population. Occupational bias means that there was a greater proportion of prisoners from the lower class than exists in the overall population. Other studies have found that the height bias of prison samples is typically not as large as occupational bias, partly because greater than average height facilitates violent criminal activities (Baten, 1999). Nevertheless, we agree with Frank (2006) that the sample is somewhat biased towards the poorest portion of the population.

¹⁸ We should note the possibility that the upward trend might be less pronounced, if the result of Frank about the inch measure being 2.73 cm is incorrect. In this case, there would also be a substantial increase, but it would be 0.7 cm smaller between the 1840s and the constant, for example (see Appendix A.2 available from the authors). However, we are convinced that Frank's assessment of the inch measure employed is correct and that the trends presented here are as strong as described.

¹⁹ See Appendix A.5 for a mapping of the numbers of cases by province http://www.wiwi.uni-tuebingen.de/cms/fileadmin/Uploads/Schulung/Schulung5/Paper/Appendix_Baten_Pelger_Twrdek.doc

²⁰ E.g., crioulo, moreno, acaboclado, fula, cabra.

For Brazil, as for Argentina, we use the Armstrong scheme of occupations. Comparing our sample's measurement cohort of the 1870s with the Brazilian census of 1872, we found that the share of unskilled workers was quite similar, but the prison sample contains about 10% more semiskilled workers (Recenseamento, 1872).

[Table 4 about here]

On the other hand, semiprofessionals are fewer in the sample by a similar percentage. At less than 1%, professionals are nearly absent in the sample, compared with 5.5 % in the census population. The share of slaves in our data and the share in the census are almost equal. Compared with the census, our sample describes more persons (10%) as "black" and similarly fewer "other" (neither white nor black, mainly mulatto).²²

Another strategy for assessing historical samples is to compare age heaping in the prison sample to that of the census population. Persons who cannot state their exact age often round it off to a multiple of five, and such persons are typically less educated than average (Baten, Crayen, and Manzel, 2008; Crayen and Baten, 2009). Age-heaping indices correlate negatively with other human-capital indicators, such as literacy and school enrolment, and even more so with modern measures of mathematical skills (see A'Hearn, Baten, and Crayen, 2009, appendix). The Whipple Index of age heaping is calculated by dividing the number of persons reporting an age ending in 0 or 5 by the total number in the study, multiplied by 500. Values substantially higher than 100 indicate problematic numeracy; the higher the number, the greater the problem. Manzel and Baten (2009) estimate a value of 205 for Brazilians born in the 1850s, while our data produce a slightly positive index of 178 due to a more urban sample than the overall population.

²¹ The same condition applies even more so for Peru, which is studied below.

²² This may be a true difference, or it may reflect different definitions of skin color used by the prison and the census.

Are the differences large? The Whipple Index runs from 0 to 500, with typical values located between 100 (no age heaping, good numeracy) and 500 (extreme age heaping, bad numeracy).²³ Throughout the 19th century, values in the Middle East and South Asia were near 500, whereas in European industrial countries they were closer to 100, with those of Latin America ranging 100 (Argentina, 1890s) to 290 (Ecuador, 1880s); the difference of 27 in the two sets of data for Brazil is small but not negligible (Manzel and Baten, 2009). Those who rounded off their age were also significantly shorter (Table 3, Col. 4 and 5). From these figures we conclude that compared with the whole Brazilian population, the prison sample does not have a strong negative educational bias.

Brazilian height trends. We report four height regressions for Brazil (Table 3): Regression 3 (Col.3) excludes immigrants, Regression 4 (Col. 4) excludes immigrants and slaves, whereas Regression 5 includes both, but controlling with dummy variables for slave status and the origins of the immigrants. Regression 6 (Col. 6) is limited to the sub-sample of slaves. Interpreting the birth decade dummies, we find that Brazilian heights stagnated at first, but time coefficients after 1860 imply a distinct upward trend, a bit stronger if immigrants are included, and less strong with native-born Brazilians only.²⁴

[Figure 5 about here]

The result of an upward trend is robust in both the regression results (Table 3 and its graphic representation in Figure 5), and the raw data (Table 2).²⁵ Brazilians born in the 1880s, were 2.41 cm taller than those born in the 1830s, if we consider all Brazilians, and 1.66 cm, if we include only native Brazilians. We also controlled for age composition by including

²³ A value of 0 would mean complete avoidance of all multiples of five.

²⁴ The constant is roughly one centimeter higher including immigrants, and most time dummies for the first six decades are smaller by a similar amount, hence the level of height is similar for native Brazilian and all prisoners (except for the 1880s).

dummy variables for age groups 19 to 22 and 51 to 60 in the regression. The reason for our selecting these age groups is that those in the younger group have not yet achieved their adult height, whereas some of those in the older group may have actually shrunk. The results were as expected, with the exception of those aged 51 to 60, who were not significantly shorter. Among the young men, height continued to increase until the age of 20 or 21.²⁶

Were there significant regional height differences, and did migration within Brazil play a role? Because our data are drawn from data collected in a Rio de Janeiro prison, in the booming Southern coffee-plantation region, there is potential bias for the anthropometric trend. Did the region's successful development cause the positive height trend, while heights in other parts of the country stagnated or declined? Although our data include all Brazilian convicts measured in the Rio de Janeiro prison, their places of birth varied widely. Of the adult males, only 58% were born in the Southeast, and a mere 3% in the West.

[Figure 6 about here]

In contrast, height levels of the 39% born in the Northeast actually resembled that of those born in the South (Figure 6). Could this have been caused by selective migration from the Northeast to the South? Most studies focusing on this period find that migration from poorer to richer regions initially featured individuals who were richer (and often taller) than those who stayed behind, but that their human capital later declined. This trend suggests that the heights of early cohorts might be slightly overestimated, while those of later cohorts are

²⁵ The Argentinian height trends are unadjusted, because for the study of Argentina we have a sample that is not socially biased.

²⁶ For regressions 5 and 6, we excluded those above 50.

slightly underestimated. Although this disparity supports our main finding of an upward height trend in Brazil, we conclude that selective migration was not the cause.²⁷

A second possible distortion could derive from European immigration. In the second half of the century Brazil was the destination of increasing numbers of immigrants, mostly from Portugal. Could the influx of taller individuals into a region bring about an upward trend in height there? When measurements exclude immigrants, the answer is no (Table 3, Col. 3 and 4).²⁸ There is also a substantial upward trend among native Brazilian prisoners only. Moreover, those who emigrated from Portugal, not to mention Italy, Spain, and France, were not statistically different from those born in Brazil (Table 3, Col. 5). In contrast, German, British, and North American immigrants were 3 to 4 cm taller.²⁹

[Figure 7 about here]

The data also provide a rough estimate of regional height differences (Figure 7). Our discussion of height estimates, based on over 30 observations, assumes that selective migration does not account for all the differences. The tallest Brazilians were living between São Paulo and Bahia, and in Paraíba. With the exception of residents of the latter two states, Northeasterners were relatively short, as were those in the coastal regions of Rio de Janeiro, Santa Catarina, and Espírito Santo. Looking at Bauer's map of agricultural specialization, we note that most tall men were found in grain- and cattle-producing regions. This holds true for the booming São Paulo and Minas Gerais coffee-plantation belt (Bauer, 1986).³⁰

²⁷ The upswing in 1870 is almost 3 cm in one decade which might be exaggerated. There could well have been an upswing but not of this magnitude.

²⁸ Figure available from the authors.

²⁹ All those groups are based on sufficiently large numbers of cases.

³⁰ In other countries, very strong advantages of proximity have been found (Baten, 1999). The proximity to the production of perishable proteins had the effect of relatively positive health and height levels, even among populations of modest purchasing power e.g. milk or offal, which could not be transported and traded over longer distances before the mid-20th century (see Baten, 1999; Komlos, 1996).

It should be note that the South attracted many tall Europeans. Moreover, in Minas Gerais there was a remarkably high number of freed slaves. Characterized by smaller slave plantations, the number of slaves per

In contrast, the Northeast plantations (cotton, sugar, and tobacco) and those of Espírito Santo (cocoa), on the southern coast, had shorter-than-average people, perhaps because the diet there was based on local, low-protein foods, or because they could not afford adequate housing. The taller population of Paraíba can be explained by the favorable economy of its cattle farming and coffee plantations, which stretched to the coast. The unexpectedly moderate heights recorded in the Rio de Janeiro region may be partly due to the rapid expansion of the city itself. Frank (2006) hypothesized that Rio, in becoming, along with Mexico City, one of the two largest cities in Latin America (Klein, 1986), imposed an “urban penalty” on its population.

Heights by occupation in Brazil. Only modest differences in height can be observed between unskilled and skilled groups, with the exception of professionals, who were as much as 3.2 cm taller than unskilled workers, and even 5.4 cm if only native Brazilians are considered. Thus, the greatest difference in height was between the elite and the rest of the population, and not between the unskilled workers and skilled craftsmen.³¹

Height differences by skin color. Controlling for occupation, slave status, birth decade and all other characteristics, black people were not significantly shorter than native Brazilian white people on average (Table 3, Col. 3). Including migrants, whites were even slightly shorter than blacks.³² That black Brazilians were relatively tall in spite of their low status -- compared to whites -- probably cannot be explained genetically, as black people born in Africa were in fact much shorter than those born in those regions of Brazil where *feijoda* was an important component of the diet (Table 3, Col. 6). On average, black people of

slaveholder was relatively small in Minas Gerais, a situation that may have fostered social interaction between slaves and their owners (Klein, 1986).

³¹ In fact, farmers in the sample were shorter than all other groups, but we have only 64 observations on farmers ages 20 to 60. Perhaps those of them who were measured while living in Rio de Janeiro had gone there in search of work, having failed at farming.

³² During the 19th century Portugal's population was the shortest in Europe, mostly on account of a low-protein, and especially a low-milk, diet (Stolz, 2008).

African birth were 161.7 cm (N=151) tall, while those born in Brazil were significantly taller, at 164.9 cm (N=921).³³

Slaves in the United States were considerably taller than their Brazilian counterparts. According to Margo and Steckel (1983), the mean height of U.S. slaves (ages 25 to 39 in the 1790s to 1840s) was 4 cm greater than that of Brazilian slaves. The white population in the U.S. was also considerably taller than that of Brazil: around 173 cm from the 1800s to the 1830s, and then falling to 169.1 cm in the 1890s. In the U.S. South, whites were about 2.5 centimeters taller than slaves (Komlos and Coclanis, 1997). Fogel and Engerman (1974/1995), Steckel (1986) and more recently Rees et al. (2003) have argued that U.S. slaveholders provided those of their slaves who reached adulthood, with reasonably nutritious food. This may have been true in Latin America as well. As importing slaves became more difficult and expensive, some slaveholders began to provide their slaves with offal and other cheap sources of protein.

3. Lima (Peru)

Social and Economic History

The pronounced stratification of Peruvian society can be traced back to the conquistadors, who took possession of most of the fertile land and introduced slavery. Peru gained independence from Spain in 1821, but the social and economic inequalities introduced during the colonial era did not diminish significantly (Gootenberg, 1990). The legacy of the Spanish Empire was a two-class system defined by rigid social rules and tax laws. A white elite held the privileged positions (Contreras, 2004). The elite appropriated the riches of the country and

³³ Our results are in line with the arguments that Eltis (1982) has provided against strong height selectivity in the slave-trade. For example, he argues that if traders put a significant premium on taller slaves, prices and volumes of slaves traded in those areas with taller populations would have been higher, which does not appear to have happened in the 19th century. Second, by the 19th century, physically strong (and tall) Africans were also demanded by Africa's plantations and farms. Finally, Eltis observed that the height distributions from all regions were quite normal. If there had been something like a minimum height requirement of slaves or a height interval which was much less demanded, slaves from the regions with shorter stature should have displayed some shortfall.

was able to protect its social status and profit over time. White men often had children by their Indio servants, creating a mixed racial group, mestizos. The abolition of slave trade, in the 1850s, had serious consequences for farmers, who had relied on slave labor.

Peru was an important exporter of silver throughout the colonial era, but in the early 19th century investments and profits declined during and after the independence conflicts (Contreras, 2004). In the same period, Peru launched a new export, guano; the profits therefrom replenished the public treasury and enabled enormous profits to be captured until the 1860s, where many middlemen and retailers could make large profits. Due to their demand for other goods, income increased also for other inhabitants of the capital (Gootenberg, 1990).

Nevertheless, Peru's finances remained unstable. Violent political upheavals, including frequent coups d'état, made governing the country next to impossible, and contributed to a rise in government debt. The government borrowed on future revenues from guano, and then squandered the money within a few years. After three decades of frenetic prosperity, Peru sank into a recession in the mid-1870s. The country's undiversified export structure depended on the markets of Great Britain and France, and orders diminished as international trade in general slowed (Gootenberg, 1989).

Agriculture in Peru. Cotton plantations dominated the coastal region around Lima (Bauer, 1986) while sheep, llamas, and alpacas were raised in the interior of the country. In Peru's northern mountains, cattle production was more pronounced, and the meat consumption of Lima's upper class may have therefore been fairly high.³⁴ However, the cost of transporting meat from the North was probably prohibitive for the urban poor. Due to the

³⁴ Peru had by far the smallest number of cattle per capita, with only 1 million in 1917 relative to a population somewhere between less than 3 million in 1876 and 7 million in 1940 (Mitchell, 1993). Brazil had 31 million cattle in 1912 and 17 million population in 1900, and Argentina's per capita values declined from more than 7 per capita in the late 1860s/early 1870s to 4 per capita in 1910. Hence in Peru 5-6 inhabitants "shared" one cattle, whereas Brazil had initially around 2 cattle per capita and Argentina between 8 and 4 cattle per capita. The decline of cattle per capita could have contributed to the disappointing stagnation of Argentinean heights, but of course, Argentina had a much higher export of first salted, later refrigerated cattle meat, hence production does not equal consumption.

distance, milk was not consumed in large amounts in Lima, neither by rich nor by poor persons.

New Anthropometric Evidence from Lima

For Peru as well, we rely on a prison sample comprising 1,139 cases, mostly convicts from Lima and a modest number of immigrants.³⁵ They were measured in the years 1866 to 1909, allowing us to study the birth decades of the 1820s to 1880s. Since sample size for each birth decade would be too small, we aggregated Peruvian birth cohorts into 20-year birth groups.

We assess representativeness by comparing the Whipple Index of the prison sample to the overall population, as we did for Brazil. The Whipple Index of age heaping of the whole prison sample is 127 (ages 33 to 62, 1820s to 1880s). Manzel and Baten (2009) estimate a Whipple Index for Lima's population at 139 for the birth cohort of the 1880s, a much better value than in Brazil. In other words, from an age-heaping perspective, our prison sample and the overall population are quite similar.

Another approach is to compare the social and occupational structure in the mostly urban prison sample with the 1876 census of population born in the Lima district. We limited the sample to those convicts measured during the 1870s. This sample actually overrepresents skilled people in comparison to that for the Lima district, which includes the city's rural surroundings (Table 4).³⁶ However, in combining semiskilled and skilled groups, the prison sample is quite representative for the Lima district, with the exception of farmers, who are, of course, underrepresented in our urban sample. In contrast, professionals and semiprofessionals are well represented, because among the prisoners were some who were slightly better off than most. This may help to explain why the standard deviations of the

³⁵ Lima/Peru – Archivo General de la Nación. Archival source “penitenciaria central”, the main prison in Lima, and Guadalupe prison. Libros de Entrada y Salida de Reos, Nr. 3.20.3.3.1.1.4 to 26.

³⁶ In order to compare the occupational structure, we took the census report from Pinto and Goicochea (1977) and classified all the occupations with the Armstrong scheme.

height distribution are relatively large: the prison population included merchants and traders, convicted of business-related crimes (Table 2).

The 1876 census provides more information about the social structure of Peruvian society, including such variables as skin color, religion, and nationality (Díaz, 1974). All skin-color groups except Asians (which usually meant Chinese) are well represented in our sample (Table 4).³⁷ Foreigners compose 22% of our prison sample, in contrast with the 3% reported by the census for the Lima district (not shown).

[Table 5 about here]

Because the prison sample is small, we restricted the regression analysis to adults. We cannot assess growth patterns or differences among immigrant groups, but we estimated one regression for native Peruvians only, and one including immigrants. Heights recorded for all the birth decades before 1859 were lower than those after 1860.³⁸

Height, ethnicity and occupation in Lima. There were no significant differences in height by occupation. The reason why the occupation coefficients are insignificant could be that most Indios in the sample were categorized as "unskilled" or "unknown," and as a consequence there is considerable multicollinearity between occupation and skin-color/ethnicity. However, there was large variation in height by ethnicity. Indios were shorter than whites by 5 to 6 cm, mestizos by around 3 cm, and Asians (mostly Chinese) by 4 cm. Blacks

³⁷ This is confirmed by Kubler's study (1952) on the Indian caste in Peru. He presents information concerning the original inhabitants of this district based upon tax records and census reports, which confirms the following census results.

³⁸ A yellow-fever epidemic during the 1840s must have made life in Lima exceedingly difficult (Sánchez-Albornoz, 1986). Lima may have been particularly vulnerable to epidemic disease because its citizens, and small children in particular, consumed almost no milk.

were not significantly shorter than whites, and those born in Peru were even significantly taller.³⁹

We can graph a time trend based on the birth group coefficients of this regression analysis. By using census weights, we can also adjust for occupational group and skin color to obtain population averages for each birth cohort (Figure 5). These adjusted anthropometric series are considerably lower for Lima because the procedure takes into account the higher percentage of Indios in the overall population.⁴⁰

[Figure 8 about here]

Height differences between whites and Indios increased during the 19th century (Figure 8). White people born in the 1880s were eight centimeters taller than Indios of the same age. This widening gap may indicate that the height difference was not due to genetic but rather to socioeconomic variables.

How different were the heights in Lima from those in other regions of Peru? The first representative data set on heights with a sufficient number of cases refers to birth cohorts of 1950 to 1967 (Baten and Fraunholz, 2004), when Lima recorded average female heights of 151 cm. The average height of women in the Northeast, East (Madre de Dios), and South was about 152 cm, while women in the central highlands and the Northwest measured 150 cm or less. This pattern persisted for birth cohorts of 1968 to 1979, although the region around Lima gained somewhat in height. Assuming that the 19th century and the post-1950 periods were not dramatically different, one can reasonably conclude that heights not only in Lima but in

³⁹ In a separate regression model, we also checked whether occupational groups became more significant if we considered only individuals born after the 1840s, but the difference to the original regression was quite modest (not shown).

⁴⁰ The share of black people was actually slightly higher in the 19th century than our population weights suggest. However, given the insignificant coefficient for black people, the results would change only very modestly. We thank Ricardo Salvatore for this hint.

the rest of Peru as well were not dramatically different. But this conclusion is tentative, and requires further study.

A number of anthropological studies of height using data derived exclusively from tribes in the Andes estimated the height of rural male Indios in Peru and Northern Bolivia born mostly between the 1880s and 1900s at somewhat under 159 cm (Steggerda, 1943; Bogin and Keep, 1999). The urban Indios of our sample who were born in the 1870s and 1880s were slightly taller (about 160 cm). Limiting our sample to the Peruvian Indians (Farabee 1922), we obtain a mean stature of 159.7 cm, very close to our estimate. Although our Lima sample is small, it seems safe to conclude that the height level of its population was substantially shorter than that of Brazil. The height gap between white and Indio prisoners steadily widened.

4. Conclusion

Argentina's GDP grew substantially during the period 1870 to 1913. GDP rose from \$1300 to \$3800 in 1990 (Geary-Khamis \$; Table 1), and real wages reached European levels by the end of the Golden Age (Williamson, 1995). However, we can confirm Salvatore's finding that in Argentina heights did not increase and therefore reject the third hypothesis mentioned in the introduction that welfare grew during the income boom of the 1870-1913 period (Salvatore, 2004a, 2004b, 2007). The only significant benefit was to farmers, a group whose height trends could be shown separately.

Brazil's economy grew little between 1820 and 1913, certainly modest by European or by Argentinean standards (Maddison, 2001; see also Goldsmith, 1986 for the post-1850 period). Furthermore, biological progress, as measured in height trends, did not increase significantly in Brazil between 1810 and the 1860s.⁴¹ However, between the 1860s and 1880s, Brazilian heights in our urban sample increased substantially. Therefore we must modify the

first of the hypotheses about Brazilian welfare that have been presented in the introduction. While welfare stagnated from 1820 to 1860, biological components of the standard of living improved considerably between the 1860s and 1880s.

Heights in Lima, Peru, remained on a modest level. The second initial hypothesis, that the quality of life in Peru was higher than that of Brazil, needs to be modified. We find that Brazilian anthropometric indicators were at higher values than those of the inhabitants of Lima.

We assessed regional and social differences as well as welfare trends. Heights were greater in inland Brazil, in the Southern cattle- and grain-producing regions, and in the booming coffee-plantation area, whereas Brazilian prisoners born in the regions of the sugar plantations, in the Northeast, were shorter. These data support the finding that plantation economies throughout Latin America experienced a height decrease, the exception being the coffee-plantation regions of Brazil in the 1870s and 1880s.

Among the birth cohorts of the 1810s to the 1880s, the most significant height differences in Brazil distinguished the elite from the vast majority of the population. In contrast, by the 1870s Argentina's middle class was considerably taller than the lower class. In Peru, where the height gap between Indios and whites was particularly wide, skin color may have compounded the social and economic differences between the races, complicating any attempt at an analysis of heights according to occupational classifications.

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⁴¹ See Morgan 2006, Baten and Hira 2006, Baten 2006.

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Tables

Table 1: GDP per capita in selected Latin American economies (Source: Maddison, 2001)

	1820	1850	1870	1890	1900	1910	1913	2001
Argentina			1,311	2,152	2,756	3,822	3,797	8,137
Brazil	646	686	713	794	678	769	811	5,570
Peru					817	975	1,037	3,630
Uruguay			2,181	2,147	2,219	3,136	3,310	7,557
Total Latin America	692		681		1,109		1,481	5,811

Table 2: Numbers of cases by country and birth decade

Numbers of cases			
	Argentina	Brazil	Lima (Peru)
1810		75	
1820		323	65
1830		705	205
1840		1265	317
1850		1604	146
1860		1740	78
1870	668	887	158
1880	1475	172	170
1890	1842		
1900	2066		
1910	902		
	6953	6771	1139
Raw average height			
	Argentina	Brazil	Lima (Peru)
1810		164.3	
1820		164.3	162.8
1830		164.8	165.0
1840		164.6	162.2
1850		164.5	164.5
1860		165.0	164.3
1870	167.6	166.5	163.5
1880	167.6	166.1	164.0
1890	167.8		
1900	167.9		
1910	167.8		
Standard deviation			
	Argentina	Brazil	Lima (Peru)
1810		6.58	
1820		7.38	7.15
1830		7.30	8.47
1840		7.04	8.08
1850		6.85	7.13
1860		6.71	6.16
1870	6.49	6.77	6.68
1880	6.39	6.53	6.85
1890	6.28		
1900	6.58		
1910	6.60		

Table 3: Determinants of heights (cm) in Argentina and Brazil

	(1)	(2)	(3)	(4)	(5)	(6)
Country	Argentina	Argentina	Brazil	Brazil	Brazil	Brazil
Who included	all	farmers	no imm.	no imm., no slaves	all	slaves
Birth Decades						
1810			-1.60	-1.83	-2.42*	0.00
1820			-0.87	-1.24	-2.06***	0.20
1830			-1.66**	-1.36*	-2.41***	-1.50
1840			-1.78***	-1.61**	-2.45***	-2.04
1850			-1.81***	-1.60**	-2.48***	-2.47
1860			-2.28***	-2.19***	-1.81***	-2.74
1870	0.00		-0.18	-0.15	-0.25	0.00
1880	-0.00	0.94	ref.cat.	ref.cat.	ref.cat.	ref.cat.
1890	0.25	1.13*				
1900	0.40	1.04				
1910	0.30					
Unskilled	ref.cat.	ref.cat.	ref.cat.	ref.cat.	ref.cat.	ref.cat.
Semiskilled	1.64***		0.30	0.54*	0.52**	
Skilled	0.59**		1.30***	1.22***	0.82***	
Semiprofessional	1.58***		1.10*	1.20*	0.74*	
Professional	2.88***		5.39***	5.38***	3.21***	
Farmer	2.04***		-0.73	-0.78	-1.41*	
Round Age			-1.16***	-1.13***	-0.77***	-0.97
Age 19			-1.73***	-1.62***	-1.89***	-2.38
Age 20			-0.21	-0.18	-1.00***	0.04
Age 21			-0.36	-0.21	-0.66	-1.69
Age 22			0.14	0.23	-0.48	-0.03
Age 51-60			0.27	0.37		
Black			0.29	0.39	ref.cat.	
White			-0.29	-0.27	-0.65**	
Brown			ref.cat.	ref.cat.	-0.40	
Slave					-0.99**	
Africa						-3.59***
France					0.49	
Germany					3.71***	
UK					3.48***	
North America					3.24***	
Spain					0.18	
Portugal					-0.13	
Italy					0.26	
Other Immigrant					1.56***	
Constant	166.42***	168.02***	166.56***	166.37***	167.36***	166.53***
Observations	6951	1356	3827	3469	6491	430
R-squared	0.03	0.00	0.03	0.03	0.03	0.03

Notes: The Argentina regression constant in model (1) refers to an unskilled male of age 52, born in the 1870s; model (2) refers to farmers only, and excludes the 1910s. The Brazil regression constants refer to a criminal unskilled free male of brown (Col. 3-5) or black (Col. 6) skin color aged 23-50 (Col. 3 and 4: aged 23-60), born in Brazil in the 1880s.

Table 4: Occupational and social structure, in Lima in 1876 and in Brazil in 1872

	Lima Census share 1876	Lima sample share 1870s	Brazil Census share 1872	Brazil sample share 1870s
Occupational group				
No occupation	0.1	0.6	n.a.	3.1
Unskilled	16.3	16.5	33.9	35.9
Farmers	47.8	18.4	n.a.	1.7
Semiskilled	21.7	14.6	26.5	34.5
Skilled	9.4	34.8	20.6	21.1
Semiprofessionals	4.2	12.0	13.5	3.0
Professionals	0.5	3.2	5.5	0.7
Slaves				
free	100	100	84.29	82.88
slave	0	0	15.71	17.12
Skin color				
White	22.7	20.7	38.5	41.6
Indio	44.1	43.0	n.a.	n.a.
Mestizo	15.7	21.8	41.5	30.4
Black	6.8	10.5	20.0	28.0
Asian	10.7	3.2	n.a.	n.a.

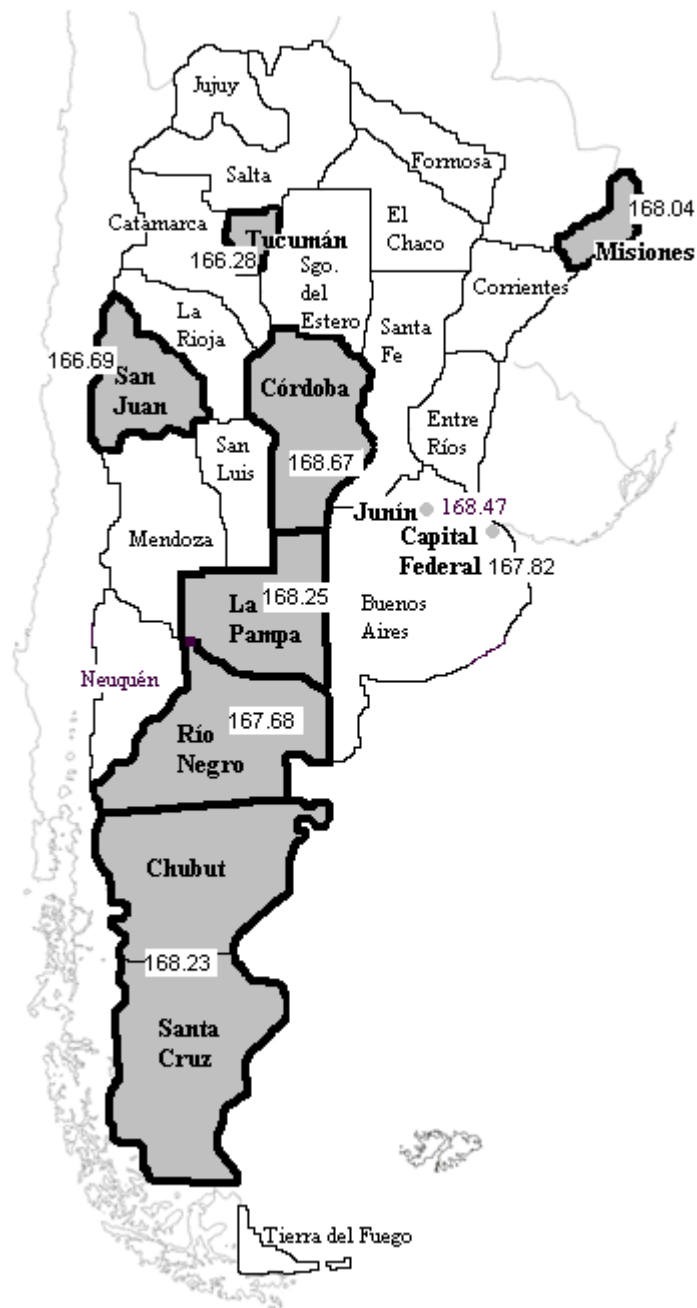
Notes: Brazil without considering farmers.

Table 5: Determinants of heights (cm) in Lima

Who included	no imm.	all
Birth Decades		
1820/30	-2.22*	-2.34**
1840/50	-2.27***	-2.31***
1860/70	0.11	0.07
Unskilled	ref.cat.	ref.cat.
Semiskilled	0.75	0.39
Skilled	0.32	0.21
Semiprofessional	0.58	0.24
Professional	-1.62	0.47
Farmer	-0.34	-0.4
Indio/Cholo	-5.02***	-6.03***
Mestizo	-2.91***	-3.37***
Zambo	0.73	-0.45
Black	2.25*	1.01
Asia		-3.58***
Constant	165.78***	166.88***
Observations	884	1139
R-squared	0.14	0.13

Notes: the Peru regression constant refers to a criminal unskilled male of white skin color and age 23-50, born in the 1880s.

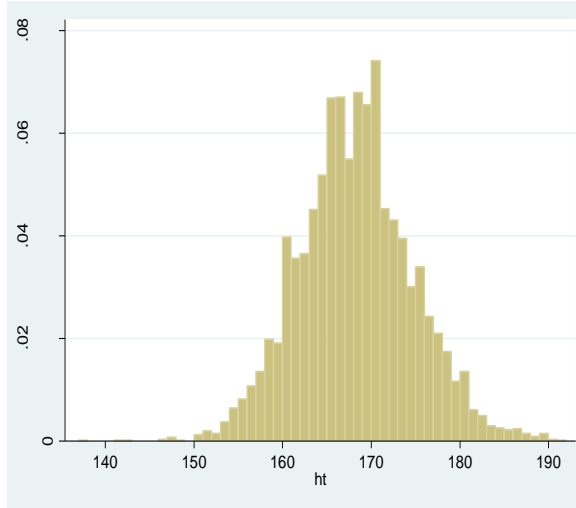
Figure 1: Spatial distribution of heights in Argentina



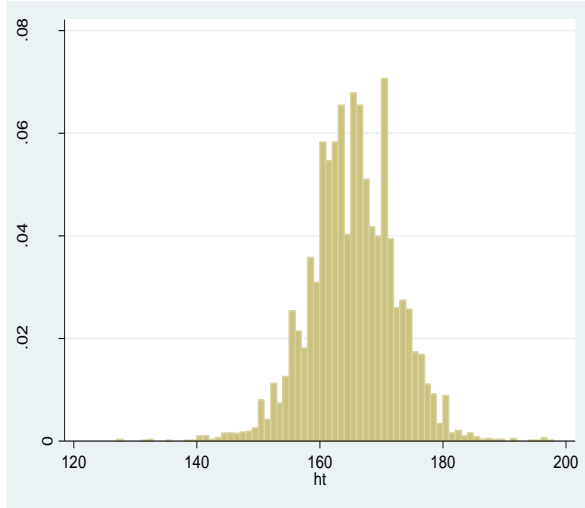
Note: the grey-shaded provinces plus the cities of Buenos Aires and Junín are included in the sample. Their mean heights in cm are reported in the white boxes.

Figure 2: Distribution of heights in Argentina, Brazil, and Lima

Argentina



Brazil



Peru

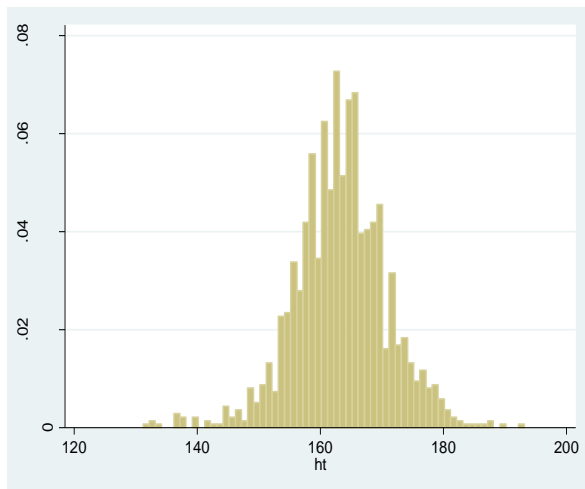


Figure 3: Comparison of various height estimates for Argentina (Source: Salvatore, 2007)

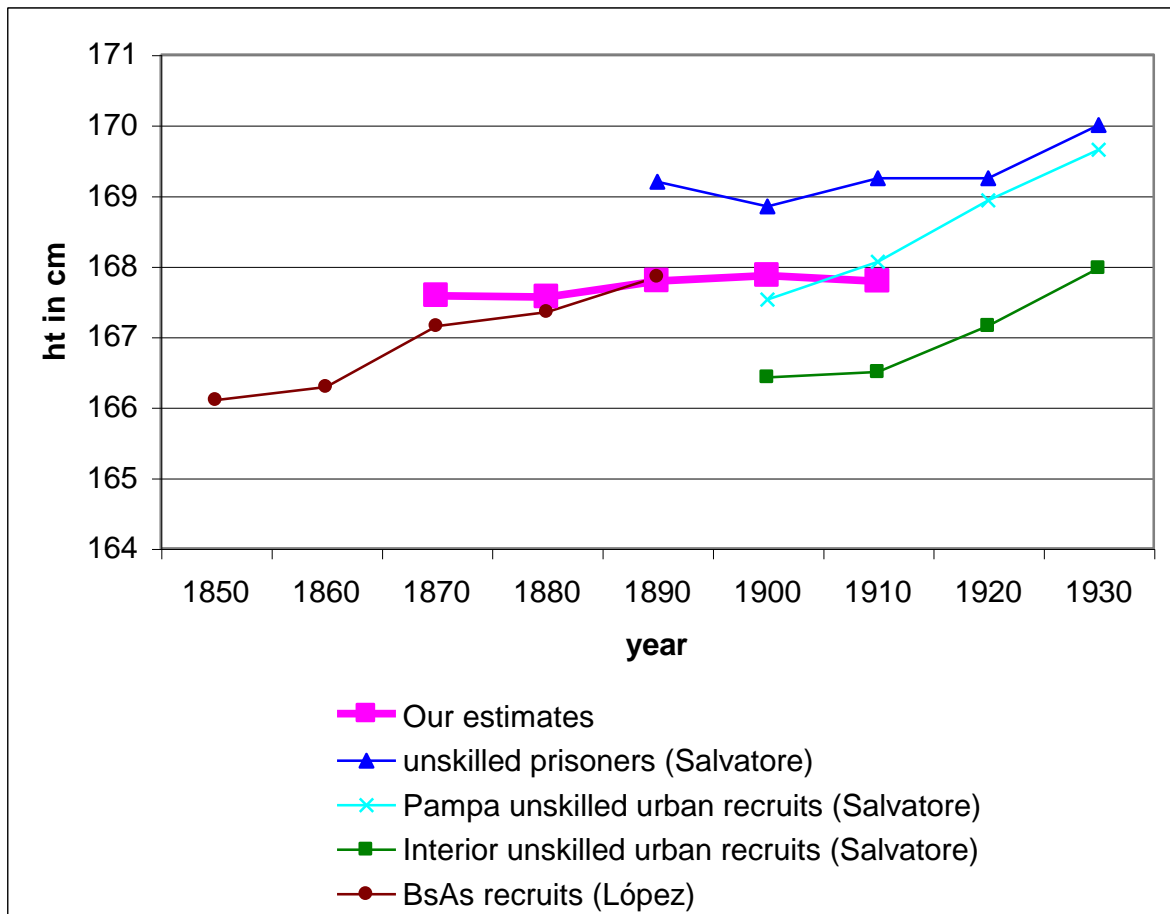


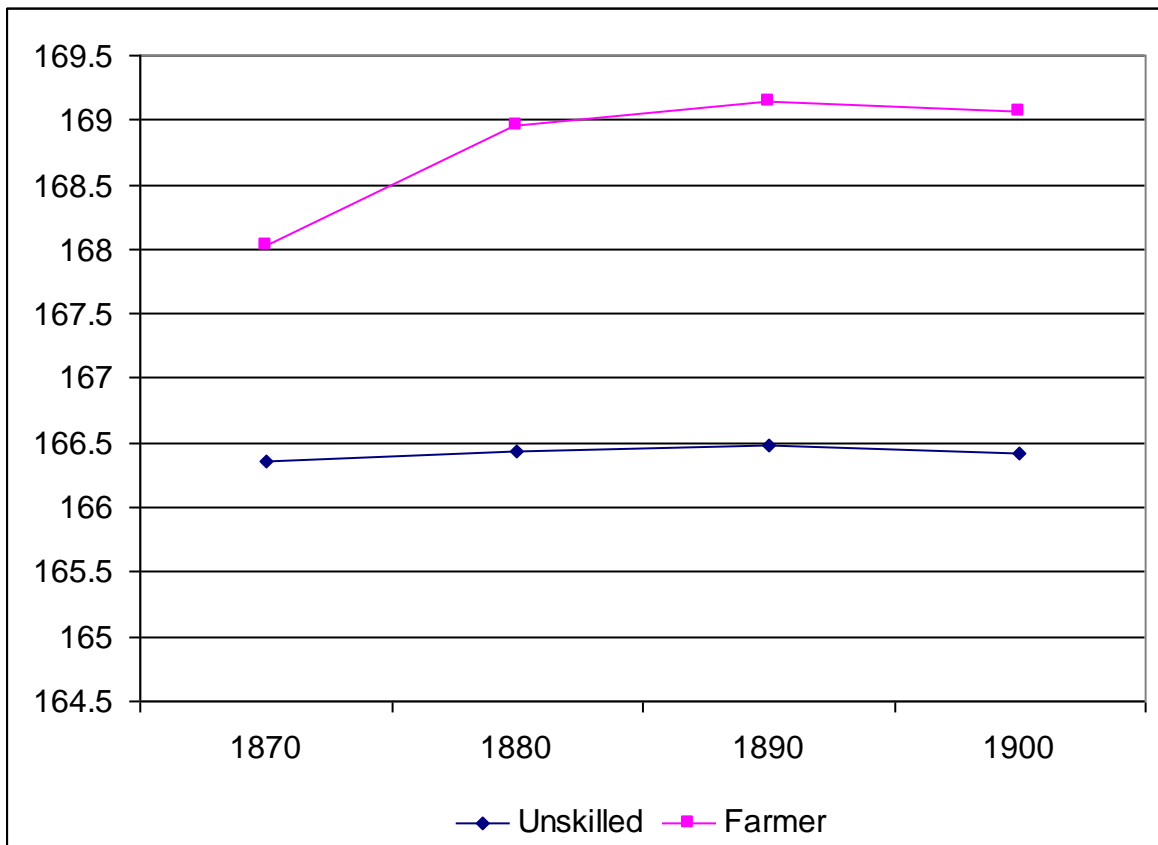
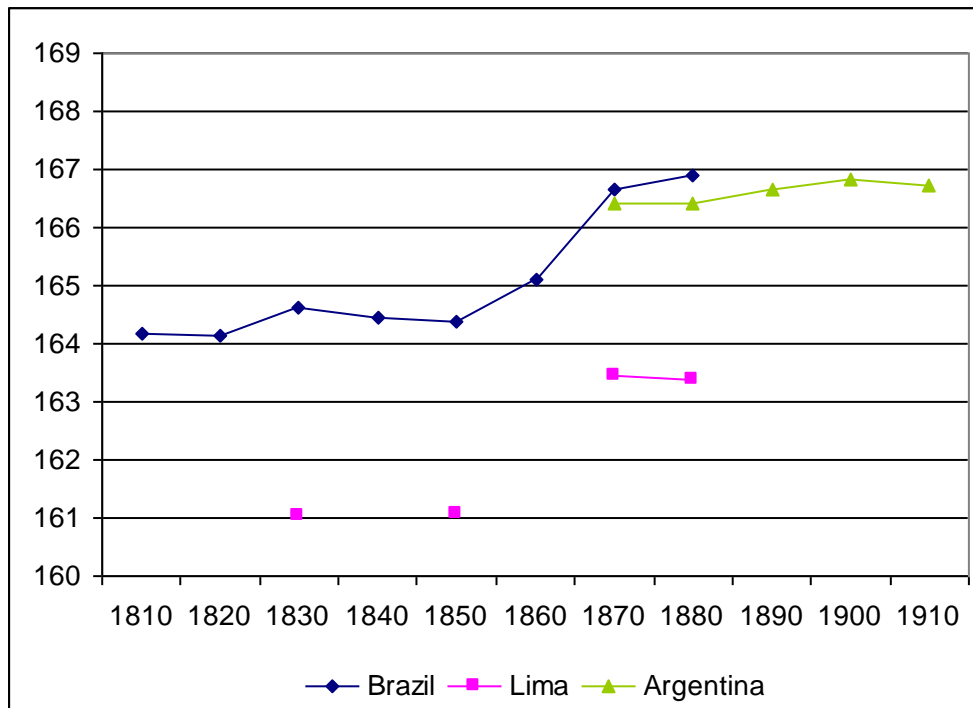
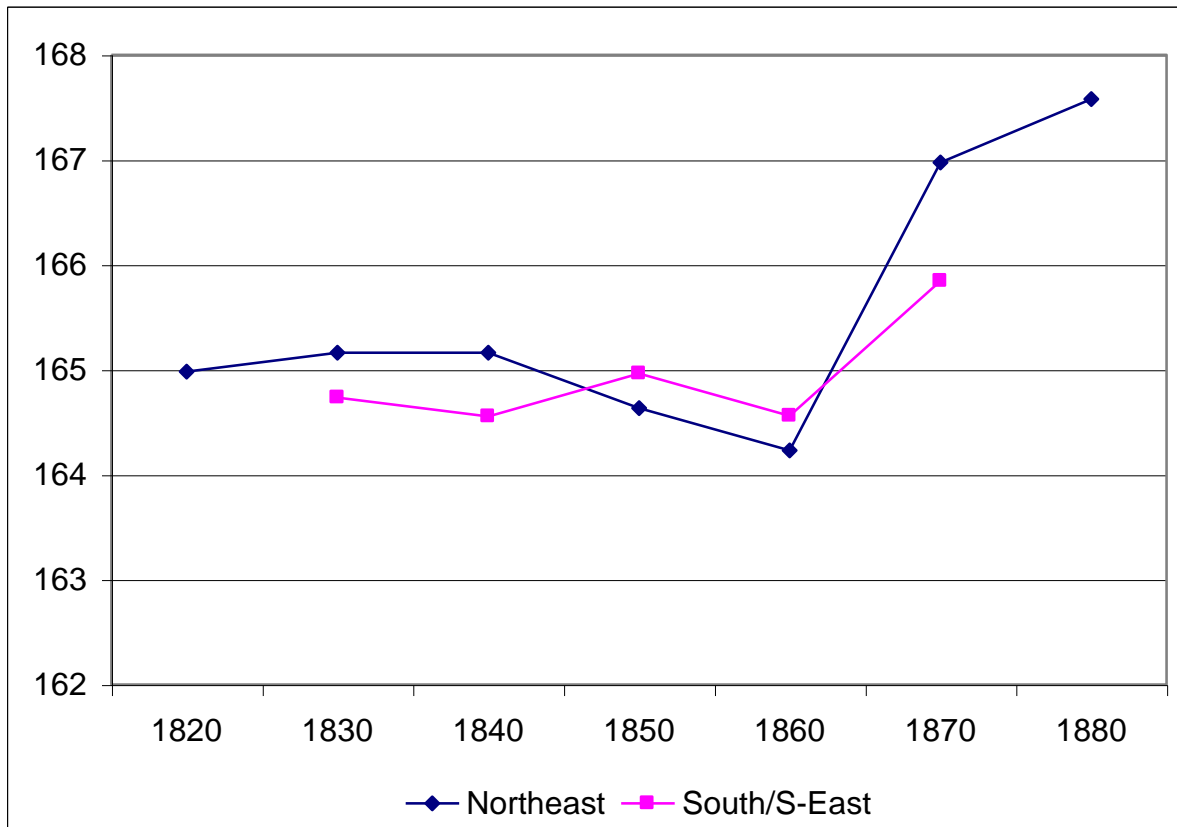
Figure 4: Height trends of farmers and unskilled workers: Argentina

Figure 5: Height trends in Argentina, Brazil, and Lima by birth decade (Brazil, Argentina), and 20- or 10-year birth cohort (Lima)

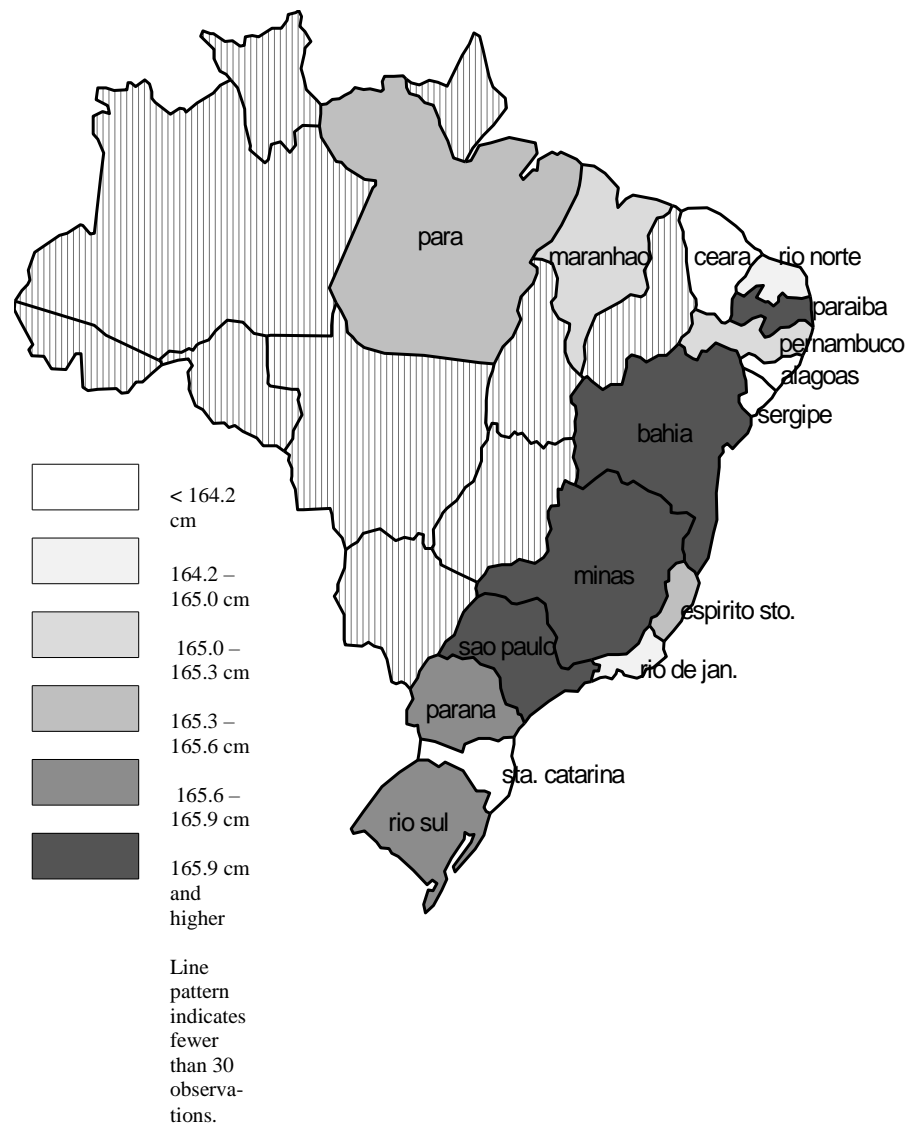


Note: The Lima value for 1830 refers to those born 1820-39, the one for 1850 to 1840-59, the one for 1870 to 1860-1879, the one for 1880 to 1880-89. The years denote the beginning of a birth decade for Brazil and Argentina (1810 for 1810-19 etc.). We adjusted for occupational group and for skin color by using the coefficients of the main regression tables, and census weights so as to obtain unbiased population averages for each birth cohort and country (the census weights were derived from the Peruvian census of 1876, values for the Lima region, and the Brazilian census of 1872)

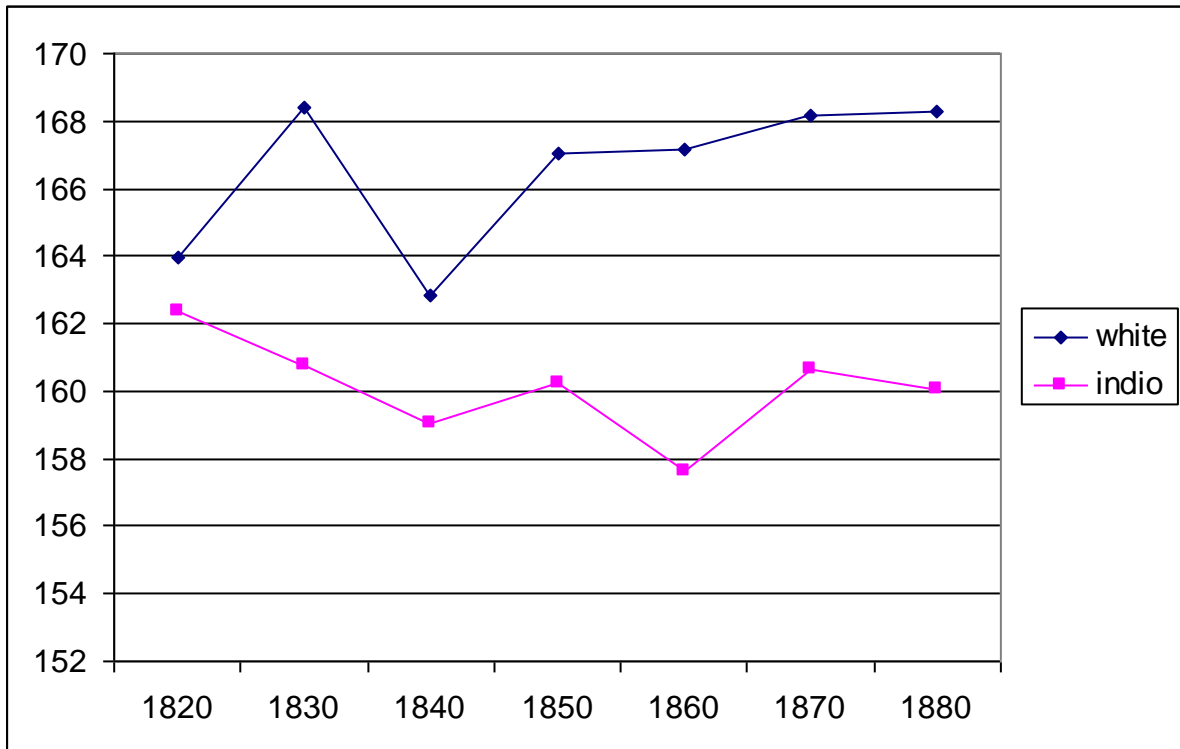
Figure 6: Height trend in Northeast and Southeast/South Brazil

Notes: “Northeast” refers to Pernambuco, Bahia, Sergipe, Alagoas, Paraíba, Rio Grande do Norte, Ceará, Piauí, and Maranhão. “South/Southeast” refers to Rio de Janeiro, São Paulo, Minas Gerais, Espírito Santo, Paraná, Santa Catarina, and Rio Grande do Sul. We included only birth decades with at least 50 observations, and only adult males aged 23-60.

Figure 7: Height by province in Brazil

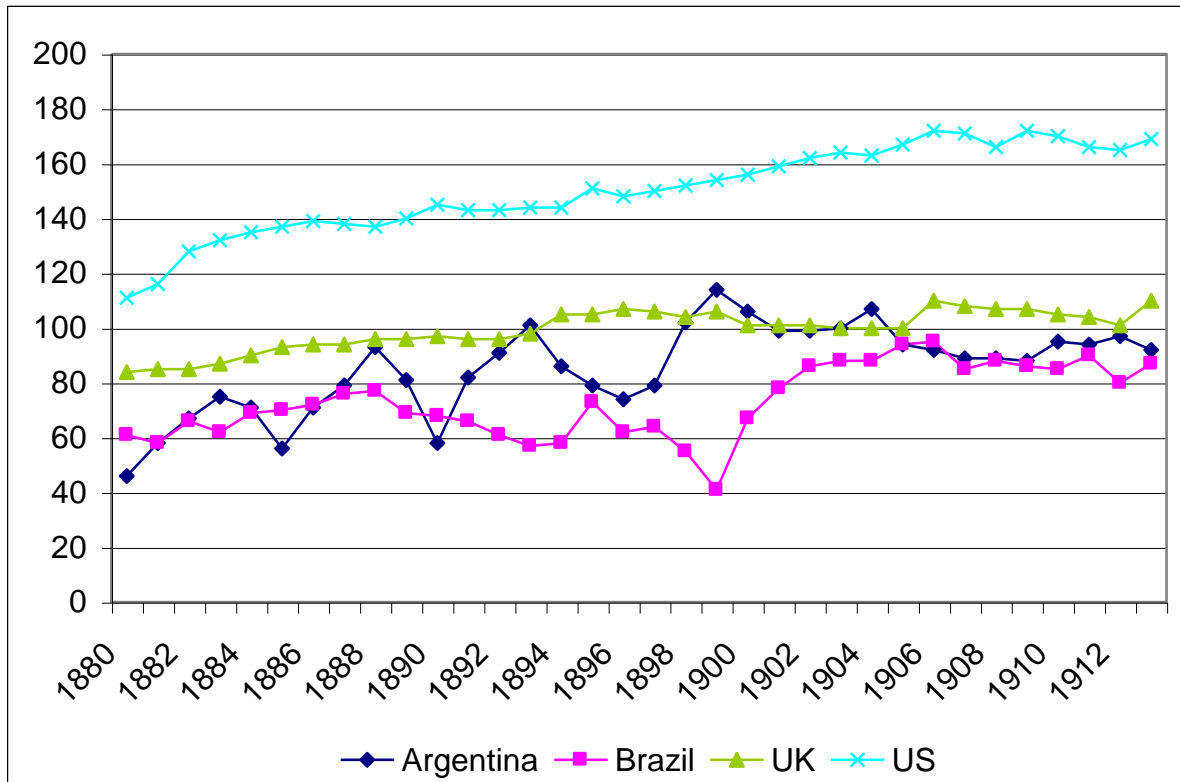


Note: The mapping software does not allow the special Portuguese characters. Please refer to the text for the correct spelling of the province names.

Figure 8: Height differences by skin color: Peru

Appendix Figure A.1: Real wages in Argentina, Brazil, UK, and US (index value, relative to UK 1905=100. Source: Williamson 1995)

(This appendix will be made available on the Internet and does not have to be included in the printed text)



Appendix A.2: Recalculation of Brazilian height trend if 2.75 cm is taken for the inch used in the prison

In this appendix, we report the results for Brazil if the height-measurement unit used for the inch-based early measurements is 2.75 cm per inch results, and not 2.73, as Frank (2006) argued. As expected, the level of height for the early cohorts is clearly higher, as the difference between the measures is 0.73 %. The 1840s would have around 0.7 cm higher heights, the 1820s 1.4 cm, and the coefficient of the 1810s would become insignificant. However, we think that the empirical way in which Frank (2006) assessed the measurement is superior to a decision based on official rules. Hence we regard the original series as closer to the true height trends. But we stress the possibility of alternative height trends in the Internet appendix.

	(1)	(2)	(3)
	Brazil (all)	Brazil (all)	Brazil (slaves)
Semiskilled	0.81*** (0.000070)	0.59*** (0.0047)	
Skilled	0.93*** (0.000032)	0.88*** (0.00012)	
Semiprofessional	1.01** (0.013)	0.80* (0.060)	
Professional	3.28*** (0.0024)	3.32*** (0.0024)	
Farmer	-1.23* (0.078)	-1.36* (0.061)	
Round age	-0.81*** (0.00022)	-0.80*** (0.00038)	-1.03 (0.33)
Imigrant	0.18 (0.43)		
Black	0.22 (0.38)		
White	-0.16 (0.51)	-0.62* (0.052)	
Birth decades			
1810	-1.00 (0.30)	-0.98 (0.44)	0.00 ()
1820	-1.42** (0.045)	-0.64 (0.40)	0.17 (0.93)
1830	-1.26** (0.039)	-1.37** (0.028)	-1.87 (0.36)
1840	-1.76*** (0.0021)	-1.77*** (0.0021)	-2.94 (0.19)
1850	-2.13*** (0.00013)	-2.08*** (0.00020)	-3.49 (0.11)
1860	-1.65*** (0.0020)	-1.66*** (0.0020)	-4.32 (0.12)
1870	-0.13 (0.82)	-0.14 (0.79)	0.00 ()
Age 19	-1.67*** (0.0000037)	-1.64*** (0.0000063)	-1.52 (0.54)
Age 20	-0.75** (0.048)	-0.72* (0.063)	0.44 (0.85)
Age 21	-0.54 (0.19)	-0.47 (0.26)	-1.37 (0.62)
Age 22	-0.30	-0.27	0.41

	(0.40)	(0.46)	(0.81)
Age 51-60	-0.83*		
	(0.068)		
Brown	Ref.cat.	-0.42	
		(0.12)	
Slave		-0.99**	
		(0.021)	
France		0.64	
		(0.53)	
Germany		3.79***	
		(0.00011)	
UK		3.60***	
		(0.000034)	
North America		3.30***	
		(0.000079)	
Spain		0.12	
		(0.80)	
Portugal		-0.12	
		(0.65)	
Italy		0.21	
		(0.65)	
Other Immigrant		1.60***	
		(0.0083)	
Africa			-3.56***
			(0.0014)
Constant	166.62***	167.09***	167.74***
Observations	6771	6491	430
R-squared	0.02	0.03	0.03

Appendix A.3 Was there survivor bias among the Argentinean conscripts? (This will be made available on the Internet and does not have to be included in the printed text.)

Alter (2004) emphasized the effect of survivorship bias in anthropometric research, and this bias could affect our Argentinean sample measured in 1927 in particular. Infant and child mortality was very high in historical populations, and it is likely that malnourished infants died from a variety of diseases. Therefore the surviving group does not represent universal values for all persons born in a given country or year. In this respect, height studies are actually quite similar to GDP and real-wage studies of living standards. We can measure only those who survived to income-earning age.

The income-mortality link establishes that some who died as infants may have had below-average abilities and talent, and might have earned a lower income had they lived. Therefore GDP-per-capita measures could be biased. Jackson (1994) made a similar argument for inequality measures. Abrupt changes in the disease environment, for example during epidemics, when many children died and the growth of those who survived was stunted, might generate upwardly biased height values for survivors born in those years. However, in anthropometric studies, most years of epidemic outbreaks produced lower measurements than did adjacent years, perhaps because the “big killers” typically stunted the growth of many surviving children.

There may be an additional survivorship bias among age groups typically included in height studies, namely mortality between the late teen years and age 50. Malnourished people may have died in greater numbers. However, even in societies with overall high-mortality rates, infant, child and old-age mortality far outweighs the mortality of that age bracket, so any possible bias is insignificant. Empirical studies that compared surviving numbers of the poorest and richest strata of society did not find that the richest stratum was markedly overrepresented among older people in the data set. We performed the same exercise for Argentina, calculating the ratio of mortality among the unskilled to that among the rest of the

population. Assuming that the hypothesis that selective mortality had a major influence was valid, we would expect the unskilled to be overrepresented among younger cohorts, and underrepresented among older cohorts. However, there is no consistent trend and no visible bias. The share of unskilled Argentineans developed from 38 % in the 1870s, and from 36% and 35% in the 1880s and 1890s, to 39% in the 1900s. Only the share of the youngest cohort, 17-year-olds, increased, to 42%. Therefore this cohort of the Argentinean sample should be treated with care.

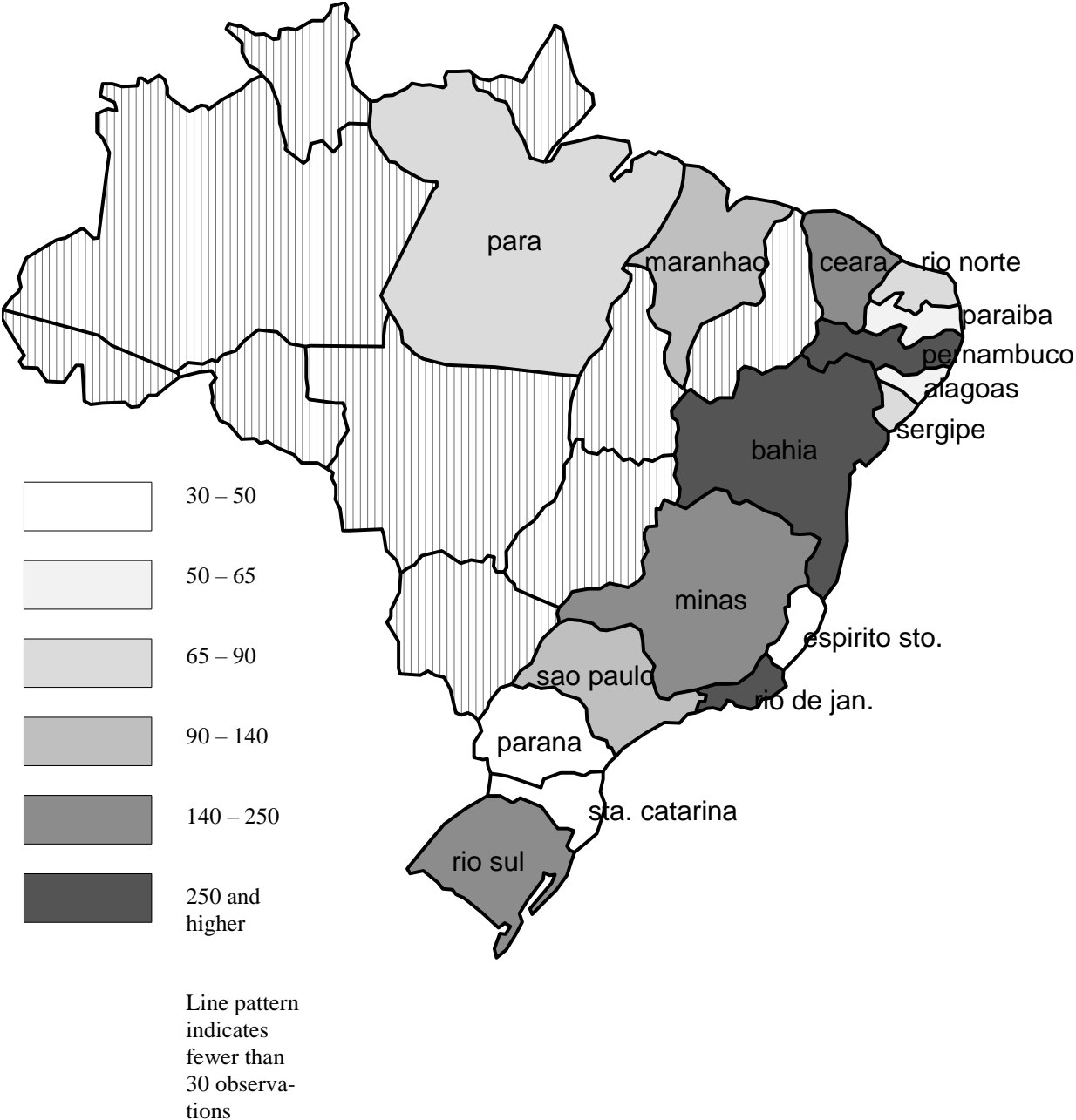
References

Alter, G., 2004. Height, Frailty, and the Standard of Living: Modelling the Effects of Diet and Disease on Declining Mortality and Increasing Height. *Population Studies* 58 (3), pp. 265-279.

Jackson, R.V., 1994. Inequality of incomes and lifespans in England since 1688.

Economic History Review 47 (3), pp. 508-524.

Appendix A.5: Number of cases by Brazilian provinces



Note: The mapping software does not allow the special Portuguese characters. Please refer to the main article for the correct spelling of the province names.