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HEALTH DURING INDUSTRIALIZATION: EVIDENCE FROM THE 19TH CENTURY PENNSYLVANIA STATE PRISON SYSTEM

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Abstract

The use of height data to measure living standards is now a well-established method in economic history. Moreover, a number of core findings in this literature are widely agreed upon. There are still some populations, places, and times, however, for which anthropometric evidence remains thin. One example is African-Americans in the US Northeast and Middle Atlantic states during the 1800s. Here, a new data is used from the Pennsylvania state prison to track black and white male heights incarcerated between 1829 to 1909. Throughout the century, and controlling for a number of characteristics, Pennsylvania black men in were shorter than white men. The well-known mid-century height decline is confirmed among white men, however, extended to blacks as well.

JEL Code: N31, J15, J70, I12, I31.

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Health during Industrialization: Additional Evidence from the 19th Century Pennsylvania State Prison System

1. Introduction

Industrialization and modernization frequently bring about rising incomes, wages and life expectancy, particularly in the long run (Komlos, 1985, 1987; Floud, Wachter and Gregory, 1990, pp. 272-273). However, in the short run economic change also creates social turmoil, such as increasing inequality, crime and a more virulent disease environment, which leads to deteriorating biological conditions. Hence, the overall effect of industrialization on biological conditions depends on which effect dominates. A growing body of evidence indicates that during the earliest stages of American industrialization the net effect on Northern whites was negative. In the case of Middle Atlantic States, economic growth was associated with greater factor mobility, and greater income accumulation, which enhanced biological conditions (Atack and Bateman, 1980, p. 125; Atack and Bateman, 1987, p. 87-92; Easterlin, 1971, p. 40-41; Soltow, 1975, p. 103; Steckel, 1983). However, Middle Atlantic States also experienced rapid industrial growth, high population densities, high transaction costs to acquire food, and more virulent disease environments, which impeded biological conditions (Atack and Bateman, 1987, p. 156; Komlos, 1987, p. 918).

Stature measures the net cumulative difference between nutrition, environmental conditions, disease insults and calorie claims for work; consequently, environment can influence a population's average stature (Eveleth and Tanner 1976). When diets, health

or physical environments improve, average stature increases and decreases when diets become less nutritious, disease environments deteriorate or the physical environment places more stress on the body. Hence, stature provides significant insights into understanding historical processes and augments other 19th century welfare measures.

A common theme throughout many 19th-century European and American anthropometric samples is the existence of an early-industrial growth puzzle, insofar as wages and output per capita increased, while average physical stature underwent a noticeable decline (Margo and Steckel, 1982; Komlos, 1987; Steckel and Haurin, 1994; Cuff, 2005). Stature also varied by socioeconomic status and nativity. Farmers were consistently taller than non-farmers, and Northeastern and Middle-Atlantic males were shorter than other Americans (Komlos and Coclanis, 1997, p. 441; Komlos, 1987, p. 902; Steckel and Haurin, 1994, p. 170; Sokoloff and Villaflor, 1982, p. 463; Fogel, 1986, p. 500; Margo and Steckel, 1983, pp. 171-172).

It is against this backdrop that this study considers whether these observed biological patterns and explanations held for 19th-century black and white males in Pennsylvania's state prison system. Prison records are particularly useful for examining changes in biological conditions because they provide accurate stature measurements and are drawn from lower socioeconomic groups, that segment of society most vulnerable to economic change (Bogin, 1991, p. 288; Godoy et al, 2005, pp. 469-470).[1] Three questions are considered. First, how did Pennsylvania inmate statures compare to other

[1] Many 19th century and earlier stature measurements were rounded to the nearest inch or half inch. However, there was great care in recording inmate statures because accurate measurement may have had legal implications in the event that an inmate escaped and later recaptured. Most inmates' statures were recorded at quarter, eighth, and even sixteenth increments.

American statures? Pennsylvania was sufficiently close to the Northeast's rapidly developing industries and sufficiently far from Great Lake States with their access to dairy production to place Pennsylvanians at a relative biological disadvantage. Second, how did Pennsylvania statures compare by race and how did African and European-American statures vary over the course of the 19th century? This comparison is intriguing because when brought to maturity under similar net nutritional conditions, blacks and whites reach comparable adult terminal statures (Eveleth and Tanner, 1966; Tanner, 1977; Margo and Steckel, 1982; Komlos and Baur, 2004; Barondess, Nelson, and Schlaen, 1997; Nelson et al, 1993, pp. 18-20; Godoy et al, 2005, pp. 472-473). [2] Third, how did Pennsylvania prison inmate statures vary by occupation, and birth year, and were time or socioeconomic status more significant in black and white stature variation?

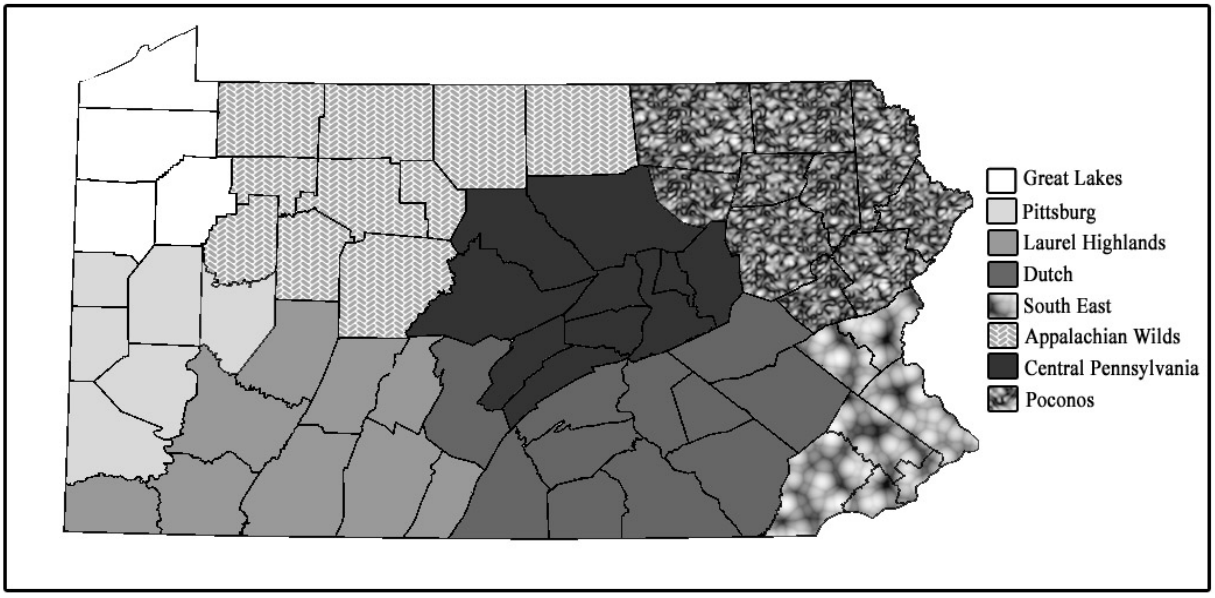
2. Nineteenth Century Pennsylvania

Nineteenth century Pennsylvania creates a natural experiment to study the effects of Northern industrialization on biological conditions by race. During the antebellum period, when slaves escaped North, Southern owners had the right to return their slaves to the South. However, the 1847 Pennsylvania Fugitive Slave law prohibited the kidnapping of free northern blacks, protected black fugitives from unlawful seizure, gave judges the power to issue writs of habeas corpus in fugitive slave cases and banned the use of Pennsylvania jails for detaining fugitive slaves (Blackett, 1997, pp. 151, 163). This Pennsylvania law required federal action to resolve fugitive slave cases, and on

[2] Eveleth and Tanner, *Worldwide Variation in Human Growth.* Appendix. Tables 5, 29, and 44; Tanner, "Factors Controlling Growth," pp. 341-342; Margo and Steckel, "Heights of American Slaves". Komlos and Baur, 2004; Barondess, Nelson and Schlaen, 1997, p. 698.

September 18, 1850, President Millard Fillmore signed the United States' Fugitive Slave Law, requiring northerners to return run-away slaves to their southern owners.

Figure 1, Nineteenth Century Pennsylvania Regions



Notes: Pennsylvania's northwestern Great Lakes region consists of Crawford, Erie, Mercer and Venango counties. The Appalachian Wilds consists of Warren, Forest, Clarion, Jefferson, Elk, McKean, Clearfield, Cameron, Potter, and Tioga counties. Central Pennsylvania consists of Center, Clinton, Lycoming, Union, Snyder, Mifflin, Juniata, Columbia, Montour, and Northumberland counties. Pocono counties include Bradford, Wayne, Lackawanna, Wyoming, Sullivan, Luzerne, Pike, Monroe, Carbon, Schuylkill, Susquehanna, and Scranton counties. Counties in southeastern Pennsylvania include Northampton, Lehigh, Bucks, Montgomery, Chester, Delaware, and Philadelphia counties. Counties in the Pennsylvania Dutch region are Berks, Lancaster, Lebanon, York, Adams, Dauphin, Perry, Cumberland, Huntington, and Franklin counties. The Laurel Highlands consist of Bedford, Fulton, Blair, Cambria, Somerset, Indiana, Westmoreland, Fayette, Greene, Altoona, Mount Pleasant and Johnston counties.

Counties in the Pittsburg region include Butler, Lawrence, Beaver, Armstrong, Alleghany, Washington and Pittsburg counties. Proximity to a river means a county sharing a border with the Susquehanna river or Alleghany River Basin. For the Susquehanna, these counties include Bradford, Wyoming, Lackawanna, Luzerne, Columbia, Montour, Northumberland, Union, Snyder, Dauphin, Perry, and Cumberland counties. Western counties sharing a border with the Alleghany, Monongahela, and Ohio rivers include Ohio, Beaver, Alleghany, Greene, Fayette, Washington, Westmoreland, Erie, Crawford, Venango, Clarion, and Armstrong counties.

Within Pennsylvania there were seven economically distinct geographic regions: Great Lakes, Alleghany Wilds, Northeast Poconoes, Susquehanna Valleys, Philadelphia, Pennsylvania Dutch, and Pittsburgh regions. Because the prison system allowed for entry under a United States and Pennsylvania state prison jurisdiction, an At Large classification is also included. These eight diffuse regions span Pennsylvania's economic and political environments. In 1800, Pennsylvania's population was rural, and lived in towns of 2,500 persons or fewer (Andriot, 1983, p. 670); throughout the 19th century, nearly half of the state's population resided in the Southeastern Philadelphia region, which was among America's most economically developed regions (Cuff, 2005, pp. 68, 82-84). At the other extreme were Pennsylvania's Alleghany Wilds and Northeast Poconoes, where populations were sparse, communities fragmented and most economic production occurred in agricultural sectors (Cuff, 2005, pp. 88-92). In the early 19th century, Pennsylvania's North Central Wild, and Northeastern Poconoes formed a natural impediment to economic development, and lagged behind Philadelphia and Pittsburgh.

Pennsylvania also varied regionally by race. In 1850, 4.2 percent of Pittsburgh and 2.5 percent of Alleghany County's population was black (Blackett, 1997, p. 149). By 1860, Philadelphia's free-black population was the second largest free-black community outside of the South —second only to Baltimore—making Pennsylvania racially and economically diverse (Hershberg, 1997, p. 124).

Pennsylvania is also unique in its river transportation systems. On the eastern side of the state runs the Susquehanna River and is America's longest river with an East Coast outlet that drains into the Atlantic Ocean. The Susquehanna originates in New York's Lake Otsego, runs through Pennsylvania's Southeastern rural farmland, and empties into the Chesapeake Bay. Moreover, the Susquehanna's proximity to Pennsylvania's anthracite coal region made it an integral part of Pennsylvania's 19th century development (Cuff, 2005, pp. 84-86). On the Western side of the state is Pennsylvania's Alleghany River Basin, which contains the Alleghany, Ohio, and Mononghela rivers, and was one of America's most productive 19th century energy producing regions. Consequently, Pennsylvania's physical geography and river basins influenced Pennsylvania's economic production, population distribution, biological conditions and statures.

3. Nineteenth century biological conditions in the Northeast

An extensive literature on white 19th century biological living conditions provides numerous insights. Several studies suggest that white average stature declined throughout the 19th century's 2nd and 3rd quarters, even though wages and output per capita increased (Margo and Steckel, 1983, p. 170; Komlos, John, 1998, p. 780-81; Komlos and Coclanis, 1997, p. 439. Steckel, 1995, p. 1919-1921; Steckel and Haurin,

1994, p. 124; Costa, 1993). Possible reasons for this paradox include increased inequality, changes in relative food prices, increased income variability, population growth and urbanization, agriculture commercialization, changes in work intensity, climatic variation, and changes in the disease environment (Komlos, 1998; Steckel, 2004, p. 217; Haines, 2004, p. 252). Moreover, white biological living conditions were sensitive to American occupations and nativity (Margo and Steckle, 1983, pp. 171-172; Vilaflour and Sokoloff, 1982, p. 465; Wannamethee, 1996, pp. 1259-1261). Rural farmers consistently benefited from their close proxity to nutritious food sources and removal from population centers, where disease was more easily spread (Komlos and Coclanis, 1997, p. 441; Steckel and Haurin. 1994, p. 123; Margo and Steckel 1983, p. 170; Sokoloff and Vilaflour, 1983, p. 463). Because the Northeast was America's first to industrialize, Northeastern natives were generally shorter than other white Americans, while residents in the South, Plains and Far West reached taller average statures (Steckel, 1995, p. 1921; Steckel and Haurin, 1994, pp. 158-59; Costa, 1993, p. 366).

Stature also varied by race, indicating that 19th century biological inequality reflected its material inequality. Robert Margo and Richard Steckel (1982) demonstrate that adult male slaves were shorter than northern whites, and slaves born in the New South fared better than slaves in the Old South (Margo, and Steckel, 1982, p. 519). There were also significant stature variations among slaves over time; slaves born between 1790 and 1810 were shorter than slaves born before 1790 and after 1810. Moreover, slave biological conditions did not demonstrate the 'Antebellum Paradox' observed in other 19th century white samples (Komlos, 1998, p. 58). Nevertheless, black average stature varied by occupation; black unskilled workers and field hands were generally taller than

domestic and skilled slaves (Margo and Steckel, 1982, p. 525). Part of these occupational stature differentials may have come from taller slaves' comparative advantage in skilled occupations and field work (Metzer, 1975, p. 134). Cuff (2005, pp. 181-204, Tables 5.22-5.33) also finds that Pennsylvania farmers were taller than non-farmers, and soldiers who enlisted in Western Pennsylvania were taller than those who enlisted elsewhere within Pennsylvania.

4. Data

There were two prominent state penitentiaries that comprise the Pennsylvania prison data: the Eastern and Western state prisons. Philadelphia's Eastern State Penitentiary is the most notorious, and was at the center of the 19th century debate concerning how American correctional facilities should operate. Opened in 1829, Eastern Pennsylvania prison directors held that inmates were best rehabilitated through strict isolation and given rudimentary tasks to complete. However, techniques used in the Pennsylvania prison system did not evade public scrutiny. After his 1842 visit to the Eastern Pennsylvania Prison, English author Charles Dickens commented "The system is rigid, strict and hopeless solitary confinement, and I believe it, in its effects, to be cruel and wrong . . ." On the other side of the penitentiary debate was the New York or Auburn System, where instead of completing their sentences in complete isolation, inmates worked to maintain prison facilities, completing their prison sentences with greater social interaction. However, like the Pennsylvania system, the New York system maintained that while working, prisoners were not to speak with guards or other inmates. Because of prison distance and population density, a second prison was opened in 1882 in Western Pennsylvania (Walker, 1988, pp. 6-8).

Prison records are particularly useful for examining changes in biological living conditions because their accurate recording had legal implications.[3] While prison records are not random samples, the selectivity they represent has its own advantages, such as being drawn from low socioeconomic groups with consistent entry requirements over time. For stature studies as an indicator of biological change, this kind of selection is preferable to the type of selection that afflicts military samples—minimum stature enlistment requirements (Fogel et al, 1978, p. 85). Stature differences in Pennsylvania are likely genuine because inmates were incarcerated for criminal, not biological, reasons.

Together, nearly 20,000 American-born male inmates from the Pennsylvania East and West prisons were incarcerated between 1829 and 1909. Because the comparison is between black and white American males, females and immigrants are excluded from the analysis. Prison guards routinely recorded the dates inmates were received, age at incarceration, complexion, nativity, stature, pre-incarceration occupation, inmate crimes, and the county in which inmates were received. Fortunately, inmate enumerators were quite thorough when recording inmate complexion and occupation. For instance, enumerators recorded African-Americans as black, various shades of brown, colored, mulatto, and negro. While inmates classified as mulatto possessed genetic traits from both black and white ancestry, racial prejudice against blacks was the rule throughout

[3] Many 19th century and earlier stature measurements were rounded to the nearest inch or half inch. However, there was great care in recording inmate statures because accurate measurement may have had legal implications in the event that inmates escaped and later was recaptured. Most inmates' statures were recorded at a quarter, eighth, and even sixteenth increments. Cutler, Deaton, and Lleras-Muney, 2006, p. 110.

19th century America, and mulattos are grouped here with blacks. Enumerators recorded white complexions as light, medium, dark and fair. The white inmate complexion classification is further supported by European immigrant complexion, who were always of fair complexion and were also recorded as light, medium and dark.[4]

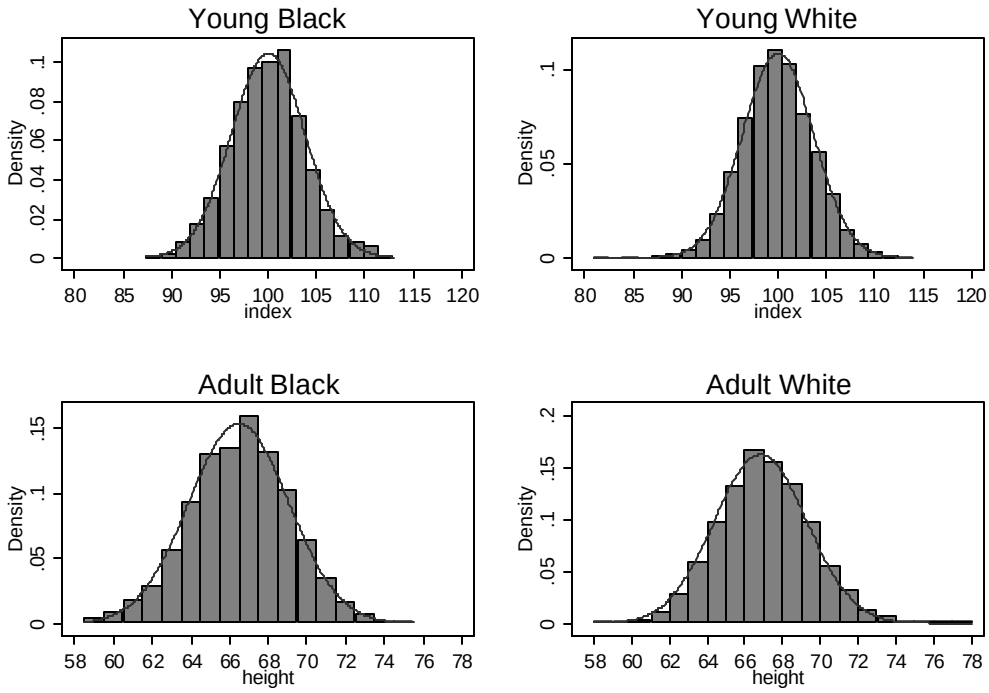
Enumerators recorded a broad continuum of occupations and defined them narrowly, recording over 200 different occupations. These occupations are classified into four categories. Workers who were merchants and highly skilled are classified as white-collar workers; manufacturing workers and carpenters are classified as skilled workers; workers in the agricultural sector are classified as farmers; laborers are classified as unskilled workers. Unfortunately, inmate enumerators did not distinguish between farm and common laborers. Since common laborers probably came to maturity under less favorable biological conditions, this potentially overestimates the biological benefits of being a common laborer and underestimates the advantages of being a farm laborer. By having the same prison official record characteristics over much of the period, the consistency of the Pennsylvania sample creates reliable comparisons across race and time.

A vital distinction in anthropometric studies is between adult and youth stature. Adult average stature reflects nutritional advantages and disadvantages during childhood, less environmental conditions, disease insults and calorie claims for work. Youth stature is even more sensitive to the immediate effects of privation because adults may undergo

[4] I am currently collecting 19th century Irish prison records. Irish prison enumerators also used light, medium, dark, fresh and sallow to describe white prisoners in prisons from a traditionally white population. To date, no inmate in an Irish prison has been recorded with a complexion consistent with African heritage.

catch-up growth (Steckel, 1995, p. 1910). Because the immediate effects of age on stature are different between youths and adults, their statures within the Pennsylvania prison sample are considered separately here. Adults are inmates between the ages of 23 and 55 years of age; youths are inmates between the ages of 14 and 22.

Figure 2, Pennsylvania Black and White Stature Distributions



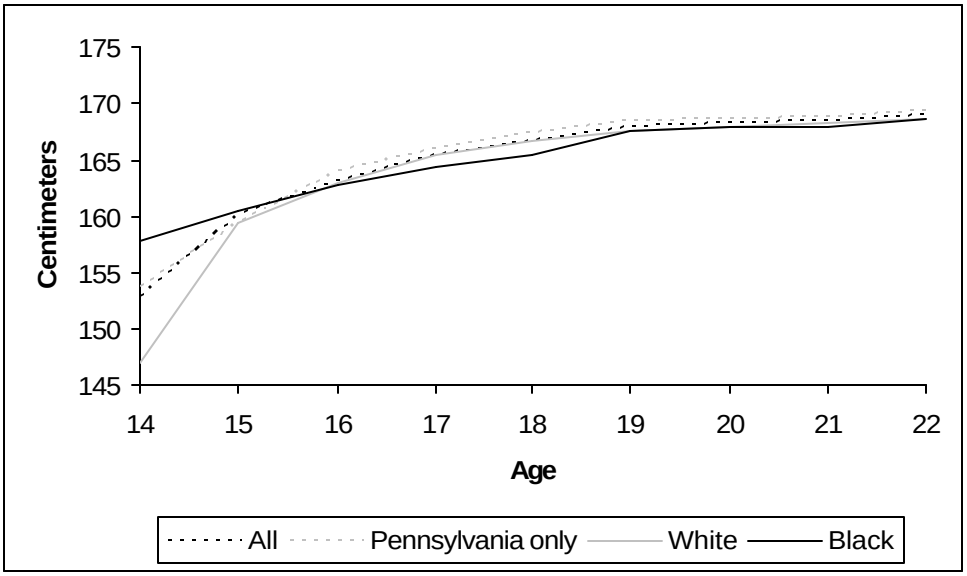
Source: See Table 1 and 2.

Note: The youth stature index is constructed by first caculating average stature for each youth age category. Second, each observation is then devided by average stature for the relevant age group (Komlos, 1987, p. 899).

One common shortfall of many military samples is a truncation bias imposed by minimum stature requirements (Fogel et al, 1978, p. 85). Fortunately, prison records do

not implicitly suffer from such a constraint and the subsequent truncation biases observed in military samples. Because the youth height distribution is itself a function of the age distribution, a youth height index is constructed that standardizes for age to determine youth stature normality. First, each youth age category's average stature is calculated. Second, each observation is then divided by the average stature for the relevant age group (Komlos, 1987, p. 899). Figure 2 demonstrates that black and white statures were distributed approximately normal.

Figure 3, Pennsylvania Black and White Youth Stature Profile by Age



Source: See Table 4.

For ages 14 and 15, average black stature exceeded average white stature (Figure 3); however, the rate of white adolescent growth at 14 and 15 was significantly greater than blacks, which allowed their statures to exceed blacks by age 16. The growth process lasted somewhat longer for whites, however, there was some catch-up growth for blacks after age 18, which is consistent with Steckel (1979, pp. 374-376).

Tables 1 and 2 present youth and adult male average statures by race and proportions by occupations, proximity to water (residence prior to incarceration in a county containing or bordering the Susquehanna or Alleghany Rivers) and residence. Although average statures are included, they are not reliable because of possible compositional effects, which are accounted for in the regression models that follow.

Table 1, Nineteenth Century Pennsylvania Youth Stature

Occupations	*White*			*Black*			*Stature Difference*	*Percent Difference*
	Height	Percent	N	Height	Percent	N		
White-Collar	168.71	8.51	382	166.19	6.26	80	2.52	2.25
Skilled	168.45	24.87	1,116	167.37	8.38	107	1.08	16.49
Farmer	170.65	3.65	164	170.24	1.72	22	.41	1.93
Unskilled	168.39	55.04	2,470	167.48	75.88	969	.91	-20.85
No Occupation	166.18	7.93	356	165.24	7.75	99	.94	.18
Proximity to Water								
Susquehanna	168.39	13.97	627	168.04	11.83	151	.35	2.15
No River	168.19	57.89	2,598	166.55	65.00	830	1.64	-7.11
Alleghany	168.63	28.14	1,263	168.87	23.18	296	-.24	4.96
Region								
Dutch	168.50	10.94	491	167.31	18.01	230	1.19	-7.07
Erie	169.03	7.49	336	167.15	1.72	22	1.88	5.76
Laurel	169.18	10.63	477	169.51	10.81	130	-.33	.45
North Central Wilds	169.37	7.82	351	168.81	1.49	19	.56	6.33
Philadelphia	166.91	22.17	995	166.49	30.00	383	.42	-7.82
Pittsburg	168.44	19.72	885	168.28	15.98	204	.16	3.74
Pocono	169.02	7.15	321	165.91	2.66	34	3.11	4.49
Susquehanna	168.23	7.73	347	167.76	4.62	59	.47	3.11
At Large	168.65	6.35	285	166.14	15.35	196	2.51	-9.00

Source: Data used to study black and white anthropometrics is a subset of a much larger 19th century prison sample. All available records from American state repositories have been acquired and entered into a master file. These records include Arizona, California,

Colorado, Idaho, Illinois, Kansas, Kentucky, Missouri, New Mexico, Ohio, Oregon, Pennsylvania, Tennessee, Texas, Utah and Washington. Only prison records for inmates incarcerated in the Pennsylvania prison are used in this project.

Notes: Stature is in centimeters. The occupation classification scheme is consistent with Ferrie (1997); The following geographic classification scheme is consistent with Carlino and Sill (2000): New England= CT, ME, MA, NH, RI and VT; Middle Atlantic= DE, DC, MD, NJ, NY, and PA; Great Lakes= IL, IN, MI, OH, and WI; Plains= IA, KS, MN, MO, NE, ND, and SD; South East= AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, and WV; South West= AZ, NM, OK, and TX; Far West= CA, CO, ID, MT, NV, OR, UT, WA, and WA. Stature difference is average white stature less average black stature. Proportion difference is white proportion less black proportion.

Table 2, Nineteenth Century Pennsylvania Adult Stature

Occupations	*White*			*Black*			*Stature Difference*	*Proportion Difference*
	Height	Percent	N	Height	Percent	N		
White-Collar	169.74	14.38	1,640	167.91	8.68	227	1.83	5.70
Skilled	169.50	33.21	3,787	168.70	14.45	378	.8	18.76
Farmer	171.37	4.68	534	169.23	1.80	47	2.14	2.89
Unskilled	169.72	42.92	4,894	169.00	71.48	1,870	.72	-28.57
No Occupation	169.02	4.82	550	167.55	3.59	94	1.47	1.23
Proximity to Water								
East River	169.57	14.37	1,639	168.68	16.02	419	.89	-1.65
No River	169.52	61.25	6,985	168.56	62.42	1,633	.96	-1.80
West River	170.20	24.38	2,781	169.63	21.56	564	.57	2.82
Region								
Dutch	168.84	12.03	1,372	168.53	17.20	450	.31	-5.17
Erie	170.79	6.93	790	169.21	1.49	39	1.58	5.44
Laurel	170.24	10.26	1,170	169.92	10.93	286	.32	-.67
North Central Wilds	170.87	8.05	918	168.98	1.34	35	1.89	6.71
Philadelphia	168.67	22.60	2,577	168.18	34.90	913	.49	-12.31
Pittsburg	169.71	16.05	1,831	169.35	14.41	377	.36	1.64
Pocono	170.28	6.67	761	168.11	2.71	71	2.17	3.96
Susquehanna	169.60	6.82	778	169.58	4.13	108	.02	2.96
At Large	170.39	10.59	1,208	169.19	12.88	337	1.2	-2.29

Source: Data used to study black and white anthropometrics is a subset of a much larger 19th century prison sample. All available records from American state repositories have been acquired and entered into a master file. These records include Arizona, California, Colorado, Idaho, Illinois, Kansas, Kentucky, Missouri, New Mexico, Ohio, Oregon, Pennsylvania, Tennessee, Texas, Utah and Washington.

Note: Stature difference is average white stature less average black stature. Proportion difference is white proportion less black proportion.

Blacks in the prison sample concentrated near Philadelphia and the Laurel Dutch Highlands, away from rivers and were unskilled; whites were skilled artisans and farmers and resided in the Alleghany river Basin and northern Pennsylvania. White white-collar and skilled workers were noticeably taller than black skilled workers, indicating the greatest Middle Atlantic biological disparity occurred in market related occupations.

Table 3, Nineteenth Century Pennsylvania Occupation Distributions by Race

	1860		*1870*		*1880*		*1900*	
	Black	White	Black	White	Black	White	Black	White
White-Collar	3.17	10.92	1.64	10.69	6.43	10.23	6.27	12.72
Skilled	1.59	22.16	5.74	20.40	2.34	16.82	4.53	21.10
Farmer	3.17	32.20	4.92	25.55	2.31	19.77	1.39	15.83
Unskilled	90.48	34.21	87.70	42.79	84.80	50.14	87.8	49.13
No Occupation	1.59	.51	0	.57	4.09	3.03	0	1.22

Source: Steven Ruggles, Matthew Sobek, Trent Alexander, Catherine A. Fitch, Ronald Goeken, Patricia Kelly Hall, Miriam King, and Chad Ronnander. *Integrated Public Use Microdata Series: Version 3.0* [Machine-readable database]. Minneapolis, MN: Minnesota Population Center [producer and distributor], 2004.

How well the Pennsylvania prison population reflects Pennsylvania's general population is observed by comparing prison to census population occupational and residential distributions. Table 3 illustrates that blacks in Pennsylvania censuses were predictably less likely than whites to be white-collar, skilled workers and farmers, and were more likely to be unskilled workers. Compared to Pennsylvania censuses, black inmates were surprisingly less likely to be unskilled. Pennsylvania urbanized between 1860 and 1900, and urbanization occurred along racial lines. In 1860, 30.63 percent of

Pennsylvania whites lived in urban locations; 44.44 percent of blacks lived in urban locations. By 1900, 46.11 percent of Pennsylvania whites lived in urban locations; 76.44 percent of blacks lived in urban locations (IPUMS, 1860, 1870, 1880 and 1900; Cuff, 2005, pp. 69-72).

5. Comparison of Pennsylvanians with other Americans

To account for possible compositional effects and to determine how demographic and socioeconomic characteristics were related to stature, the Pennsylvania prison sample is partitioned by age and complexion. Tables 4 and 5 regress individual youth and adult stature on observable characteristics. Models 1 in both Tables 4 and 5 regresses both black and white statures on characteristics. To isolate how Pennsylvania biological conditions contrasted with the rest of the US, Model 2 regresses stature on only Pennsylvania-born male characteristics. Model 3 regresses stature on only white males, while Model 4 does the same for blacks. Figure 4 illustrates black and white secular trend variation by using time coefficients from Tables 4 and 5.

Table 4, Pennsylvania Youth Stature by Birth Year, Occupations, Residence, Birth period and Stature.

	All		*Pennsylvania*		*White*		*Black*	
	(Coeff)	(P-Value)	(Coeff)	(P-Value)	(Coeff)	(P-Value)	(Coeff)	(P-Value)
Intercept	168.92	<.01	169.29	<.01	168.63	<.01	168.60	<.01
Black	-.985	<.01	-.876	<.01				
Ages								
14	-16.04	<.01	-15.45	<.01	-21.77	<.01	-10.63	<.01
15	-8.76	<.01	-9.88	<.01	-9.23	<.01	-8.03	<.01
16	-5.72	<.01	-5.31	<.01	-5.70	<.01	-5.82	<.01
17	-3.38	<.01	-3.29	<.01	-3.11	<.01	-4.20	<.01
18	-2.23	<.01	-1.93	<.01	-1.99	<.01	-3.10	<.01
19	-1.06	<.01	-.891	<.01	-1.04	<.01	-.999	.09
20	-.704	<.01	-.707	.03	-.700	.01	-.579	.29
21	-.405	.10	-.389	.19	-.288	.29	-.697	.22
22	Ref.		Ref.		Ref.		Ref.	
Birth Cohort								
1810	Ref.		Ref.		Ref.		Ref.	
1820	-.283	.64	-.790	.28	.686	.40	-1.87	.04
1830	.056	.94	-.435	.61	.241	.78	.109	.94
1840	-.742	.25	-.804	.29	-.218	.78	-1.74	.16
1850	-1.48	.02	-1.56	.04	-.994	.21	-2.24	.06
1860	-1.04	.11	-1.07	.15	-.494	.53	-2.60	.03
1870	.017	.98	-.529	.48	.649	.41	-2.14	.06
1880	.425	.51	.265	.73	1.39	.08	-2.54	.08
1890	.361	.76	-.144	.92	1.10	.42	-2.07	.35
Occupations								
White-collar	.602	.17	.950	.07	.991	.04	-1.31	.20
Skilled	.562	.11	.751	.08	.676	.08	-.047	.96
Farmer	2.57	<.01	2.70	<.01	2.65	<.01	2.06	.12
Unskilled	.670	.04	.899	.02	.790	.03	.131	.85
Birth Region								
Northeast	.269	.61			.431	.46	-.899	.38
Middle Atlantic	Ref.		Pennsylvania Born Only		Ref.		Ref.	
Great Lakes	.760	.06			.983	.02	-1.17	.30
Plains	2.79	.01			3.45	<.01	-2.42	.51
Southeast	.749	.03			-.280	.63	1.15	<.01
West	1.43	.27			1.31	.34	1.92	.64
No Occupation	Ref.		Ref.		Ref.		Ref.	
River Basin								
Susquehanna	-.333	.30	-.807	.03	-.743	.04	1.38	.07

None	Ref.		Ref.		Ref.		Ref.	
Alleghany	.031	.93	-.358	.39	-.314	.40	1.85	.03
Pennsylvania Residence								
Great Lakes	.863	.19	.486	.54	.739	.31	.623	.74
Alleghany Wilds	1.48	.01	.950	.16	.987	.12	3.02	.05
Central	.449	.42	.328	.61	.020	.98	2.12	.07
Pocono	.821	.17	1.05	.13	.556	.41	.737	.57
Philadelphia	-.835	.08	-1.28	.02	-1.28	.02	.709	.43
Dutch	.266	.62	.032	.96	-.112	.85	.916	.37
Laurel	1.35	.01	1.15	.07	.984	.11	2.24	.05
Pittsburgh	.771	.18	.488	.48	.525	.42	1.19	.35
At Large	Ref.		Ref.		Ref.		Ref.	
N	5,765		4,001		4,488		1,277	
R^2	.1060		.1041		.1061		.1366	

Source: See Table 1.

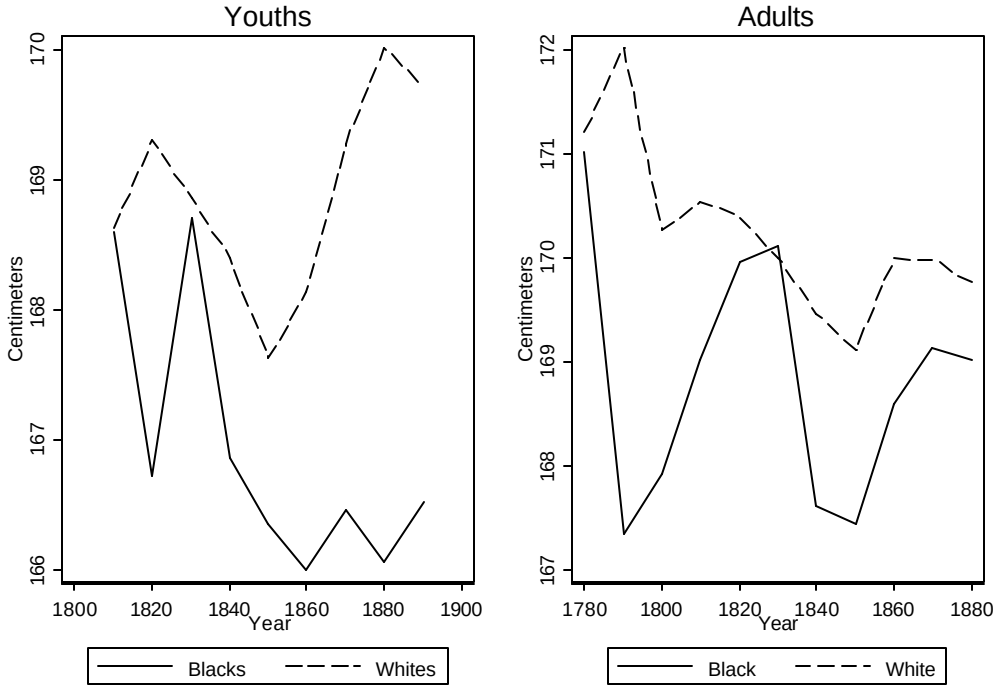
Table 5, Pennsylvania Adult Stature by Birth Year, Occupations, Residence, and Stature

	All		*Pennsylvania*		*White*		*Black*	
	(Coeff)	(P-Value)	(Coeff)	(P-Value)	(Coeff)	(P-Value)	(Coeff)	(P-Value)
Intercept	169.91	<.01	169.37	<.01	169.99	<.01	168.60	<.01
Black	-1.13	<.01	-1.05	<.01				
Birth Cohort								
1780	1.45	.15	1.27	.31	1.22	.26	2.42	.30
1790	1.11	.04	.916	<.01	2.02	<.01	-1.26	.22
1800	.071	.84	.082	.20	.283	.36	-.681	.39
1810	.534	.09	.439	.26	.543	.14	.426	.57
1820	.556	.05	.322	.37	.407	.19	1.37	.06
1830	.186	.40	.492	.07	.006	.98	1.51	<.01
1840	.576	<.01	-.613	<.01	-.525	<.01	-.990	.05
1850	-.908	<.01	-.818	<.01	-.877	<.01	-1.15	.01
1860	Ref.		Ref.		Ref.		Ref.	
1870	.125	.47	-.104	.63	-.004	.99	.530	.18
1880	-.035	.92	-.112	.79	-.233	.55	.423	.53
Occupations								
White-collar	.245	.40	.696	.06	.286	.36	-.345	.66
Skilled	.021	.08	.410	.24	-.069	.82	.361	.64
Farmer	1.43	<.01	1.72	<.01	1.40	<.01	1.27	.26
Unskilled	.290	.28	.690	.04	.152	.60	.749	.28
No Occupation	Ref.		Ref.		Ref.		Ref.	
Birth Region								
Northeast	.021	.95			.013	.97	-.453	.76
Middle Atlantic	Ref.		Pennsylvania Born Only		Ref.		Ref.	
Great Lakes	.634	.02			.666	.03	.575	.46
Plains	.562	.43			.712	.35	-.096	.96
Southeast	1.35	<.01			1.58	<.01	1.05	<.01
West	.021	.98			-.093	.92	.165	.90
River Basin								
Susquehanna	.351	.11	.348	.18	.316	.18	.448	.48
None	Ref.		Ref.		Ref.		Ref.	
Alleghany	.494	.03	.516	.06	.493	.05	.557	.39
Pennsylvania Residence								
Great Lakes	.315	.38	1.17	<.01	.367	.33	-.651	.66
Alleghany	.839	<.01	.907	.01	.915	<.01	-.526	.69
Wilds								
Central	-.415	.15	-.270	.43	-.457	.15	.180	.83

Pocono	-.179	.59	.118	.78	.027	.94	-1.80	.07
Philadelphia	-1.20	<.01	-1.19	<.01	-1.21	<.01	-1.34	.04
Dutch	-1.33	<.01	-1.21	<.01	-1.35	<.01	-1.40	.10
Laurel	.052	.85	.385	.25	.048	.80	-.088	.92
Pittsburgh	-.628	.05	-.546	.15	-.630	.06	-.668	.49
At Large	Ref.		Ref.		Ref.		Ref.	
N	14,021		9,201		11,405		2,616	
R^2	.0271		.0284		.0259		.0320	

Source: See Table 2.

Figure 4, Youth and Adult Black and White Stature Comparison over Time



Source: See Table 4 and 5.

Two general patterns materialize when comparing black and white stature variation overtime. First, it is striking the degree to which white average stature exceeds black stature. This is even more notable since when brought to maturity under optimal net nutritional conditions, blacks and whites reach comparable adult terminal statures (Eveleth and Tanner, 1966, Appendix. Tables 5, 29, and 44; Tanner, 1977, pp. 341-342; Margo and Steckel, 1982; Komlos and Baur, 2004, pp. 64, 69; Barondess, Nelson, and Schlaen, 1997, pp. 968). However, comparison of 19th century blacks and whites in America's Middle Atlantic region indicates that blacks were physically shorter than whites, even in the North where 19th century slavery did not apply. Figure 2's second general pattern is that black and white statures declined throughout the nineteenth century, which indicates that instead of increasing during the antebellum period like enslaved blacks in the South, free-black statures in the North followed stature variations comparable to Northern whites (Conrad and Meyer, 1964, p. 50; Komlos and Coclanis, 1997; Cuff, 2005, p. 216).

For several other categories, expected patterns hold. Farmers were taller than white-collar, skilled and unskilled workers, reflecting an urban-rural comparison, and there was little difference between skilled and unskilled statures (Cuff, 2005, pp. 207 and 216). Two novel aspects of the Pennsylvania prison sample are proximity to major waterways and micro-level geographic detail (county at time of incarceration). Two possibly contradictory factors may obscure the relationship between proximity to water and stature. First, because close proximity to water decreased transportation costs, heights may have increased with proximity to water. This would be especially true if

trade increased access to imported foods. However, if Pennsylvania agricultural products were exported and left fewer nutrients and calories for human growth, heights may have decreased with proximity to water. Close proximity to water also increases exposure to disease through human and insect vectors, which, in turn, may have increased calorie requirements to fend off disease (Haines, Craig, and Weiss, 2003, p. 405; Craig and Weiss, 1998, p. 197-198, 205; Haines, pp.167-170). For the most part, blacks and whites responded similarly to proximity to water. Adult white and Pennsylvania-born males who resided in counties that shared a border with the Alleghany River were significantly taller than those who did not, indicating that whites in rural western counties were taller in areas with access to trade routes and waterways (Cuff, 2005, pp. 181-204). However, white youths in the industrializing east near the Susquehanna encountered a biological penalty (Cuff, 2005, p. 217). Alternatively, black youths near both the Susquehanna and Alleghany rivers were taller than black youths who did not reside near these rivers, yet this black stature advantage is not observed for black adults.

American stature variation by nativity within Pennsylvania is consistent with expectations. Individuals from Great Lakes and Southeastern states were taller than those from the Middle Atlantic, which includes Pennsylvania (Komlos, 1987, p. 902; Sokoloff and Vilaflour, 1982, pp. 462,465, and 468; Steckel, 1995, p. 1921; Margo, 2000; Rosenbloom, 2002). As expected, statures within Pennsylvania were shorter in densely populated, rapidly urbanizing and industrializing areas—such as Philadelphia and

Pittsburgh (Cuff, 2005, pp. 84, 207 and 216).[5] Although the difference is insignificant, young blacks in western Pittsburgh were taller than black youths in Philadelphia, which may reflect relative economic, social and biological differences with southeastern Philadelphia. Throughout the 19th century, Southeastern Pennsylvania was a region of rigid occupation mobility and economic exclusion (Hershberg, 1997, p. 126-132); alternatively, blacks in the western Alleghenies found greater favor among white abolitionists and free-blacks, although Allegheny black occupations were still limited to unskilled positions (Blackett, 1997, p. 150-151, 159-163). Individuals from the rural Alleghany Wilds' Laurel Mountains were tall, indicating that rural Pennsylvanians benefited from their isolation and removal from population centers, and this was similar by race (Cuff, 2005, pp. 206-7, 215, 217).

6. Conclusion

Results from the 19th century Pennsylvania prisons confirm biological patterns observed in other studies and highlight important differences by race and region within developing Pennsylvania. First, whites were ubiquitously taller than blacks, even though when brought to maturity under optimal biological conditions, modern black and white statures are comparable. Second, individuals born in the developed middle-Atlantic were shorter than other Americans, confirming that biological conditions were sensitive to Northeastern industrialization, mass migration and social displacement associated with 19th century economic development. Where greater access to dairy

[5] Cuff (2004, pp. 114-117, 120-121, and 151-153, Tables 5.3-5.6, 5.14-5.15) finds that soldiers enlisted in western Pennsylvania were the tallest. However, Cuff's estimates include rural western counties. Estimates reported here only include more densely populated Alleghany counties.

products benefits stature and human growth, inmates from Pennsylvania did not benefit by their closer proximity to Great Lake's dairy production. Third, the antebellum paradox observed in other studies is confirmed here, and free northern blacks experienced stature variation during industrialization comparable to that experienced by whites, supporting a direct relationship between industrialization and biology that was not sensitive to race.

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