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Occupational Mobility and Old-age Survival Among Union Army Veterans: 1861-1946

Dejun Su[1]

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Department of Sociology and The Center for Population Economics
Graduate School of Business
University of Chicago
5807 S. Woodlawn Ave.
Chicago, IL 60637

[1]This paper is still in progress, but the basic findings are here. Correspondence to: dejunsu@uchicago.edu
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Abstract

This paper explores the relationship between occupational mobility and old-age survival among Union Army veterans (N=11,978) who fought the American Civil War in early 1860s. Being a farmer at enlistment is associated with a significant survival advantage at old ages, and this advantage is robust regardless of socioeconomic conditions in later life. Occupational immobility for manual labors and to a less extent for artisans poses a threat to old-age survival, but for farmers, it helps reduce mortality risk. For veterans who were not farmers at enlistment, changing occupation to farmers is associated with a better chance of survival in old age. Living conditions circa birth and war-related traumatic experience both play a significant role in veterans' old-age survival. These findings highlight the impact of early life conditions on old-age survival. The advantages of bringing occupational mobility into health studies, as well as the necessity of a life course perspective to mortality disparity in old age were discussed.

Key Words: **Occupation; Occupational Mobility; Mortality; Union Army Veterans.**

Introduction

It has been well established that higher occupational status is associated with lower mortality (e.g. Kitagawa and Hauser 1973; Mott and Haurin 1985; Davey Smith et al 1997; Bassuk et al 2002; Gregorio et al 1997). What remains unclear is the relation between occupational mobility and mortality. A review of scattered findings on this issue suggests that whereas several studies report that health-induced mobility contributes to occupational disparity in mortality, as healthier individuals are more likely to move upwardly, findings from several others downplay the role of occupational mobility in mortality differentials (Hart et al. 1998).

An advantage of using occupational history, as compared to using occupation at a single life stage, is that the former conveys dynamic and more comprehensive information on economic status. Incorporation of these longitudinal information in mortality studies can not only help reveal the relation between social mobility and mortality, but also to pinpoint the life stages in which inequality in occupational status might lead to mortality differentials in later life. Several studies along this line have highlighted the necessity of bringing occupational mobility into the study of mortality disparity and the insights it offers (e.g. Hart et al. 1998; Davey Smith et al. 1997; Davey Smith et al. 2001).

This paper explores the relationship between occupational mobility and old-age mortality among Union Army veterans who fought the American Civil War in the early 1860s. It has two objectives. One is to reveal how economic status as indicated by occupation and the change of it were related to old-age mortality in a historical population. To take into account the rapid socioeconomic changes during the period of industrialization, such an investigation can help identify the dynamic association between economic status and health over time when both economic structure and epidemiological environment have been greatly transformed. The other objective is, by incorporating life conditions circa birth and early adulthood, to assess the role of early-life conditions in old-age mortality in the past. Quite a few studies have documented the negative impact of exposure to social deprivation in early life on later health outcomes (e.g. Barker 1998; Avchen et al 2001; Davey Smith et al 2001; Luo and Waite 2005), but few addressed the question using detailed life course data dating back to birth cohorts in early nineteenth century.

Data and Methodology

The Union Army data have three components: 1) the military records that contain comprehensive demographic information at enlistment, war-related experience, pension application and medical records and so on; 2) the Surgeon's Certificate Data that contain detailed medical records on physical examinations the veterans had after the war; and 3) the census data that preserve socioeconomic information for those Union Army veterans who can

be identified in the US censuses from 1850 to 1910. By integrating all relevant information from different sources, I rearranged the data sets into a life course structure that covers three life stages including early-life conditions (birth place and season, population size of city, occupation and height at enlistment etc), war-related experience (injury, whether being captured or not, death rate of recruiting company during war etc), and socioeconomic conditions circa 1900 (occupation, marital status, own or rent house, literacy, region of residence etc). These variables are later used to explain mortality differentials among Union Army veterans. Among 17,700 veterans in the Surgeon's Certificate data, about 12,000 survived to 1900 and applied for pension before 1900. These survived veterans constitute the working sample for this study. Most of them had occupational information at enlistment and more than 60% of them can be linked to the 1900 census where their occupations circa 1900 can be found.

Occupations at enlistment were classified into five categories: Farmer, Artisan, Manual Labor, Professional and Proprietor, and Other[2], which is based on the Wilcox codes that originated from the studies of labor force distribution in the antebellum economy (Wilcox, 1994). Similarly, occupations from the 1900 census were also classified into the same five categories except adding an 'Unknown' category for those veterans who survived to 1900 but failed to be linked to the 1900 census data.

I adopted a set of Cox Proportional Hazard models to analyze how occupation, occupational mobility and other explanatory variables were related to veterans' survival after 1900. Deviation contrast in the SPSS Cox regression analysis was applied to these occupational and occupational mobility categories prior to 1900. As a result, the coefficient for each occupation and occupational mobility category in the Cox models reflects how much its effect deviates from the average mortality in the whole sample. To test the sensitivity of the relationship between occupational mobility and mortality to inclusion of other explanatory variables, I first only used occupations and age as explanatory variables in the Cox models, and then reran the models with more explanatory variables incorporated.

[2] Mainly includes service, operative, semiskilled and unclassifiable occupations.

Results

Before exploring the relationship between occupational mobility and mortality, I first review the patterns of occupational mobility among Union Army veterans, as indicated in **Table 1**. Given the big size of the 'unknown' category in occupational distribution in 1900, it becomes necessary to make assumptions regarding this category before the pattern of occupational mobility can be discerned. Can it be assumed that the occupational distribution within this "unknown" category largely follows the proportional distribution of the five occupational categories that can be observed in 1900? This assumption seems reasonable. A comparison between 'Unknown' and the other five occupations, as indicated in **Table 2,** suggests that these two groups of veterans resemble each other in terms of age in 1900, age at death, height at enlistment, percentage wounded during war, and occupational distribution at enlistment, although veterans with occupation unknown in 1900 have a higher proportion of being born in a foreign country.

(**Table 1** about here.)

(**Table 2** about here.)

Based on this assumption, the change in occupational structure from enlistment to 1900 can be illustrated in **Figure 1.** The proportion of farmers declined from 60 percent at enlistment to about 40 percent in 1900, whereas the proportion of professional (including proprietors) and 'Other' occupation both experienced a substantial increase.

(**Figure 1** about here.)

Occupational mobility was vibrant among Union Army veterans in the postwar period. 54 percent of the veterans changed their occupations between enlistment and 1900. The corresponding percentage for those who were enlisted as farmers is 46 percent. This means that compared to the sample average, farmers were more likely to stay in their original occupation. The chance of immobility for professionals and proprietors is also found to be higher than that for artisans, manual labor and those in 'Other' occupation.

A relevant question is how to define upward and downward mobility among Union Army veterans. Based on the information from the 1860 census, **Figure 2** shows the

occupational difference in real estate and personal property values in 1860. Professionals and proprietors were the wealthiest among all occupations, with manual labors being at the bottom of this hierarchy.

(**Figure 2** about here.)

If downward mobility can be narrowly specified as changing occupation to manual labor, and upward mobility can be specified as changing occupation to professional and proprietor, veterans whose occupation at enlistment were professionals and proprietors were least likely to move downwardly, with about eight percent experiencing downward mobility; those who were in 'Other' occupation at enlistment had the highest risk of downward mobility (17 percent). In terms of upward mobility, those in 'Other' occupation at enlistment had the best chance (28 percent), whereas manual labor had the least chance (13 percent). It thus appears that veterans in the 'Other' category are pretty heterogeneous.

I then investigate how occupation at different life stages and occupational mobility were related to veterans' survival after 1900 through a set of Cox proportional hazard models. Using occupations at enlistment and in 1900 as strata, a survival plot diagnosis of the proportionality assumption, which is required by the proportional hazard analysis, suggests that the assumption largely holds.

Table 3 presents the relationship between occupation, occupational mobility, and relative mortality risk after 1900, with only age in 1900 and occupation being controlled. The hazard ratios in **Table 3** come from three separate Cox regressions: to regress mortality risk on age in 1900 and occupations at enlistment; on age and occupations in 1900; and on age in 1900 and occupational mobility (30 categories).

(**Table 3** about here.)

A detailed reading of **Table 3** yields several observations. First, being a farmer at enlistment is associated with a significant survival advantage in old age, with a mortality risk 11 percent lower than the sample average. Moreover, this advantage is generally robust regardless of occupations in 1900. Even for farmers who changed their occupation to manual labors or "unknown" occupation, the mortality risk is still seven or eight percent lower than

the sample average, and these effects are statistically significant. Occupational immobility for farmers is associated with a mortality advantage of 15 percent below the sample average.

Secondly, occupational immobility for manual labors, those in 'Other' occupation, and to a less extent for artisans, all poses a threat to old-age survival. Staying in manual labor or 'Other' occupation are both associated with an excess of 25 percent mortality risk as compared to the sample average. The corresponding elevated risk associated with immobility for artisans is seven percent.

Finally, in most cases, changing occupation to farmers is associated with lower mortality risk. This is especially the case for veterans who were manual labors or professionals at enlistment. For manual labors, if they continued their occupation to 1900, the relative mortality risk after 1900 would be 25 percent higher than the sample average. However, for those veterans who changed occupation from manual labors to farmers, the relative mortality risk became eight percent lower than the sample average, an impressive gap of 33 percent. The corresponding percentage of gap among professionals and proprietors at enlistment is 19 percent.

To test the robustness of the observed association between occupational mobility and mortality under alternative model specifications, I replicated the three Cox regressions above with more explanatory variables added. The new relative mortality risks associated with occupation and occupational mobility were summarized in **Table 4**. A comparison between the results in **Table 4** and **3** suggests that most of the significant effects observed in **Table 3** still hold in **Table 4**, except for two notable differences. The first one is that occupational difference in mortality tends to become less salient after early-life living conditions, wartime stress and socioeconomic conditions circa 1900 having been taken into consideration. For instance, being farmer at enlistment or in 1900 are still both associated with lower mortality, the advantage, however, becomes smaller. The second difference is that being in "other" occupation now becomes the most unfavorable occupation for survival after 1900, and this holds true for occupation both at enlistment and in 1900.

(Table 4 about here.)

Living conditions circa birth turn out to have a significant impact on old-age survival, as indicated by the results for Model 2 in **Table 5** where the hazard ratios for the added explanatory variables were presented. The relative mortality risk after 1900 for those born in autumn is six percent lower than that for those born in spring. Veterans whose birth season were unknown had a mortality risk more than four times that of those born in spring. This is because information on detailed birth dates was not collected until 1907 when the pension law increased pension solely based on veterans' age. Therefore, veterans with missing birth dates are much more likely to have died before 1907 as compared to those with detailed birth dates on records.

(Table 5 about here.)

Birthplace also plays an important role in old-age survival. Veterans born in Germany and Ireland had significantly higher mortality risk than native-born counterparts. The case is especially salient for veterans born in Ireland whose relative mortality risk is 16 percent higher than that for native-born veterans. This could be related to the Irish famine happened during the mid nineteenth century. If it can be assumed that at the time when they started migrating to America, foreign-born veterans were at least as healthy as those who did not migrate in their originating European countries, the finding here tends to imply that the living conditions in America in early and mid-nineteenth century were more favorable to survival than those in the European countries from which the veterans migrated. This is consistent with the estimate that the American height advantage over Western and Northern Europeans was in between 3 to 9 centimeters in the middle of the nineteenth century (Komlos and Baur 2004).

It was also found that living in big cities prior to enlistment poses a threat to old-age survival, with an excess relative mortality risk of 14 percent. Similar findings were also documented in other studies where urban settings are shown to be associated with poor health in the United States in nineteenth century (Fogel et al. 2001, Haines 2001, Wilson and Pope 2003).

Somewhat surprisingly, height at enlistment shows a negative association with chance of survival after 1900. After adjusting for age at enlistment, veterans whose height at enlistment is in the top one third had an elevated mortality risk of seven percent as compared to those whose height is in the bottom one third. This is contradictory to previous findings where being taller is associated with a lower mortality risk (e.g. Waaler 1984; Costa 1993). A plausible explanation could be that since the veterans in this study were relatively old, with an average age above 60 in 1900, a higher proportion of short veterans could have died out before they could survive to 1900. As a result, those short veterans who survived to 1900 turned out to have a better chance to survive than their taller counterparts did.

(Figure 3 about here.)

A check on the occupational difference in height at enlistment, as shown in **Figure 3**, reveals that farmers were substantially taller than those from other occupations. This implies that the survival advantages for veterans who were farmers at enlistment cannot have resulted from their taller stature, but from something else, since taller veterans were shown to have higher mortality risk after occupation and occupational mobility having been controlled as discussed earlier.

Traumatic war experience is also negatively associated with survival after 1900. Veterans whose company had a higher casualty rate during war turn out to have higher mortality risk after 1900. Elevated mortality risk is also observed for those who were captured during the war, although the effect is not statistically significant.

Finally, socioeconomic conditions circa 1900 help explain mortality differentials later on. Living in areas other than North-Atlantic regions, being married, and owning a house as compared to renting a house are all associated with advantages in old-age survival.

Discussion and Conclusions

The finding that being a farmer is significantly associated with lower mortality risk at old ages among Union Army veterans has also been documented in several other studies (e. g. Costa 2003; Costa and Lahey 2005; Su 2005). Two plausible explanations can account for the

survival advantages of farmers. One is that prior to the 20th century, food availability and food quality were usually better in rural areas than in urban areas in the United States. The other is the less exposure to infectious diseases in rural areas than in urban areas (Wilson and Pope, 2003; Lee, 2003). The evidence in this paper further suggests that the survival advantage associated with being a farmer at enlistment is generally robust regardless of socioeconomic conditions in later life.

This study highlights the additional insights that occupational mobility can bring to the study of health inequality. For example, based on findings from **Table 3**, if only occupation in 1900 is used to predict survival after 1900, the largest mortality differentials that can be observed is 15 percent, which is between manual labors and farmers. However, after bringing in occupational mobility, the largest mortality differential becomes 43 percent, which is between those who stayed in manual labor or 'Other' occupation since enlistment and those who changed occupation from professional to farmer.

Another advantage of bringing occupational mobility in mortality studies is that the utilization of employment history enables to capture the dynamic association between occupation and mortality over time. For instance, when using occupations at enlistment to predict old-age mortality, the lowest mortality risk was observed among farmers, but there are signs that the survival prospect for professionals and proprietors in 1900 tended to catch up with that for farmers. As sanitary conditions and quality of health care delivery in urban areas gradually got improved, the rural-urban gap in terms of health status became smaller. With the transformation of economic structure and epidemiological environment, the favorable or unfavorable occupations in terms of old-age survival might change over time. Correspondingly, a simple dichotomization of upward or downward shift of occupation, as prevalent in concurrent literature in social stratification, seems not adequate to address occupational disparity in mortality in a historical population. In this case, it becomes important to ask what health-related information occupation and occupational mobility captures in different historical periods.

This study reveals the importance of early-life conditions in old-age survival. Being native-born, born in autumn, living in small towns or countryside, having a farmer occupation and so on all have a positive impact on old-age survival. This impact is observed after taking into account the effect of socioeconomic conditions in later life. The findings here provide some support for both the critical period hypothesis and the accumulative disadvantage hypothesis in the life course approach to health inequality. On the one hand, birthplace and timing convey important information regarding the nutritional and epidemiological environment during the critical period of fetal development and infancy. On the other hand, the finding that exposure to war-related traumatic events and occupational immobility for manual labor and artisans both pose a threat to old-age survival suggests that these negative effects through the life course can be accumulative over time. Correspondingly, a comprehensive explanation to health inequality in old age requires a life course approach that could ideally pinpoint the relevant contributing factors at different life stages and quantify their effects with statistical soundness.

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Appendix: Tables and Figures

Table 1: Occupational Mobility among Union Army Veterans between 1860s and 1900

Occupation At Enlistment	Occupation in 1900						Total
	Farmer	Artisan	Manual Labor	Professional	Other	Unknown	
Farmer	2298	339	479	649	484	2889	7138
Artisan	245	481	102	244	188	803	2063
Manual Labor	263	103	230	110	127	605	1438
Professional	73	49	35	194	74	301	726
Other	72	38	56	93	70	243	572
Total	2951	1010	902	1290	943	4841	11937

Source: Union Army Records.

Table 2: Comparisons between Veterans with Occupation Known and Unknown in 1900

Variables	Occupation Known	Occupation Unknown
Age in 1900	60.6	62.2
Age at Death	76.0	75.7
% born in foreign countries	15.1	19.0
% coming from big cities	6.1	7.5
Height at enlistment (inches)	67.6	67.7
% Wounded during war	31.5	32.7
Occupation at enlistment (%)		
Farmer	59.7	59.9
Artisan	16.6	17.8
Manual Labor	12.5	11.7
Professional and Proprietor	6.2	6.0
Other	5.0	4.6
Number of Observations	7,122	4,856

Source: Union Army Records.

Table 3: Occupational Mobility and Relative Mortality Risk for Survival after 1900 Controlling only for Age in 1900

	Occupation in 1900						
Occupation At Enlistment	Farmer	Artisan	Manual Labor	Professional	Other	Unknown	Average
Farmer	0.85***	0.83***	0.92*	0.88**	0.93	0.93***	0.89***
Artisan	0.95	1.07	0.99	0.91	1.09	1.08**	1.02
Manual Labor	0.92	1.00	1.25***	0.95	1.03	1.06	1.03
Professional	0.82*	1.07	1.01	0.97	0.92	1.15**	1.01
Other	0.98	1.16	1.11	1.05	1.25*	1.04	1.06
Average	0.91***	1.02	1.06**	0.96	1.04	1.03*	**1.00**

*Source: The Union Army Records. * p<0.1; ** p<0.05; *** p<0.01.*

Table 4: Occupational Mobility and Relative Mortality Risk for Survival after 1900 Controlling for Age in 1900 and Other Explanatory Variables

	Occupation in 1900						
Occupation At Enlistment	Farmer	Artisan	Manual Labor	Professional	Other	Unknown	Average
Farmer	0.90***	0.83***	0.94	0.91**	0.98	0.92***	0.91***
Artisan	1.05	1.10*	0.96	0.91	1.15*	1.04	1.04
Manual Labor	0.96	0.98	1.20***	0.88	1.01	1.00	1.00
Professional	0.86	0.99	0.99	0.96	0.90	1.09	0.99
Other	1.01	1.31*	1.09	1.06	1.21	1.01	1.06*
Average	0.96**	1.01	1.04	0.96	1.05*	0.98	**1.00**

*Source: The Union Army Records. * p<0.1; ** p<0.05; *** p<0.01.*

Table 5: Occupational Mobility and Survival after 1900: Cox Regression Results

Explanatory Variables	Mean or Percentage	Hazard Ratio	
		Model 1	Model 2
Age in 1900	61.2	1.08***	1.08***
Occupational Mobility (Deviation Contrast)		***	***
Artisan to Artisan	4.0	1.07	1.10*
Artisan to Farmer	2.1	0.95	1.05
Artisan to Manual Labor	0.9	0.99	0.96
Artisan to Professional	2.1	0.91	0.91
Artisan to Other	4.0	1.09	1.15*
Artisan to Unknown	6.4	1.08**	1.04
Farmer to Artisan	2.9	0.83***	0.83***
Farmer to Farmer	19.3	0.85***	0.90***
Farmer to Manual Labor	4.1	0.92*	0.94
Farmer to Professional	5.5	0.88**	0.91**
Farmer to Other	4.1	0.93	0.98
Farmer to Unknown	23.7	0.93***	0.92***
Manual Labor to Artisan	0.9	1.00	0.98
Manual Labor to Farmer	2.2	0.92	0.96
Manual Labor to Manual Labor	1.9	1.25***	1.20***
Manual Labor to Professional	0.9	0.95	0.88
Manual Labor to Other	1.1	1.03	1.01
Manual Labor to Unknown	5.1	1.06	1.00
Professional to Artisan	0.4	1.07	0.99
Professional to Farmer	0.6	0.82*	0.86
Professional to Manual Labor	0.3	1.01	0.99
Professional to Professional	1.8	0.97	0.96
Professional to Other	0.7	0.92	0.90
Professional to Unknown	2.4	1.15**	1.09
Other to Artisan	0.3	1.16	1.31*
Other to Farmer	0.6	0.98	1.01
Other to Manual Labor	0.5	1.11	1.09
Other to Professional	0.8	1.05	1.06
Other to Other	0.6	1.25*	1.21*
Other to Unknown	2.1	1.04	1.01
Birth Season			***
Spring	24.9		Omitted
Summer	22.0		1.01
Autumn	22.7		0.94**
Winter	23.7		0.97
Unknown	6.8		4.83***

To be continued at next page.

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Birth Country			***
Native	83.0		Omitted
Britain	2.7		0.99
Canada	2.8		0.99
Germany	5.8		1.10**
Ireland	3.7		1.16***
Other Countries	2.0		0.86**
Coming from Big Cities at Enlistment	6.6		1.14***
Height at Enlistment (adjusted for age)			
Short	32.5		Omitted
Middle	34.0		1.01
Tall	33.5		1.07***
Injured during Civil War	32.2		1.00
Prisoner of War	8.7		1.05
Death Rate of Recruit Company	0.15		1.22*
Residential Area in 1900			***
North Atlantic	22.4		Omitted
South Atlantic	3.4		0.93
North Central	49.0		0.89***
South Central	3.5		0.90*
Western States	3.5		0.91*
Unknown	18.2		0.80**
Marital Status in 1900			***
Married	68.8		Omitted
Single	3.9		1.12**
Widowered	9.0		1.14***
Divorced	0.6		1.20
Unknown	17.6		0.88
Literacy in 1900			
Not Able to Read	4.1		Omitted
Able to Read	77.7		0.96
Unknown	18.3		1.01
Own or Rent House in 1900			***
Rent	20.2		Omitted
Own	51.0		0.92***
Unknown	28.7		1.01
Number of Cases		11,923	11,325
Chi-square		2910.8 (d.f.=30)	4802.5 (d.f. =58)

Source: Union Army records. * p<0.1; ** p<0.05; *** p<0.01.

Mean or Percentage was calculated based on the number of cases in Model 2.

Figure 1: Changes in Occupational Structure from Enlistment to 1900

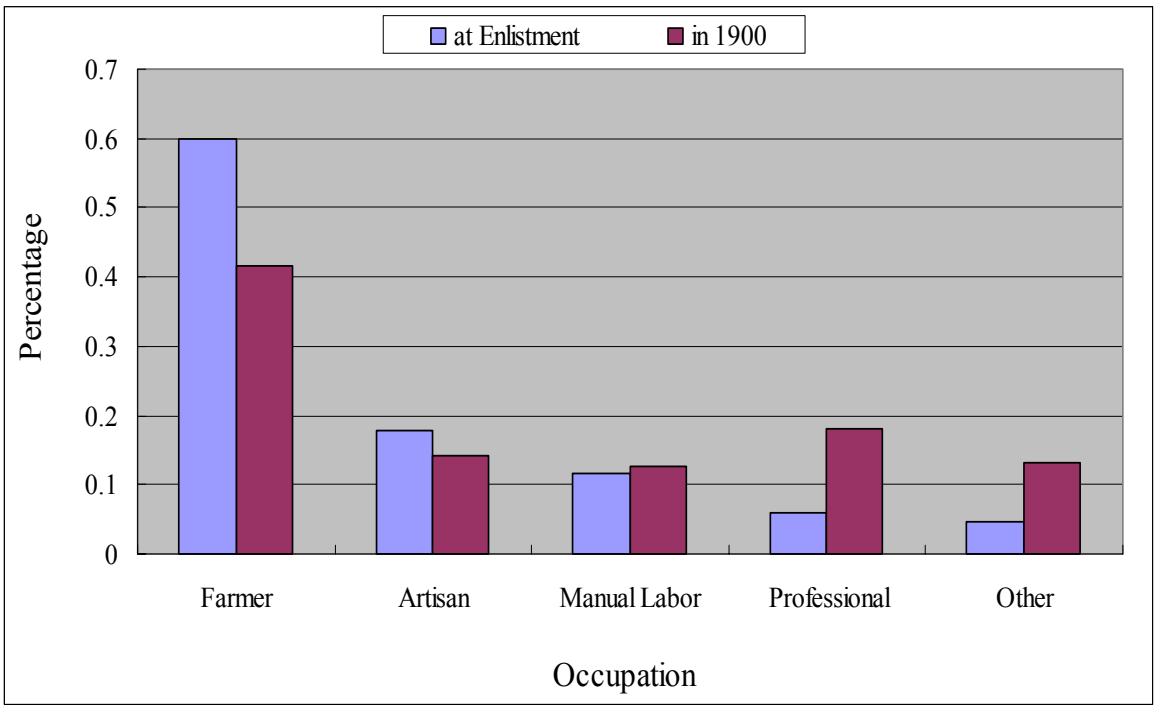

Figure 2: Occupational Difference in Wealth in 1860

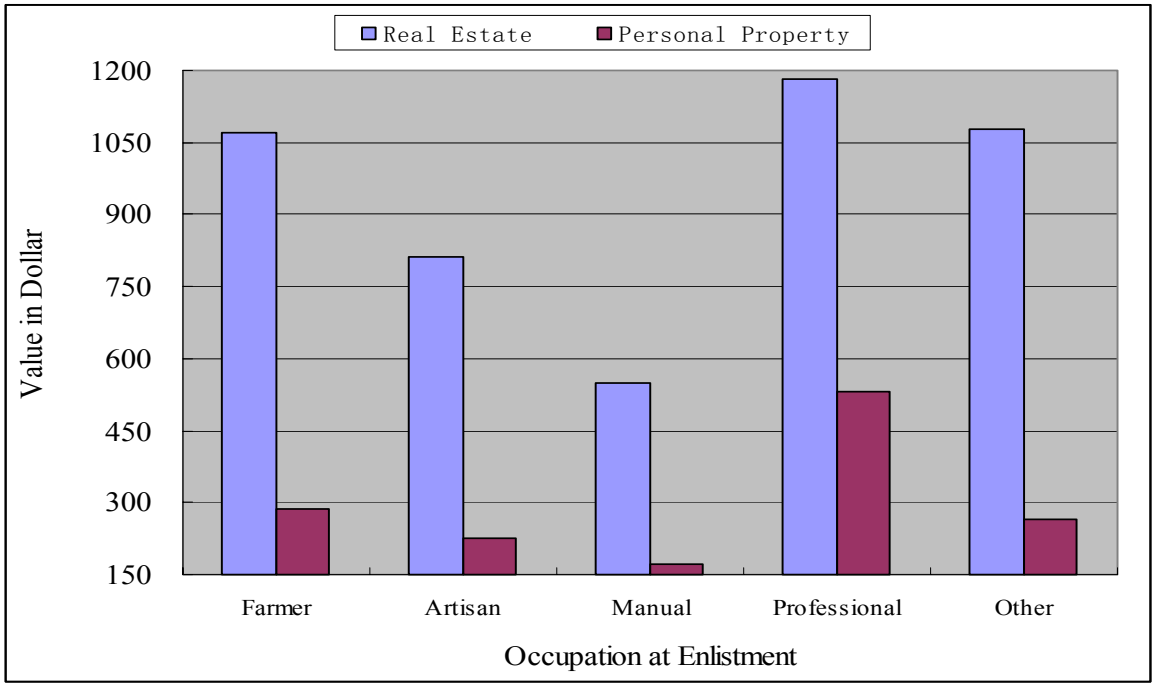

Figure 3: Occupational Difference in Height at Enlistment