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Status and mortality: Is there a Whitehall effect in the United States?

Tom Nicholas

Harvard Business School

Correspondence
Tom Nicholas
Email: tnicholas@hbs.edu

Abstract

The influential Whitehall studies found that top-ranking civil servants in Britain experienced lower mortality than civil servants below them in the organizational hierarchy due to differential exposure to workplace stress. I test for a Whitehall effect in the United States using a 1930 cohort of white-collar employees at a leading firm – General Electric (GE). All had access to a corporate health and welfare program during a critical period associated with the health transition. I measure status using position in the managerial hierarchy, attendance at prestigious management training camps and promotions, none of which is associated with a Whitehall-like rank-mortality gradient. Instead, senior managers and executives experienced a 3–5-year decrease in lifespan relative to those in lower levels, with the largest mortality penalty experienced by individuals in the second level of the hierarchy. I discuss generalizability and potential explanations for this reversal of the Whitehall phenomenon using additional data on the status and lifespan of top business executives and US senators.

KEYWORDS
mortality, socioeconomic determinants of health, status

JEL CLASSIFICATION
I12, I14, N32

Reducing inequalities in health is core to public policy because health and lifespan informs our understanding of how the needs of society are being met.[1] Historical perspectives can inform these debates by assessing the determinants of mortality gradients by social status. In a highly cited set of studies started in the 1960s, researchers found lower rank in the UK civil service to be detrimental to health, controlling for socioeconomic status (SES) and lifestyle.[2] The Whitehall finding – after the area of London in which these civil servants worked – was attributed to a link between mortality risk and psychological stress in subordinate workplace positions.[3]

Recent research, however, has shown that individuals in higher ranks can also be subjected to emotional stress leading to detrimental health outcomes. CEOs who were exposed to more aggressive legal takeover standards in the United States during the late twentieth century experienced premature ageing and reduced life expectancy.[4] Furthermore, the biology literature suggests the link between social status and health can be mediated by the structure of hierarchies. Studies of baboons find that leaders can be insulated from stress in stable hierarchies, but in unstable hierarchies they must exert stress-inducing effort to prevent displacement.[5] Reverse Whitehall effects might therefore be possible.

This paper examines the Whitehall phenomenon in the United States using new data on the lifespan and SES characteristics of more than a thousand white-collar workers employed at one of America's most prominent early-twentieth-century corporations – General Electric (GE). In doing so, it provides new evidence on the health gradient for white-collar employees who would have already experienced secular improvements in life expectancy as a consequence of the health transition in the United States.

Health gradients by SES have been observed in the United States, England, and France during the nineteenth century, while differences in mortality by occupation have also been documented for the US population as a whole. Global life expectancy more than doubled from about 30 years of age in 1800 to around 73 years of age today.[6] In that context, the economic history literature has focused on explaining convergence from below, namely the impact of rising incomes, better nutrition, or medical and public health interventions in reducing inequalities in mortality.[7] However, white-collar variation in lifespan and the link to psychosocial stress factors have not been extensively studied in historical perspective. Bengtsson et al. find a health gradient by social class from the 1950s for women and the 1970s for men using rich longitudinal Swedish data.[8] They argue psychosocial stress in modern economic environments, including the workplace, might help to explain the late emergence of these disparities in health outcomes since Sweden had a comprehensive and universal welfare state at this time.

[1] Cutler et al., 'The determinants of mortality'; Costa, 'Health and the economy'; Case and Deaton, 'Rising morbidity and mortality'.

[2] Marmot et al., 'Employment grade'; Marmot et al., 'Health inequalities'; Marmot et al., 'Contribution of job control'.

[3] Cutler, Lleras-Muney and Vogl, 'Socioeconomic status and health', cite the Whitehall studies as the leading examples of efforts to investigate the health impact of occupational hierarchies, though these findings do remain controversial. For a critical review of these studies see further Case and Paxson, 'The long reach' and Chandra and Vogl, 'Rising up with shoe leather?'. For a causal analysis of the Whitehall effect, see further Anderson and Marmot, 'The effects of promotions'.

[4] Borgschulte et al., 'CEO stress and life expectancy'.

[5] Sapolsky, 'The influence of social hierarchy'; Anderson et al., 'High social status males'.

[6] Shaw-Taylor, 'An introduction to the history of infectious diseases', p. E2.

[7] Costa, 'Health and the economy'.

[8] Bengtsson et al., 'When did the health gradient emerge?'.

White-collar variation in status through occupational hierarchies is typically difficult to measure due to lack of data on reporting relationships. I exploit the fact that workers at GE were organized hierarchically at a time when managerial hierarchies were becoming core to the structure of American business.[9] Using GE's 1930 *Organization Directory*, an internal personnel document, I profile the position of white-collar workers in GE's hierarchy, focusing on those living in the Schenectady area of New York state, the firm's headquarter city. I sort employees into six hierarchical levels, from executives and senior managers at the top to lower order employees. This approach mimics the ordering of civil servants in Whitehall by their employment grade.

There are several reasons why this setting is ideally suited to an examination of the Whitehall phenomenon. First, just like Whitehall, I study a population of employees that share the same employer, live in the same area, and share the same race (white) and lifestyle (comfortable middle class, at least by the standards of the 1930s). Second, GE in 1930 was so large that it was not unlike the UK civil service: turnover was low, and rank was well established and stable within the managerial hierarchy. Third, GE was particularly forward-looking from the standpoint of the welfare of its workers, so its employees had access to health programs just like civil servants could access the UK national health service.[10] Fourth, although I cannot construct a contemporary measure of health, as was done in the Whitehall studies, I can look further into the future of each employee because all have now died. I use employee death records held at the GE archive, local cemetery records from Schenectady, and deaths identified through searches using multiple databases collated by Ancestry.com. I can also exploit GE and federal census data to construct youth and adult SES indicators such as family background and education for each individual.

While there are obvious difficulties associated with regression-adjusting for interrelated SES characteristics, the estimates provide a Whitehall-like window into the relationship between rank and lifespan.[11] Generally, mortality declines with income, so observing health gradients among groups of individuals in upper tiers of the income distribution, not just at the bottom, suggests an important role for biological, socioeconomic, or psychosocial stress factors in driving the relationship between social status and health. Extrapolating from the Whitehall studies – where psychosocial stress was found to be the dominant mechanism – we would expect to see a strong mortality gradient in the status hierarchy at GE, with declining lifespan by lower rank.

Figure 1 illustrates and contextualizes some salient aspects of longevity by rank in the GE hierarchy using broader datasets of business and political elites. Figure 1a shows mean lifespan by birth cohort was comparably high for all GE employees relative to the lifespan of US senators and top executives in US corporations, conditional on survival to the 1930s. For individuals in the upper levels of the GE hierarchy, lifespan fluctuated around that of top executives generally (figure 1b). Yet, figures 1c,d imply a mortality penalty for upper-level executives at GE relative to individuals in lower levels of the hierarchy based on mean and median lifespan, respectively. These descriptive plots are inconsistent with a Whitehall-like mortality gradient because they suggest senior executives at the firm from the same birth cohorts lived relatively shorter lives.

There are three main empirical challenges when estimating the relationship between status and mortality in status hierarchies. First, as the Whitehall researchers noted, any misclassification of individuals in an organizational structure will lead to biased estimates. They assumed that the bias would be towards zero (i.e. no effect of status on longevity) given classical measurement error

[9] Chandler, *The visible hand*.

[10] Moriguchi, 'Did American welfare capitalists'.

[11] Adler et al., 'Socioeconomic status and health'.

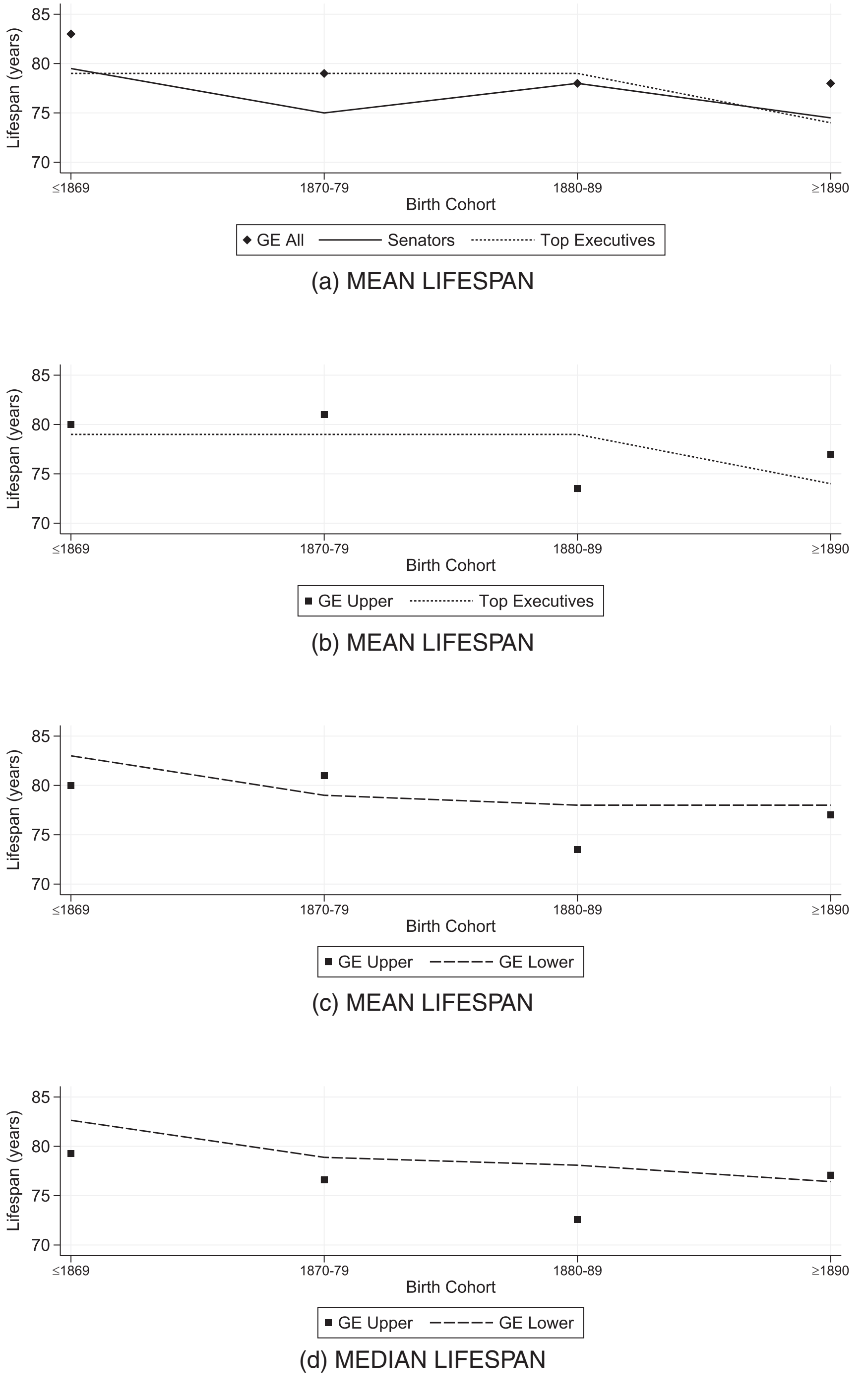

FIGURE 1 Benchmarking the lifespan of GE employees. *Notes*: These figures show the mean or median lifespan of GE employees by birth cohort compared with the lifespan of top US business executives ($n = 245$) active between 1936 and 1939 in the dataset compiled by Frydman and Saks 'Executive compensation' and the lifespan of US senators in political office during the 1930s ($n = 214$). GE upper refers to individuals in levels 1, 2, and 3 of the hierarchy, and GE lower to individuals lower down in levels 4, 5, and 6. Section IV provides additional details on the construction of these datasets. *Source:* Author's own creation.

in assigning individuals to ranks.[12] Misclassification using the GE data is unlikely because the boundaries in the hierarchy are codifiable on the basis of the *Organization Directory*. Moreover, I verify the ordering of individuals using independent measures of their social status using data from the 1930 census – the value of an individual's home and the number of servants.

I also define status using additional indicators. GE held extensive management training camps on an isolated island on Lake Ontario in upstate New York (see figure A1 in the online appendix), the most prestigious of which was called 'Camp General'. I use attendee lists during the 1920s and 1930s from GE's personnel records. Attendance was seen as a significant mark of status, and it signalled professional advancement. Employees were organized into management training camp categories through performance appraisal, in line with economic theories of status contests.[13] Finally, I traced individuals from the 1930 *Organization Directory* to the 1940 directory to observe status changes through promotions. Although I do not exploit exogenous variation in status, an attractive feature of the data is that I can test for consistency of the results using these different measures of status orderings within the same firm.

The second empirical challenge is selection, both by rank and selection into the sample by rank. While I control for observable SES characteristics, any graded relationship between status and mortality could be driven by unobservable attributes such as intellectual acumen, which I do not model or identify empirically. If these factors are positively correlated with rank and lifespan, the analysis will be biased towards finding a Whitehall-like gradient, which the results ultimately reject. On the second form of selection, the analysis relies on observing individuals in census and death records. I observe 1806 individuals in the 1930 *Organization Directory*, matching 1519 (84 per cent) of those to the 1930 census and 1024 (57 per cent) to death records. Notably, individuals in lower-level ranks of the hierarchy are less likely to be matched. If these individuals were fired, had problems with alcohol, or died in poverty, they would be non-randomly missing from the data. This type of sample selection would bias estimates of lifespan against individuals in higher ranks, thereby spuriously rejecting the hypothesis of a Whitehall-type rank mortality gradient at GE.

To address the robustness of the results to this specific form of sample selection bias, I use three approaches, albeit with strong identifying assumptions. First, I simply drop individuals in the lowest levels of the hierarchy from the regression estimates altogether. This excludes levels of the hierarchy where missing individuals may be most likely to experience premature death. Second, I implement Heckman correction methods to adjust for selective sampling on death records. In these specifications I use an exclusion restriction by identifying individuals who stayed at the firm through to 1940. These individuals would be easier to trace in archival death records held at GE or locally in the cemetery records, thus offering a mechanism driving selection into the data that should be unrelated to residual determinants of lifespan. Third, I estimate the probability of near-term survival by tracing individuals across the 1930 and 1940 censuses. Although surviving a decade represents a weaker test of longevity, it lessens selection bias by utilizing a fuller component of the dataset – the 1519 observations linked to the census rather than the 1024 linked to the death records.

The third estimation challenge is that I observe rank in 1930 for each individual rather than maximum rank over the life cycle of a career, so individuals would need to be alive long enough to reach upper levels of management by that year. The relationship between status and mortality is therefore endogenous to individuals entering the data at a specific point in time. As such,

[12] I use binary indicators for the six levels of the managerial hierarchy. Any misclassification would lead to non-classical measurement error since flipping a 1 to a 0, or vice versa, would be mechanically correlated with the true value.

[13] Besley and Ghatak, 'Status incentives'; Moldovanu et al., 'Contests for status'.

those reaching senior positions should mechanically live longer lives. To address this issue empirically, I estimate models using cutoffs above 40 years of age, where position in the hierarchy is less likely to change over time. Thus, I capture the relationship between 'permanent status' and mortality.

I estimate the relationship between status and lifespan using ordinary least squares (OLS), median regressions, and Cox proportional hazard models. I also construct life cycle survival probabilities for the time period each person in the dataset remained alive so I can illustrate the age ranges at which any relationship between status and mortality is strongest. I use a vast array of controls, estimating the link between lifespan and status with birthplace and age covariates, and controls for youth and adult SES characteristics. I also exploit within-GE-department variation, comparing the lifespan of observationally similar sets of employees at different ranks who were employed in the same area of the firm.

According to the Whitehall studies of the health gradient, individuals in senior positions should have lived longer, with monotonically shorter lives further down the hierarchy. None of the measures of status that I use (levels in the management structure, attendance at Camp General, and promotions) produce a mortality gradient consistent with the Whitehall studies. In some specifications (Camp General and promotions), I do not find a statistically significant relationship between status and lifespan at all. Where I do find a relationship, it is in the opposite direction to Whitehall. High-ranked employees lived shorter lives relative to lower-ranked employees, with point estimates suggesting a morality penalty for top managers and executives of around 3–5 years. The decrease in lifespan is concentrated in the second tier of the organization, which I can replicate in a broader dataset of business executives active in US companies. The findings are suggestive of a transmission mechanism related to the structure of the hierarchy and workplace stress.

The remainder of the paper is organized as follows. Section I covers related literature. Section II discusses the relationship between hierarchy, job demands, and health at GE. Section III outlines the data, and section IV presents the results and validation checks. Section V offers potential explanations for the differences between my findings and those of the Whitehall studies. Section VI concludes.

I | RELATED LITERATURE ON RANK, HEALTH, AND MORTALITY

The Whitehall studies are among the most highly cited papers in the epidemiology literature. Whitehall I, starting in 1967, studied a group of male civil servants, whereas a subsequent study – Whitehall II – also included women (see appendix A.1 for a more detailed description). These studies became widely influential in policy circles because they connected the negative health gradient by rank in the civil service to workplace stress and perceptions of low social standing.

The findings from the Whitehall studies are as controversial, as they are influential. Chandra and Vogl point to several identification issues, especially endogenous selection into occupational categories within the civil service.[14] Case and Paxson showed that current health status in the Whitehall II data could predict subsequent promotion, so unobserved traits such as tenacity may jointly determine health and position in the hierarchy.[15] On the other hand, Anderson and Marmot exploit exogenous variation in status through department promotion rates in the Whitehall

[14] Chandra and Vogl, 'Rising up with shoe leather?'.

[15] Case and Paxson, 'The long reach'.

II data, finding a large causal reduction in heart disease risk for those who were promoted.[16] As a general rule, coping mechanisms through 'fight or flight' responses can lessen adverse health effects in the short run, but persistent stress can lead to immune system suppression, causing, for example, cardiovascular related diseases or gastrointestinal disorders. The Whitehall studies showed these adverse health effects were strongest in lower levels of the hierarchy.

Differential health and mortality outcomes by rank in a hierarchy, however, might be influenced by the potentially nuanced impact of job-related stress factors. Research in the biology literature suggests more complex causal channels, highlighting the importance of tests for generalizability. Sapolsky's famous work on wild baboons in Kenya showed status in the hierarchy was inversely related to health risk. Lower-ranked baboons had higher levels of the stress hormone, cortisol. Subsequent studies showed a mediating role for the structure of the hierarchy: in top-down hierarchies, dominant males can experience high stress hormone levels due to the threat of displacement, whereas in flatter hierarchies the negative health effects of lower rank can be mitigated, as subordinates may receive support through kinship or social interactions.[17] The literature remains controversial. Gesquiere et al. argue that 'no consensus exists about the rank-associated stress physiology of individuals in stratified mammal societies', while Petticrew and Smith caution against generalizing to human hierarchies.[18] In a recent study, Anderson et al. use DNA methylation measurements to capture the 'epigenetic clock' of baboons. They link rivalry for status to premature biological ageing for baboons at the top of the hierarchy.[19]

The relationship between rank, health, and mortality is especially hard to identify in human populations. As Sapolsky noted, animals belong to a single hierarchy, whereas humans can belong to multiple hierarchies with potentially offsetting effects. An employee may be subjected to stress in the workplace but experience social support through clubs, associations, or religion. Falk et al. found in a sample of Swedish men during the early 1980s that social support significantly reduced mortality and morbidity risk arising from job strain.[20] Complicating estimation further, the relationship between stress and lifespan can be determined by early childhood circumstances and be confounded by interactions with morphological characteristics such as weight and height. The impact of workplace stress can also be affected by context or the treatment population.

Modern-day studies suggest the relationship between hierarchy in firms, stress, and longevity can be complex. Keloharju et al. find strong selection into high-status corporate positions in Sweden, implying that CEOs should have the physical and mental fortitude to cope with extreme job demands.[21] On the other hand, Borgschulte et al. show that United States-based CEOs lose 1.2 years of life due to exogenous industry shocks, whereas less-stressed CEOs gain about 2 years of life due to legislation in their state of operation moderating the threat of hostile takeovers.[22] Their machine learning facial recognition approach shows stressed CEOs even look older than their biological age, consistent with the Anderson et al. finding for baboons.[23]

[16] Anderson and Marmot ,'The effects of promotions'.

[17] Sapolsky, 'The influence of social hierarchy'.

[18] Gesquiere et al., 'Life at the top', p. 357; Petticrew and Smith, 'The monkey puzzle'.

[19] Anderson et al., 'High social status males'.

[20] Falk et al., 'Job strain and mortality'.

[21] Keloharju et al., 'CEO health'.

[22] Borgschulte et al., 'CEO stress and life expectancy'.

[23] Anderson et al., 'High social status males'.

The mixed nature of the evidence extends to the relationship between status and lifespan more generally. Rablen and Oswald find that Nobel Prize winners in physics and chemistry from 1901 to 1950 lived 1–2 years longer than nominees.[24] Redelmeier and Singh show that Oscar winning actors and actresses lived almost 4 years longer than nominees who did not win, but a related study showed Oscar nominated screen writers actually lived longer than their counterparts who won.[25] Link et al. express general scepticism over a causal link between status and mortality based on their study of celebrities, sports stars, and politicians.[26] Leive shows that silver medal Olympic Track and Field winners between 1896 and 1948 lived about 1 year longer than gold medal winners.[27] He attributes this counterintuitive result to the silver medal winners following professional careers in their post-Olympic years where they earned higher incomes. The income effect then dominates as a predictor of lifespan.

Numerous studies have provided historical evidence on disparities in mortality rates by social status. It is often assumed that the gradient is systematically graduated, but using English data Jaadla et al. find a U shape in the relationship between status and child mortality.[28] Children of poor labourers had similar survival rates to children born to wealthier families, with longer birth intervals among labourers (associated with lower under-5 mortality) being one explanation for the non-monotonicity. Economic history research as a whole has tended to focus on individuals from lower income groups or at poverty thresholds. Costa shows that chronic disease rates fell for men over the twentieth century, while the shift from blue-collar to white-collar work meant that men were less exposed to occupational hazards.[29] Mortality rates tend to be pro-cyclical.[30] During the Great Depression, when the employees in my sample would have lived, New Deal social welfare programs lowered the infant mortality rate, disease-related deaths, and suicides.[31] Most of these policies, however, targeted low-income families, whereas I observe a sample of mostly higher-earning white-collar employees. Finally, in a study of the relationship between promotions and longevity in a novel setting – Second World War US submarine personnel – Suandi finds that sailors who were promoted lived 2.4 years longer. This result implies large effects on lifespan from status changes.[32]

II | HIERARCHY, HEALTH, AND JOB DEMANDS AT GENERAL ELECTRIC

In this section, I examine some of the major determinants of job-related stress, and how this may have impacted health and longevity at senior and lower levels of the managerial hierarchy.

Founded in 1892, GE became a pivotal firm in electrical products and intermediate goods. By 1930, GE was one of the largest firms in the United States, with gross revenues of $396 million

[24] Rablen and Oswald, 'Mortality and immortality'.

[25] Redelmeier and Singh, 'Survival in Academy award-winning'; eisdem, 'Longevity of screenwriters'.

[26] Link et al., 'Can honorific awards'.

[27] Leive, 'Dying to win?'.

[28] Jaadla et al., 'Infant and child mortality'.

[29] Costa, 'Understanding the twentieth-century decline'; idem, 'Health and the economy'.

[30] Ruhm, 'Are recessions good for your health?'.

[31] Fishback et al., 'Births, deaths, and New Deal relief'.

[32] Suandi, 'Promoting to opportunity'.

(about $6 billion today) and a market capitalization based on its 1929 stock market peak of $2.9 billion (about $42.5 billion today), second behind only General Motors in market value ranking. It was also one of the largest employers in the country, with 78 380 employees in 1930. Chandler identifies GE, which was hierarchically organized due to the managerial revolution in US business, as an exemplar case of a modern industrial corporation, characterized by order 'imposed from the top'.[33] GE had an executive committee where strategy was decided, a group of vice presidents to implement the strategy in functional areas from sales to finance, and a wide array of staff lower in the hierarchy.

Senior executives faced extreme financial pressures throughout the Great Depression. While GE remained profitable during the decade, and it never missed a dividend payment, the level of stock market volatility was high. The annualized standard deviation of GE's stock returns reached 83 per cent in 1932 relative to a peak of 75 per cent for the US stock market as a whole.[34] Corporate taxes increased significantly in the state of New York, leading GE to move a number of its business units to Connecticut, which did not have a business tax. Gerard Swope, president of GE between 1922 and 1940, and Owen D. Young, chairman of GE from 1922 to 1939, faced severe tests managing in this context, eschewing the assertion in Hicks that the best of all monopoly profits is a 'quiet life'.[35] Work demands increased into the Second World War. Both Swope and Young returned to GE from retirement in 1942 when the executives hired to replace them – Charles Wilson and Philip Reed – left for Washington, DC, under the war effort.

Attempts to maintain profits in a mature industry created job pressures for senior leadership. GE had long been a target of antitrust scrutiny. Between 1940 and 1950, GE was pursued in 13 antitrust cases. In a highly publicized 1961 case, a number of GE executives including Robert Paxton, president of GE, and Ralph J. Cordiner, chairman of the GE board, were investigated by the Department of Justice for price fixing with employees from 28 other electrical-equipment manufacturers. Price-fixing meetings for products such as switchgear devices and transformers had been arranged since the 1930s. Among the seven executives from the colluding firms who received jail terms for violations of the Sherman Antitrust Act, three were GE vice presidents – William S. Ginn, George E. Burens, and Lewis J. Burger. As a corporation, GE led fines paid and indictments.[36]

The price-fixing conspiracy revealed longstanding tensions in the hierarchy. As one executive explained: 'part of the pressure was the will to get ahead and to have the goodwill of the man above you. He had only to get the approval of the man above *him* to replace you, and if you wouldn't cooperate he could find lots of other faults to use to get you out'.[37] Top GE executives escaped legal sanction despite the Department of Justice's efforts to pursue convictions. Those lower down who participated in price-fixing meetings with rival firms were demoted by GE and had their pay cut.[38] All experienced severe job-related stress. According to Fisse and Braithwaite, 'Top management at GE suffered the worst obloquy, except of course for the executives who went through the trauma of conviction and sentence'.[39] Cordiner lost an honorary

[33] Chandler, *The visible hand*, p. 430.

[34] Cortes et al., 'Stock volatility', p. 1.

[35] Hicks, 'Annual survey of economic theory'.

[36] Smith, *Corporations in crisis*, pp. 97–138.

[37] Smith, *Corporations in crisis*, p. 109.

[38] Herling, *The great price conspiracy.*

[39] Fisse and Braithwaite, *The impact of publicity*, p. 191.

degree, was humiliated in a Congressional hearing into the episode, and was forced to resign from a prestigious advisory position he held at the Department of Commerce. Paxton resigned from GE in 1961 at 59 years of age due to 'reasons of health'.[40] He died of a heart attack in 1980, aged 78 years.

By contrast, employees lower in the hierarchy may have experienced relatively favourable employment circumstances. In 1940, employment at GE stood at 76 314, not that much different to what it had been in 1930. Moreover, the growing influence of labour unions at GE and elsewhere may have tilted relative incomes, and therefore health, towards lower-ranking workers. Under New Deal policies, specifically the Wagner Act and the National War Labor Board, organized labour was strengthened, leading to significant aggregate gains in the wage distribution.[41] Overall, senior executives at GE worked productively with these labour relations changes when most executives of American corporations strongly opposed the strengthening of industrial unions.

Indeed, GE had long adopted a positive approach to human resource management. GE and General Motors were described as leading welfare capitalists during the 1920s because of their commitment to employee health and well-being.[42] GE had a pension plan and a savings and investment plan, and it offered life insurance through a non-contributory group plan. Employees could receive financial assistance to buy a house; even blue-collar workers were entitled to paid vacations. Most welfare benefits were tied to length of service at the firm.

Facilities for health care were extraordinarily forward-looking. Each plant had its own hospital where employees could receive free medical services, including surgery. Moriguchi estimates GE spent around $10 million on these programs annually, equivalent to 6.4 per cent of payroll.[43] As a result, turnover was low. By the late 1920s 58 per cent of employees had been at GE for in excess of 5 years, and a remarkable 26 per cent had been with the company for over 20 years. Some of the welfare programs were scaled back during the early years of the Great Depression, but by the end of the decade, many had been restored or even expanded. Compared with General Motors, Moriguchi notes, GE was considerably stronger in its commitment to provisions for worker welfare.[44]

Environmentally, most key GE managerial departments were in Schenectady, as was GE's famous R&D facility, established there in 1900. A 1926 GE recruitment guide states of Schenectady: 'Its water supply is second to none and equalled by that of few cities. Its health conditions are un-usually good. Its schools are among the best in the state'.[45] Schenectady was described as having 'a broad and well-educated middle class, a diverse population and a bustling downtown'.[46] The 1935 business census shows Schenectady had 99 industrial establishments employing 12 015 workers. GE was the largest single employer, and the city had a low crime rate. For GE employees it was generally a healthy place to live, notwithstanding a history of intense industrial research that left a legacy of environmental degradation and toxic waste.

[40] Smith, *Corporations in crisis*, p. 113.

[41] Farber et al., 'Unions and inequality'.

[42] Moriguchi, 'Did American welfare capitalists'.

[43] Ibid, p. 61.

[44] Ibid, p. 60.

[45] Blackwelder, *Electric city*, p. 185.

[46] Ibid.

III | SOURCES AND DATA

In this section, I describe the data, beginning with GE's *Organization Directory*, which I use to sort employees into occupational levels. I also describe the construction of the two nested samples of individuals I link to the 1930 census and to death records as well as the multiple indicators of status. The number of observations in each of the samples is given below:

GE *Organization Directory*	Census link	Death records
$n = 1806$	$n = 1519$	$n = 1024$

Following the Whitehall studies, I assume that levels in a hierarchy are correlated with social status. Individuals care about their relative standing in the workplace. Conceptually, economists think about status contests with positional rewards as incentive mechanisms to drive performance.[47] The inducement of relative standing can be so strong that individuals are even willing to risk death to achieve positional differentiation, as shown by Ager et al., who use evidence from fighter pilot contests during the Second World War.[48] Status-enhancing effects have also been studied extensively in the sociology literature where agents can gain advantages such as income and public approbation through hierarchies, prizes, and networks.[49]

The managerial hierarchy at GE lends itself particularly well to the contest-like conceptualization of status differences. Managerial hierarchies divide the authority and responsibility in an organization, and the status levels are typically clearly delineated. Inside the firm, the principal rewards the agent with a 'positional good' associated with a level in the hierarchy. Just as Whitehall had permanent secretaries at the top and administrative workers at the bottom, GE's hierarchy consisted of leading executives all the way down to assistants and clerks. Chandler describes hierarchies as 'self-perpetuating human organizations', hinting at their sociological dimensions.[50]

The 1930 edition of GE's *Organization Directory* lists the job description of each individual in the managerial hierarchy, their rank and the department in which they worked across GE's US locations. A wide range of departments, such as sales, accounting, corporate affairs, and R&D, are included. This is similar to Whitehall, where civil servants are staffed according to various departmental responsibilities. I use information on 1806 male employees in the directory.[51]

The hierarchy can be identified by the ordering of individuals in the layout of the *Organization Directory*. Each department has its own box on a page, with the most important job functions at the top of the box and additional job functions lower down arranged by indents. Figure 2a shows the box containing executive officers, where Owen D. Young, the chairman of the board discussed in section II can be identified by his positioning in the directory relative to vice presidents, who are listed underneath. Figure 2b shows the box for the Industrial Services Department. The supervisor of the department is at the top of the box, whereas other employees are arranged by indents. The

[47] Besley and Ghatak, 'Status incentives'; Moldovanu et al., 'Contests for status'.

[48] Ager et al., 'Killer incentives'.

[49] Sauder et al., 'Status'; Reschke et al., 'Status spillovers'.

[50] Chandler, *The visible hand*, p. 372.

[51] There are 36 Schenectady-based women in the *Organization Directory*. Of the 31 I could trace in the 1930 census, the average age at that time was 35 years. Of the 15 I could trace in census and death records, the average age at death was 85.9 years, compared with an average age at death of 77.4 years for men. Women are dropped from the analysis because they have different lifespan profiles and because they are not observed in all the layers of the hierarchy.

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R. T. VIETS	Educational Work—Office Training and Instruction
W. J. E. SMITH, B. H. FRISS	Employment—Factory Help
R. E. RUGEN	Employment—Office Help—Supervision of Substitute Force—Employees' Service—Information Bureau, No. 44
MRS. A. HARDWIG	Employment—Office Help
MRS. M. R. HOLMES	Bureau of Instruction—Office Help
R. G. DAVIDSON	Employees' Records and Statistical Reports
	Factory Training
R. S. ROSS	Americanization Secretary, No. 44
M. M. BORING, L. MEANS	Employment and Training of Technical Students
J. O. WARREN	Employees Tests

(b) INDUSTRIAL SERVICES DEPARTMENT

FIGURE 2 Status levels and GE's *Organization Directory*. *Notes*: These figures show sections of the 1930 edition of General Electric's *Organization Directory* pertaining to executive officers at the firm and the Industrial Services Department of the main Schenectady plant. *Source:* Author's own creation.

two women working in that department are indented further into the page than most of the men, which is consistent with how gender was used as a status divider in the workplace.

Based on the structure of the *Organization Directory*, I sorted individuals into the following sequence of occupational levels, with examples of job titles at each level in parentheses:

Level 1: Executives (above Vice President)
Level 2: Vice President
Level 3: Top of box each department (e.g. Manager)
Level 4: Indent 1 (e.g. Assistant Superintendent)
Level 5: Indent 2 (e.g. Assistant General Foreman)
Level 6: Indent 3 (e.g. Inventory Control Clerk)

With multiple departments in the *Organization Directory*, an important question is whether status levels are symmetric across these departments. This is not a concern with levels 1, 2, and 3 because job levels from manager upwards are well defined. While there is some scope for misclassification when comparing lower down levels – for example, an assistant superintendent with an R&D lab worker or someone in sales or accounting – I use department fixed effects (FE) to identify off within-department changes. This approach compares the lifespan of individuals in the same department at GE.

As a check on the robustness of these status orderings to classification errors, I compiled data from the 1930 federal census (more details below) on variables that should also reflect status differences between individuals: the value of a home and the number of servants in the household.[52] Census enumerators were instructed to record the 'approximate current market value of the home' for all non-farm households, or the approximate rental value per month if rented. Enumerators were also instructed to list 'all other persons living with the family, whether relatives, boarders, lodgers, or servants'. I collected those data even though the counts are debated since the role of servant and housekeeper were often conflated using enumeration procedures.[53]

Figure 3 illustrates means and confidence intervals for these variables. Figure 3a shows a distinct ordering associated with occupational levels at GE and the market value of a home. For those in level 1 occupations, the mean home value is \$63 892 (about \$1.0 million today), and for level 6 occupations, it is \$8788 (about \$135 000 today). The median home values are \$40 000 and \$8000, respectively. The median value of a home in the 1930 census for native whites living in an urban area was \$5849, and for foreign-born whites, it was \$6076. Hence, individuals I observe working at GE were relatively affluent by comparison. F-tests reject the null of no difference in the means when all levels are included ($F = 96.91$), and the null is also rejected when dropping individuals in levels 5 and 6 ($F = 32.88$) that may contribute the most to the group differences.

Figure 3b shows that occupational levels also correspond strongly with the number of servants in the household, although there are few observations of households with more than one servant ($n = 28$). Again, F-tests reject the null of no difference in the means including all levels ($F = 107.02$) and dropping levels 5 and 6 ($F = 32.88$). Taking both 3a and 3b together, the convexity of wealth and income implied is consistent with theories of 'corporate tournaments' where individuals higher up in the corporate structure are remunerated more favourably because they win the race for hierarchy in the internal labour market.[54]

As noted in section I, individuals can belong to multiple hierarchies, both occupational and social. In the data, I can observe hierarchical position in multiple ways within GE. I can therefore test for consistency in the results on rank and lifespan to alternative indicators of occupational status.

As a second measure of status, I use lists of attendees at GE management training camps. Regular meetings were held at the GE-owned Association Island in Lake Ontario, about 160 miles north-west of Schenectady (see figure A1). GE's training camps were instrumental to competition for positions in the corporate hierarchy. Each department had its own camp, but 'Camp General' was the most prestigious, drawing attendees from all the main departments. The camps were male-only events, and participants stayed in tents. Accommodation was arranged typically as two men per tent, although top executives, such as the chairman of the board, got their own individual tent.

[52] The geographic location of a house was also a status differentiator. GE had formed the Schenectady Real Estate company early in the 1900s and sold parcels of land to its employees. Edwin Wilbur Rice, Jr., shown as Honorary Chairman of the Board in figure 2a, had the best of the land. Accordingly, it was stated that 'both the size and the location of Rice's property affirmed his preeminence' at General Electric (Blackwelder, *Electric city*).

[53] Stigler, *Domestic servants*.

[54] Baker et al., 'The internal economics of the firm'; Bognanno, 'Corporate tournaments'.

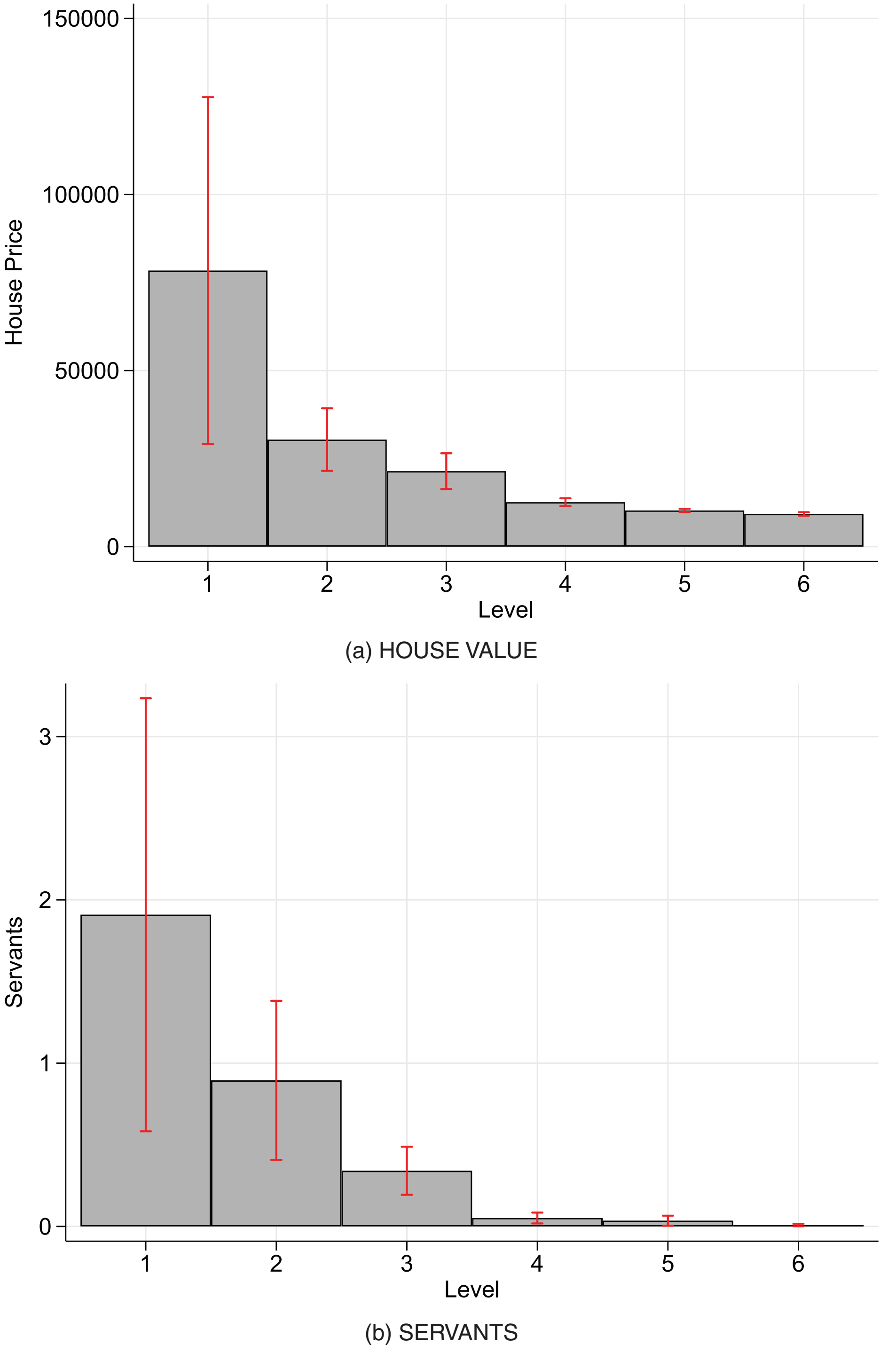

FIGURE 3 Status levels and socioeconomic characteristics. *Notes*: These figures show mean household characteristics and 95 per cent confidence intervals for employees in levels 1–6 of the General Electric managerial hierarchy. Both variables are from the 1930 census. Level 1 is the highest level. Level 6 is the lowest. *Source:* Author's own creation.
[Colour figure can be viewed at wileyonlinelibrary.com]

Each camp was a 2–3-day event. According to the pamphlet for Camp General 1929, participants were provided 'opportunity for instruction, recreation and inspiration'. The business program started 14 July at 8:00 pm and concluded Wednesday 17 July at 12:15 pm. Reports and plans were presented by each department, followed by joint sessions on management practices and business strategy. The 1929 camp focused on 'organization' with sessions on functional versus vertical organizational forms. Attendees were instructed to 'bring your golf clubs, tennis racket, 12-gauge trap shotgun, bathing suit and fishing tackle'. Meals were announced by bugle call.

Nye describes an invitation to one of these events as 'coveted', going on to say that the camps 'had the same male aura that pervades college fraternities, exclusive men's social clubs, the Masons and other groups such as the Bohemian Grove'.[55] Going to Camp General meant access to top executives at GE. It was a form of socialization that reinforced the hierarchical system of management. An inner group attended Camp General; an outer group attended departmental camps. Further down in the status hierarchy were those who did not attend at all.

Of the 1024 individuals in the dataset where I can observe a census link and death records, 221 (22 per cent) attended Camp General between 1927 and 1939. A total of 38 per cent attended once, 23 per cent attended five or more camps, with just 1.4 per cent attending all nine camps during this period.

As a third measure of status, I traced individuals in the 1930 *Organization Directory* through the 1940 *Organization Directory* to determine if they had been promoted in the hierarchy. The causal effect of promotions on health remains controversial because of selection into seniority.[56] Anderson and Marmot examine promotions as a measure of status in Whitehall II by instrumenting for individual promotion based on predetermined departmental job slot openings.[57] Promotions can lead to status gains and adverse health effects through increased job stress.[58] In a sample of British workers, Boyce and Oswald find healthy individuals are more likely to be promoted, but promotions also induce greater mental health fatigue.[59]

Of the 1024 individuals in the dataset where I can observe a census link and death records, 623 (61 per cent) can also be identified in the 1940 directory. Thirty-seven of those (6 per cent) were employed in 1940 at a higher level.

The most challenging part of the data collection effort was obtaining birth and death years for each individual in the 1930 *Organization Directory*. I started with collecting birth years by linking individuals in the directory to the 1930 census through name matching.[60] Although some individuals employed by GE had common surnames such as 'Smith', it was often the case that 'General Electric' (or some part of that string) was reported in the occupation field of the census, so the correct match could be identified. The match rate to the census of 84 per cent (1519 out of 1806) reflects the ease of using the occupation field to identify matches for individuals living in the same general location. For dates of death I used several sources. GE's archives contain a vast collection of obituaries. Employees maintained a lifelong attachment to the firm, and sent in

[55] Nye, *Corporate identities*, p. 96. Bohemian Grove is the name of an annual summer retreat for the members of The Bohemian Club, an anachronistic elite male-only club in northern California. The retreat is held in Sonoma county.

[56] Suandi, 'Promoting to opportunity'.

[57] Anderson and Marmot, 'The effects of promotions'.

[58] Johnston and Lee, 'Extra status and extra stress'.

[59] Boyce and Oswald, 'Do people become healthier after being promoted?'.

[60] Ruggles et al., 'IPUMS Ancestry Full Count Data'.

obituary notices of friends and colleagues. I also searched for obituaries using digitized newspaper collections and other sources from Ancestry.com, and I accessed about 33 000 archived burial cards recording deaths at the 100-acre Vale Cemetery in Schenectady. Figure A3 shows the burial card for John F. Madgett, who worked in the General Superintendents office at GE, dying in 1947 from a cerebral haemorrhage (few burial cards report the cause of death). Finally, I used the US Social Security Death Index, 1935–2014 for cross-checking. I matched 1024 individuals to both the census and death records.

The debate over 'place' versus 'class' as a determinant of the health and mortality gradient is longstanding in the economic history literature.[61] To measure SES in youth for each individual, I use place of birth, father's occupation, and education.

Place of birth may determine lifespan because of variation in water quality, for example. Troesken and Beeson report that '70 per cent of all cities with populations greater than 30,000 in 1900 used lead service mains exclusively or in combination with some other type of main'.[62] Lead exposure or in utero exposure to pandemics can affect SES variables such as educational attainment and health outcomes.[63] However, this literature is also highly controversial.[64] According to Schneider, our ability to accurately measure changes in foetal health is quite limited, so I use place of birth as more of a catch-all for place-based health.[65]

Father's occupation is commonly used in social mobility studies to identify intergenerational occupational change.[66] To identify father's occupations, I undertook backward census traces for the 1024 individuals I could observe in both the census and death records, arranging occupations into six categories following the *Dictionary of Occupational Titles*, from 'professional and managerial occupations' down to 'unskilled occupations'. I then followed Long and Ferrie in distinguishing 'white collar' occupations (professional, technical, and kindred; managers, officials, and proprietors; clerical; and sales) from other categories.[67] In 77 cases I was unable to find an occupation for a father, so I coded those fathers as non-white-collar. In the dataset overall, 284 individuals (28 per cent) originated from white-collar backgrounds.

GE's archives provide a wealth of personnel documents listing individuals by the colleges and universities they attended. The document 'Advanced Course in Engineering, General Electric Company, Schenectady December, 1929', for example, lists an individual in the data, Leon Goldberg, an industrial control engineer, as attending MIT. Another individual in the data, Lloyd Shildneck from the A–C engineering department, attended the University of Nebraska. Seventy-three individuals (7 per cent) in the dataset attended a college or university. In the 1940 census, 4.6 per cent of the population aged 25 years or over were college graduates.[68] With respect to the causal impact of education on lifespan, Lleras-Muney shows the effect is strongly positive based on US data, whereas Clark and Royer estimate quite small health returns to educational attainment using UK data.[69]

61 Jaadla et al., 'Infant and child mortality'.

62 Troesken and Beeson, 'The significance of lead water mains', p. 182.

63 Almond and Currie, 'Killing me softly'.

64 Beach et al., 'Reevaluating the long-term impact of in utero exposure'.

65 Schneider, 'Fetal health stagnation'.

66 Long and Ferrie, 'Intergenerational occupational mobility'.

67 Long and Ferrie, 'A tale of two labor markets'.

68 The 1940 census contains more comprehensive information on educational attainment.

69 Lleras-Muney, 'The relationship between education and adult mortality'; Clark and Royer, 'The effect of education'.

I collected additional SES measures from the 1930 census. As noted previously in this section, I know if an employee owned a home, its approximate market value (or if not owned, how much rent was being paid), and the number of servants in the household. The census also reports whether a radio was owned. Although the diffusion of the radio was rapid during the 1920s, it was not in all households by the end of the decade.[70] New York state was among few states where radio ownership was above 50 per cent, on average. In my data, 78 per cent of individuals in the census records reported owning a radio, suggesting affluence relative to the general population.[71]

Finally, I also observe marital status and the number of children in the household (total number and the number under 5 years old). Durkheim famously conjectured that marriage and family can be 'protective' mechanisms which promote psychological well-being and reduce the likelihood that an individual will engage in negative health habits.[72] Marriage has been associated with a longer lifespan empirically in historical and modern datasets.[73]

In the GE data, 82 per cent were married, and the mean number of children in the household was 1.03 for the total and 0.19 for children under 5 years. Because the number of children is tabulated 'as present' in the 1930 census, this will under-count the children of older individuals at GE if their children had already left the household. Indeed, the number of children in the household exhibits an inverted-U shape as a function of age, increasing to age 46 years and decreasing thereafter.[74]

Table 1 shows descriptive statistics for the variables available in both the census link and the census link plus death records samples. Although most of the mean values across variables, such as surname string length or the number of characters in a person's initials are quite balanced in these samples, I explore the likelihood of selection on these observables below.

Summary data show that individuals employed at GE were, on average, in their early 40s on entry into the data in 1930, and for those in the death records, mean lifespan was 77.4 years. The youngest person died at age 32; the oldest, at 104 (see figure A4 for the overall distribution of lifespan in the dataset). Because entry into the data occurs at a fixed point in time, levels in the managerial hierarchy are correlated with age with older (younger) individuals at higher (lower) levels.

Age at death is highly non-linear by level in the corporation, which contrasts sharply with the strong cross-sectional association between lifespan and job seniority often found in the literature, including in the Whitehall data. Vice presidents (level 2) at GE experienced a noticeably shorter mean lifespan of 71.3 years, and as discussed in section II, these individuals could be exposed to particularly severe circumstances of job-related stress. Their reduced life expectancy is illustrated in figure 4, which plots the Kaplan–Meier hazard rates for each occupational level.

Lower down the hierarchy, individuals were more likely to be born within the state of New York, where Schenectady is located, perhaps because of a reliance on local labour markets. As discussed at the beginning of this section, the value of home ownership is correlated with status levels, but

70 Stromberg, 'Radio's impact'.

71 Whitehall II used car ownership as a measure of SES, where it was estimated to be a useful, albeit less strong, predictor of mortality before retirement than employment grade (Marmot and Shipley, 'Do socioeconomic differences'; figure A2b).

72 Durkheim, *Suicide, a study in sociology.*

73 Gove, 'Sex, marital status, and mortality'; Johnson et al., 'Marital status and mortality'.

74 I run a regression with the number of children in the household as the dependent variable and age and a quadratic in age as independent variables, with the following results: Children $= -3.6901 + 0.2209$ Age $- 0.0024$ Age^2 (t–statistic on Age is 11.29, and on Age^2, it is -10.53). The derivative dChildren$/d$Age is then $0.2209 + (2 \times -0.0024)$. When the derivative of children with respect to Age is set to zero, the turning point is located at $-\frac{0.2209}{2 \times -0.0024} = 46$.

TABLE 1 Summary statistics

	Census link	Obs.	Census and death records	Obs.	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Surname	6.47	1519	6.46	1024	6.56	6.27	6.44	6.52	6.40	6.49
length	(1.73)		(1.69)		(1.79)	(1.44)	(1.80)	(1.66)	(1.73)	(1.67)
Initials (#)	1.91	1519	1.90	1024	2.00	2.00	2.05	1.96	1.88	1.86
	(0.40)		(0.41)		(0.52)	(0.00)	(0.51)	(0.45)	(0.36)	(0.41)
Age in 1930	41.74	1519	41.77	1024	63.38	59.20	50.68	45.00	40.46	38.81
	(11.26)		(11.03)		(8.89)	(8.67)	(11.00)	(10.09)	(9.36)	(10.46)
Age at death	–		77.43	1024	80.94	71.27	76.92	79.05	76.78	77.54
	–		(11.79)		(8.16)	(10.20)	(12.11)	(11.34)	(11.93)	(11.89)
Birth year	1888.26	1519	1888.23	1024	1866.63	1870.80	1879.32	1885.00	1889.54	1891.20
	(11.26)		(11.03)		(8.89)	(8.67)	(11.00)	(10.09)	(9.36)	(10.46)
Born in New	0.43	1519	0.45	1024	0.00	0.27	0.27	0.35	0.49	0.50
York State	(0.50)		(0.50)		(0.00)	(0.46)	(0.45)	(0.48)	(0.50)	(0.50)
Home owner	0.63	1519	0.62	1024	0.81	0.67	0.86	0.66	0.64	0.55
	(0.48)		(0.49)		(0.40)	(0.49)	(0.35)	(0.47)	(0.48)	(0.50)
Value of home	$11 953	1067	$12 466	666	$78 385	$32 100	$22 025	$12 761	$10 021	$9160
	($14 550)		($16 822)		($90 632)	($14 708)	($21 273)	($7112)	($4452)	($5331)
Monthly rent	49.93	520	49.71	259	–	63.33	60.42	56.12	46.54	46.99
	($30.56)		($33.83)		–	($22.55)	($25.94)	($28.94)	($15.44)	($34.87)
Servants (#)	0.09	1519	0.13	1024	2.63	1.13	0.51	0.08	0.07	0.02
	(0.53)		(0.64)		(2.87)	(0.99)	(0.73)	(0.32)	(0.51)	(0.12)
Radio in home	0.80	1519	0.81	1024	0.81	0.73	0.92	0.78	0.83	0.79
	(0.40)		(0.39)		(0.40)	(0.46)	(0.28)	(0.41)	(0.38)	(0.41)
Married	0.84	1519	0.85	1024	1.00	0.93	0.93	0.88	0.86	0.81
	(0.37)		(0.36)		(0.00)	(0.26)	(0.25)	(0.33)	(0.35)	(0.39)
Children (#)	1.03	1519	1.10	1024	0.88	0.87	1.36	1.30	1.16	0.94
	(1.18)		(1.21)		(1.15)	(1.13)	(1.45)	(1.32)	(1.20)	(1.11)
Children	0.19	1519	0.20	1024	0.00	0.07	0.12	0.17	0.23	0.20
under 5 (#)	(0.47)		(0.49)		(0.00)	(0.26)	(0.42)	(0.47)	(0.53)	(0.49)
White collar	–		0.30	947	0.23	0.57	0.34	0.31	0.31	0.26
	–		(0.46)		(0.44)	(0.51)	(0.48)	(0.46)	(0.46)	(0.44)
Higher	–		0.07	1024	0.31	0.60	0.17	0.08	0.05	0.04
education	–		(0.26)		(0.48)	(0.51)	(0.38)	(0.27)	(0.22)	(0.20)
In 1940 GE	0.53	1519	0.61	1024	0.63	0.40	0.59	0.70	0.66	0.53
directory	(0.50)		(0.49)		(0.50)	(0.51)	(0.50)	(0.46)	(0.47)	(0.50)
In 1940 census	0.40	1519	0.39	1024	0.19	0.13	0.27	0.40	0.42	0.41
	(0.49)		(0.49)		(0.40)	(0.35)	(0.45)	(0.49)	(0.49)	(0.49)

Notes: Means with standard deviations in parentheses. The census link sample refers to individuals I can match from GE's *Organization Directory* to the 1930 census. The census link and death records sample refers to individuals I observe in both the census and in the death records. The description of each of these variables is given in appendix A.2.
Source: Author's own creation.

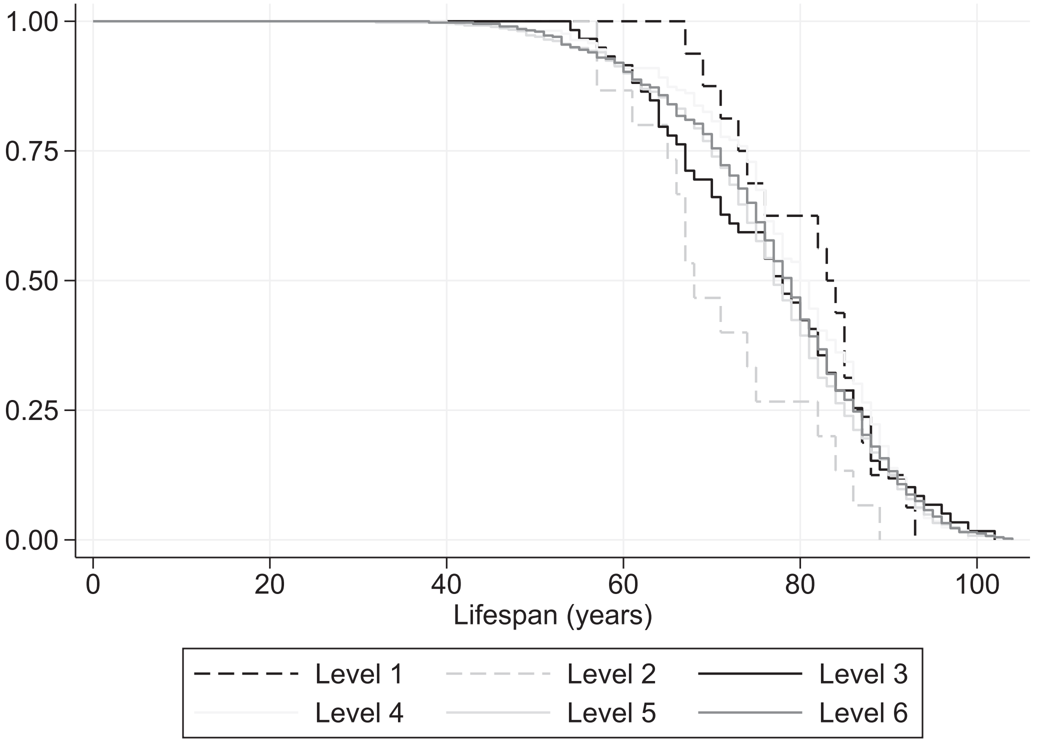

FIGURE 4 Kaplan–Meier curves by status level. *Notes*: This figure shows the Kaplan–Meier curves for employees in levels 1–6 of the General Electric managerial hierarchy. Level 1 is the highest level. Level 6 is the lowest. *Source*: Author's own creation.

mean home ownership and having a radio in the home fluctuates more widely by level, and both are quite low for level 2 vice presidents. These individuals tended to pay more in mean monthly rent compared with their counterparts at lower levels. Purely based on these observations, there appears to be something different about vice presidents in the way they organized their lives and how long they lived.

A large share of the individuals tended to be married, even at level 6. This is interesting because it may imply access to coping mechanisms or social support which have been found to be important mediating influences on stress-related health in the biology literature discussed in section I. Lower levels in the occupational hierarchy were associated with more young children being present, which makes sense because individuals at these levels were younger on average. The presence of white-collar backgrounds is reasonably flat across levels with the exception of level 2 individuals, where the mean share is much higher. These individuals also tended to be more likely to have received a higher education, which falls sharply to a low of 4 per cent for level 6 employees.

I now examine sample selection when matching individuals from the 1930 *Organization Directory* to the census and the death records. Figure 5a shows the number of individuals in each level of the hierarchy. Figure 5b shows the percentage of individuals in the 1930 *Organization Directory* matched. Whereas figure 5b shows I can match quite evenly from the directory to the census, the share of individuals with a measure of lifespan is lower at levels 5 and 6. If the unmatched lived shorter lives, this would bias any comparison of longevity across groups.

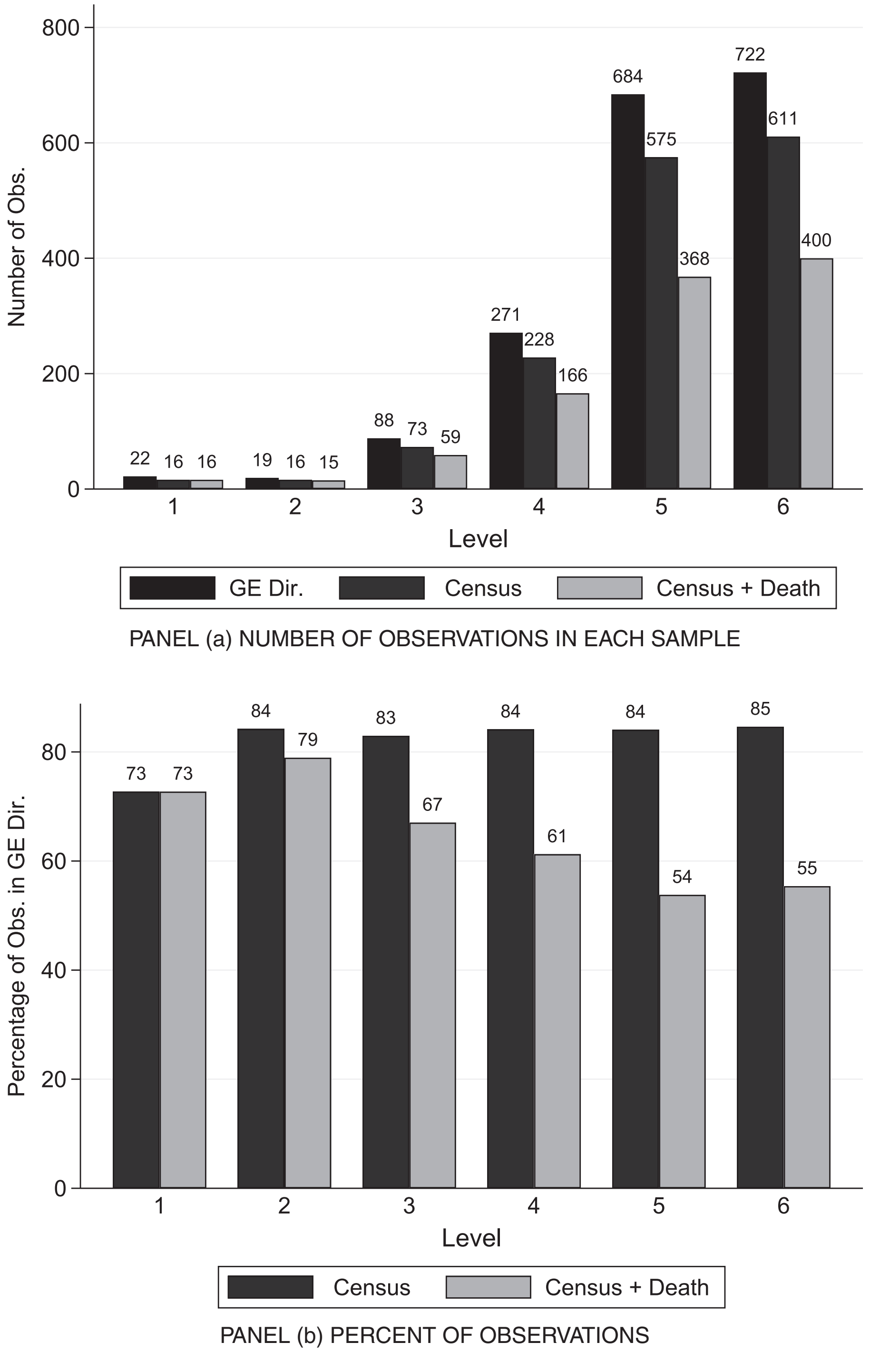

FIGURE 5 Matching to the census and death records by status level. *Notes*: Figure 5a shows the number of individuals in the General Electric *Organization Directory* and those matched to the 1930 federal census and to death records. Figure 5b shows the number of observations in the census and death records samples as a percent of those in the *Organization Directory*. For example, 85 per cent of individuals in the *Organization Directory* at level 6 can be matched to the 1930 census, and 55 per cent to both the census and death records. *Source*: Author's own creation.

TABLE 2 Sample selection

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
	Census vs. GE Dir.	**Death records vs. census link**						
	All levels					**Upper levels**	**Lower levels**	
Surname length	−0.006	−0.000	0.001	0.000	−0.002	0.008	0.002	0.7251
	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)	(0.023)	(0.007)	–
Initials (#)	−0.030	−0.033	−0.036	−0.061**	−0.066**	0.004	−0.082**	0.3008
	(0.022)	(0.030)	(0.030)	(0.030)	(0.029)	(0.106)	(0.032)	–
Home owner	–	–	−0.051*	−0.046	−0.047*	0.100	−0.057*	0.1386
	–	–	(0.029)	(0.028)	(0.028)	(0.140)	(0.029)	–
Radio in home	–	–	0.020	0.023	0.027	0.063	0.018	0.6729
	–	–	(0.033)	(0.032)	(0.031)	(0.141)	(0.033)	–
Married	–	–	0.018	0.018	0.025	−0.044	0.012	0.8202
	–	–	(0.040)	(0.040)	(0.039)	(0.332)	(0.040)	–
Children (#)	–	–	0.035***	0.032***	0.029***	0.040	0.030**	0.7554
	–	–	(0.011)	(0.011)	(0.011)	(0.044)	(0.012)	–
In 1940 GE Directory	–	–	–	0.201***	0.212***	0.106	0.200***	0.2976
	–	–	–	(0.026)	(0.025)	(0.119)	(0.027)	–
In 1940 census	–	–	–	−0.021	−0.023	−0.146	−0.012	0.1846
	–	–	–	(0.025)	(0.024)	(0.136)	(0.026)	–
Birth year FE	N	Y	Y	Y	N	Y	Y	–
Birth decade FE	N	N	N	N	Y	N	N	–
Observations	1806	1519	1519	1519	1519	105	1414	–
R^2	0.002	0.045	0.054	0.094	0.062	0.520	0.098	–
Mean of dependent variable	0.841	0.674	0.674	0.674	0.674	0.857	0.661	–

Notes: This table reports coefficients from linear probability regressions. In column 1 the dependent variable is coded 1 if an individual is in the census-linked sample and 0 if they are only in the *Organization Directory*. In columns 2–7 the dependent variable is coded 1 if an individual is in the census-linked sample and 0 if they are only in the death records sample. Columns 1–4 include all levels of the managerial hierarchy. Columns 6 and 7 split the sample by upper levels (1, 2, and 3) and lower levels (4, 5, and 6), respectively. Column 8 reports the *p*-value from a Wald test under the null of no difference between the coefficients in columns 6 and 7. Robust standard errors are in parentheses. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.
Source: Author's own creation.

To assess scope for sample selection bias, I use the rich set of variables available in the nested samples. Specifically, table 2 reports the results of linear probability regressions that test whether being in the data is systematically related to the observable characteristics of individuals. The dependent variable takes on a value of 1 if I observe an individual in a given sample and 0 if an individual is in the reference sample. Thus, I estimate the probability an individual is observed in the census-linked sample versus only the 1930 *Organization Directory* and, in turn, in the sample that includes death records versus just the census-linked sample. The coefficients on the independent variables (mostly from the census) capture the relationship between selection into each sample and observables. I use granular birth-year fixed effects in most specifications, also using birth-decade fixed effects in column 5, which identify off broader cohorts of individuals.

When analysing selection from the 1930 *Organization Directory* sample to the 1930 census-linked sample, only name diagnostics are available. Nevertheless, these variables are still informative. Complex name structures with multiple middle initials, for example, might be correlated with SES. Column 1 shows a weak relationship between the probability of selection into the census-linked sample and the characteristics of names. The coefficients on surname length and the number of initials are small, and they are estimated with large standard errors. Column 2 shows a similar pattern in the coefficients when using the same specification to compare the composition of individuals in the death records and the census-linked samples.

Column 3 examines the probability of an individual being selected into the death records sample from the 1930 census link sample using a richer array of SES covariates. Few of these variables are strong predictors of selection. There is a 5.1 per cent reduction in the probability of selection for homeowners, suggesting some bias against more affluent households. The effect of an additional child is associated with a 3.5 per cent increase in the probability of being in the death records, which may introduce bias under the assumption that individuals with children generally tend to live longer. Column 4 reports results from models that add two dummy variables: one identifying individuals in both the 1930 and 1940 *Organization Directory*, and another identifying those in both the 1930 and 1940 federal censuses using links to individuals provided by *The Census Linking Project*.[75] The effect of being a homeowner from column 3 becomes statistically insignificant with these additional controls, whereas the effect of an additional child remains robust. While there is no evidence of selection based on presence in the censuses, individuals who stayed at GE are more likely to be selected into the death records sample, which may be attributable to their deaths being observed in GE's archival collection of obituaries or in local area sources, including the Schenectady cemetery records. The direction of this selection could be positive or negative: delinquent employees may be more likely to leave the firm and die early, or the healthiest ambitious employees might leave to exploit new opportunities elsewhere. Column 5 estimates the same model using birth-decade as opposed to birth-year fixed effects, with substantively similar results.

Finally, the specifications in columns 1–5 constrain the effect of the variables on selection to be the same at all levels of the managerial hierarchy. In columns 6 and 7 I relax this assumption by splitting the sample by upper (levels 1, 2 and 3) and lower levels (levels 4, 5 and 6), an important step since much of the analysis will rely on testing for lifespan differences by individuals aggregated into these tiers. The point estimates in column 7 suggest stronger selection effects in the lower levels for the number of initials in a name, for home ownership, the number of children, and especially being in the 1940 GE directory. Although Wald tests in column 8 show the regression coefficients in columns 6 and 7 are not significantly different, I return to the estimates in table 2 later in the paper (section IV) as a basis for implementing Heckman sample-selection models as further robustness checks on the results.

IV | RESULTS

Equation (1) shows the main OLS estimating specification. I also estimate using median regressions as a robustness check against outliers, and using Cox proportional-hazards models on the uncensored data to quantify differences in survival times. The left-hand-side variable is lifespan

[75] I use the crosswalk datasets connecting individuals across federal censuses using linking algorithms. I use observations based on the conservative version of the Abramitzky, Boustan, and Eriksson (ABE) algorithm. See further, Abramitzky et al., 'Census linking project'.

in years for individual i, so the estimates are conditional on being observed in the death records. The main right-hand-side variable is status, which I capture using all the measures described in section III: levels in the hierarchy, attendance at management training camps, and promotions.

$$\text{Lifespan}_i = \alpha + \beta\text{Status Level}_i + \gamma\text{Youth SES}_i + \delta\text{Adult SES}_i + \phi D_i^{\text{BIRTH}} + \kappa D_i^{\text{BPLACE}} + \nu D_i^{\text{DEPT}} + \epsilon_i \quad (1)$$

I use youth and adult SES variables described in section III. These variables help address potential omitted variable biases since SES characteristics tend to be systematically correlated with lifespan, leaving the status variables to isolate the effects of workplace conditions. However, two estimation issues remain. First, I cannot measure any bias created by selection into rank on unobservables. These would include variables such as cognitive capacity, intellectual ability, drive, or ambition, for example. These variables tend to be positively correlated with health, which would bias the results towards the type of mortality gradient the Whitehall researchers found. Second, given the complexities of SES relationships, a concern would be conditioning on post-treatment variables as a source of bias in the estimates. Youth SES variables are confounders defined prior to status at GE being determined, whereas the adult SES variables, such as owning a home, may be correlated with both status in the managerial hierarchy and lifespan through the income channel, leading to 'collider bias' from mediated effects as discussed in Schneider.[76] At the same time, such variables may capture pre-treatment characteristics such as family wealth as a route to home ownership. To facilitate appropriate inferences – and show that the results are not being driven by these potentially 'bad controls' – I proceed by estimating the relationship between status and lifespan without any SES controls (youth or adult), then adding the SES controls sequentially.

The specifications also include fixed effects for birth year, ϕ, birth place, κ, and GE corporate department, ν. In a large organization, some departments, such as R&D, may recruit different types of individuals, such as academic versus administrative staff on a university campus, so identification of lifespan differences comes from intra-departmental variation, again in an effort to mitigate any bias created by selection on unobservables and to focus on the effects that might be driven by workplace conditions. With many fixed effects, a concern is identification off a smaller number of observations. Following the approach in table 2, I therefore use birth-year fixed effects, which reduce omitted variable bias, or birth-decade fixed effects, which allow for more within-unit identifying variation.

Table 3 reports estimates of β using a continuous measure of level in the managerial hierarchy, with individuals in level 1 assigned a value of 1 down to those in level 6 assigned a value of 6. With an inverse Whitehall mortality gradient by rank, the estimate of the coefficient on status should be negative: individuals lower in the hierarchy should experience monotonically shorter lives.

By contrast, in columns 1–6 each of the point estimates is positive. Column 1 implies an increase in longevity of around 7 months for every step down in the hierarchy, with an estimate of around 9 months in column 4 (which is statistically significant at the 10 per cent level) or 10 months in column 5 with a full set of SES controls and birth-year, birth-place, and GE department fixed effects. Using birth-decade fixed effects in column 6 produces very similar point estimates and confidence intervals. Interestingly, the SES variables are not strong predictors of lifespan, which may reflect the relative affluence of this group. In some cases, however, the SES variables in table 3 do have the expected sign. A higher education is associated with 1–2 years of added lifespan, consistent

76 Schneider, 'Collider bias'.

TABLE 3 Levels in the managerial hierarchy

	[1] OLS	[2] OLS	[3] OLS	[4] OLS	[5] OLS	[6] OLS	[7] Median	[8] Cox
Level	0.58	0.52	0.66	0.78*	0.82	0.79	0.93*	0.96
	(0.39)	(0.39)	(0.41)	(0.41)	(0.51)	(0.48)	(0.51)	[−1.01]
Home owner	–	−0.35	−0.39	−0.35	−0.39	−0.42	−0.62	1.01
	–	(0.95)	(0.95)	(0.95)	(0.95)	(0.90)	(0.80)	[0.14]
Radio in home	–	0.44	0.52	0.40	0.84	1.10	0.16	0.93
	–	(1.06)	(1.06)	(1.08)	(1.07)	(1.02)	(0.77)	[−0.86]
Married	–	−0.90	−0.86	−1.22	−1.22	−0.65	−1.52	1.09
	–	(1.41)	(1.41)	(1.44)	(1.42)	(1.38)	(1.48)	[0.81]
Children (#)	–	−0.38	−0.39	−0.38	−0.38	−0.32	−0.64**	1.04
	–	(0.34)	(0.34)	(0.34)	(0.34)	(0.34)	(0.28)	[1.40]
White collar	–	–	−0.00	−0.29	−0.42	−0.33	−0.85	1.03
	–	–	(0.87)	(0.88)	(0.88)	(0.86)	(0.70)	[0.41]
Higher education	–	–	2.36	1.94	1.14	1.19	2.11	0.76*
	–	–	(1.84)	(1.83)	(1.88)	(1.79)	(2.46)	[−1.95]
Birth year FE	Y	Y	Y	Y	Y	N	Y	Y
Birth decade FE	N	N	N	N	N	Y	N	N
Birth place FE	N	N	N	Y	Y	Y	Y	Y
Dept. FE	N	N	N	N	Y	Y	Y	Y
Observations	1024	1024	1024	1024	1024	1024	1024	1024
R^2	0.05	0.05	0.05	0.06	0.08	0.04	–	–
Mean of dependent variable	77.43	77.43	77.43	77.43	77.43	77.43	–	–

Notes: Columns 1–6 are OLS estimates, and column 7 is an estimate from a median regression with robust standard errors in parentheses where the dependent variable is lifespan in years. Column 8 reports hazard ratios from a Cox model, with z-statistics in square brackets. The level variable is a continuous measure, with a value of 1 for level 1 individuals down to 6 for level 6 individuals (the lowest rank in the hierarchy). $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.
Source: Author's own creation.

with Halpern-Manners et al., who show better-educated men born in the United States from 1910 to 1920 lived longer, although the 95 per cent confidence interval is wide.[77]

Results using a median regression (column 7) are close to the OLS estimate in column 5, suggesting that anomalous values are not influencing the baseline results. The coefficient on status level in column 7 implies an 11 month increase in median longevity further down the hierarchy, or a reversal of the Whitehall phenomenon. A Whitehall effect in a Cox proportional hazards model would produce a hazard ratio on status level above unity; that is, an increase in mortality risk over the life cycle. The reported hazard ratio in column 8, while being imprecisely estimated, is less than unity, implying a reduced mortality risk lower down in the hierarchy.

I now turn to more granular estimates of lifespan using dummy variables to capture level in the hierarchy. Figure 6a plots OLS and Cox model point estimates and 95 per cent confidence intervals for the lifespan of individuals in levels 2, 3, 4, 5, and 6 of the hierarchy relative to individuals in

[77] Halpern-Manners et al., 'The effects of education on mortality'.

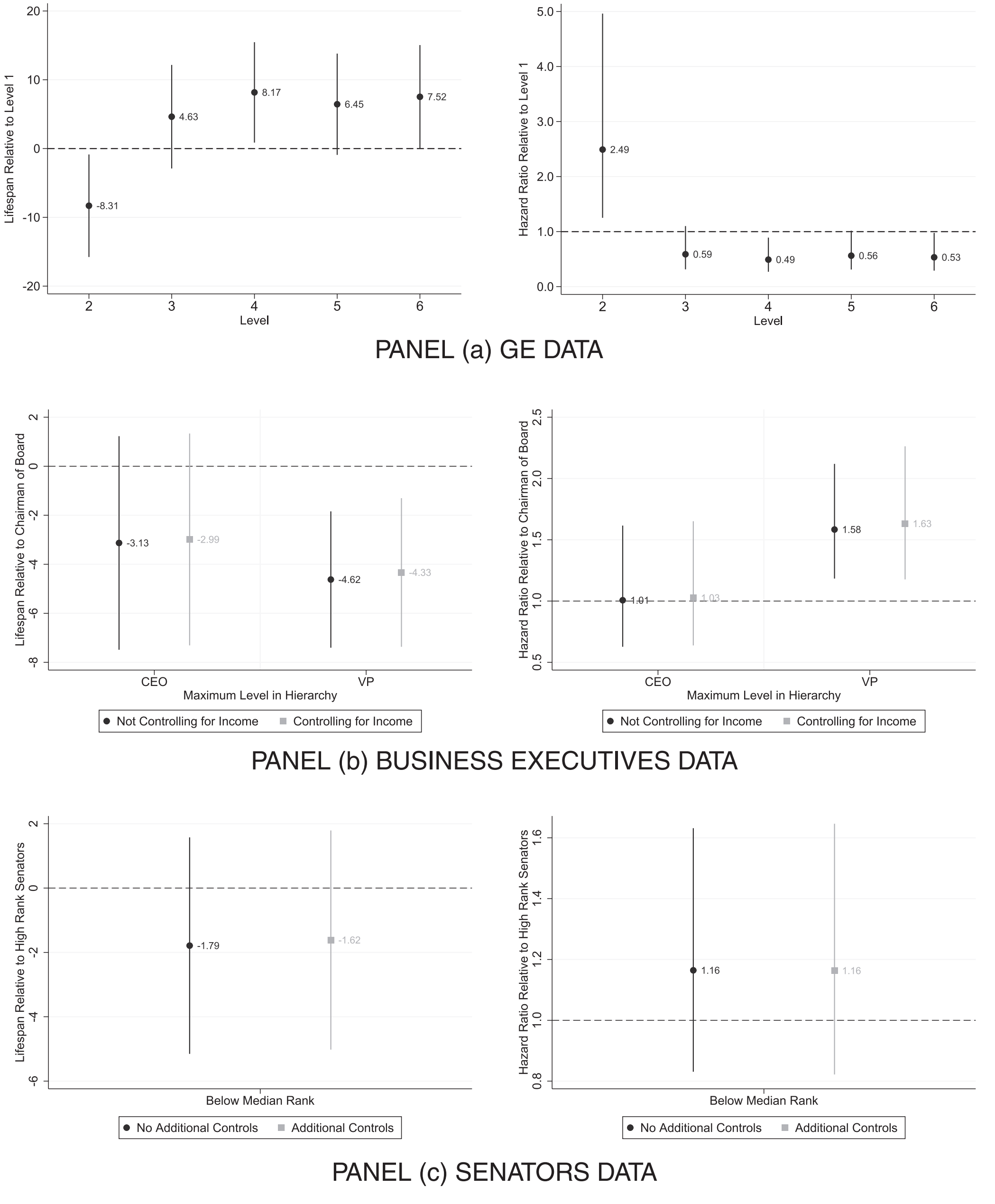

FIGURE 6 Estimates of lifespan differences by status. *Notes*: These figures show point estimates and 95 per cent confidence intervals from regressions of lifespan on status (OLS left column, Cox right column). Figure 6a uses the form in Equation (1). Status is measured by indicators for level in the hierarchy (e.g. vice presidents are level 2) with level 1 as the reference group. In figure 6b, status is measured using indicators for CEOs and vice presidents. The reference group is Chairman of the Board. In figure 6c, status is measured as an indicator for senator rank based on length of tenure in the US Senate. The indicator is coded 1 for senators with below median rank, so the reference group is high-ranking senators. The specifications in figures 6b and 6c use birth year fixed effects. Additional controls are maximum income from Frydman and Saks, 'executive compensation' in figure 6b, and indicators for political party and geographic region in figure 6c. *Source*: Author's own creation.

the reference category of level 1 – top executives in the firm. These specifications include a full set of SES controls and fixed effects used for the models in column 5 of table 3.

A striking result from figure 6 is the large variation in lifespan by status level. OLS models indicate that individuals in lower levels of the hierarchy (4, 5, and 6) lived between 6 and 8 years longer than individuals in level 1, with the difference being statistically different from zero for those in level 4. Hazard ratios from Cox models show a similar pattern, with half of the individuals in level 4 experiencing a mortality event at any point in time compared with the individuals in level 1. Of particular note is the mortality penalty at level 2. These individuals lived around 8 years less than their counterparts in level 1 (the OLS estimate), with 2.5 times as many experiencing a mortality event at any point in time compared with the reference group (the Cox estimate).

These represent large, but not implausible, mortality differences. Studies of the health effects of cigarette smoking in the United States in the 1950s, for example, showed that a heavy smoker in their 40s would lose about 7–8 years of life relative to a non-smoker.[78] Furthermore, as I show in figure 6b, the results pertaining to lifespan differences in the top level of the hierarchy are generalizable to using broader data on business executives active in the United States, suggesting that the results in 6a are not being driven by unrepresentative observations in small samples for GE.

Specifically, I traced the birth and death years for top executives in large US firms in the dataset compiled by Frydman and Saks for their study of managerial pay since 1936. These data include firms such as Du Pont, General Motors, and Westinghouse.[79] I obtained a measure of lifespan for 277 of the 289 individuals active from 1936 to 1939 (executives at GE do not enter the data until 1942). For 245 individuals I could identify their position in the hierarchy as chairman of the board, CEO, or vice president. I then followed these 245 individuals forwards in time in the data to establish their permanent status, defined as the maximum level they reached in the hierarchy. Frydman and Saks provide comprehensive compensation data for each individual over time. Mortality tends to decline with income, and snapshot income can be a poor proxy for life cycle income.[80] I therefore use maximum compensation as a control – the sum of remuneration, long-term pay, and option grants, as defined by Frydman and Saks. This exercise produced a dataset containing 86 Chairmen of the Board, 47 CEOs, and 112 vice presidents.

I also took the extra step of compiling data on a different comparison group of non-business elites, namely US senators, where status in the political hierarchy can be observed. This exercise is related to work by Borgschulte and Vogler and Barfort et al., who show that winning political office in the United States is associated with an increase in lifespan, while offering a different test to these studies based on the relationship between lifespan and status rank.[81] Senators are organized by rank according to the length of their consecutive service in the Senate, with rank being a key determinant of placement on the most prestigious committees.[82] I compiled data on members of the 71st to the 76th Congress spanning the 1930s, such as the GE and executives data. Since only men are included in these comparison datasets, I dropped the four women senators (Hattie Caraway, Rose Long, Dixie Graves, and Gladys Pyle), resulting in a dataset of 214 senators active during these years. For each, I obtained birth and death years as well as their party of affiliation

[78] Hammond, *Summary of the proceedings*.

[79] Frydman and Saks, 'Executive compensation'.

[80] Mazumder, 'Estimating the intergenerational elasticity'.

[81] Borgschulte and Vogler, 'Run for your life?'; Barfort et al., 'Longevity returns'.

[82] Groseclose and Stewart, 'The value of committee seats'.

and state. I followed these senators forwards in time to establish the maximum rank they ever achieved in the Senate as a measure of their permanent status.

Figure 6b,c presents point estimates and 95 per cent confidence intervals from OLS and Cox specifications. Three findings stand out. First, the mortality penalty associated with being a vice president in the GE data (Figure 6a) is also evident more broadly in US corporations. Vice presidents lived around 4–5 years less than their counterparts who rose to the position of Chairman of the Board, while the Cox estimates show their hazard of death was around 1.6 times higher over the life cycle (Figure 6b). For CEOs, the confidence intervals overlap with zero (OLS) or unity (Cox). Second, these effects are robust to controlling for variation in income, so income is not confounding the link between position in the hierarchy and lifespan, or distorting the estimates as a mediating variable driven by managerial rank. While additional income can insulate individuals from health risks, or soften the impact on health of stress-related work circumstances, the income-mortality gradient tends to be much flatter at higher levels of affluence. Indeed, some of the most convincing causal evidence on the relationship between wealth and mortality comes from a modern study of Swedish lottery players where the effect is a precisely estimated zero.[83] Third, in figure 6c, while the OLS coefficients are negative and the hazard ratios are above unity, there is no statistically significant mortality penalty for US senators with below median rank in the Senate, either in bivariate specifications or when controlling for party affiliation and geographic location.

Overall, these results provide suggestive out-of-sample evidence that the morality penalty identified in the second tier in the GE data holds in other corporate settings. And comparative evidence on political elites indicates that the relationship between status and lifespan appears to be working specifically through the structure of managerial hierarchies.

I now refocus on the GE data to examine differences in lifespan between upper and lower levels of the managerial hierarchy. Table 4, panel a reproduces all the specifications from table 3 using an aggregated status indicator, coded 1 for upper levels (1–3) and 0 for lower levels (4–6) of the hierarchy, which preserves an economically meaningful difference in the status ordering while allowing for estimation of lifespan differences on broader categories of the data.

Since the largest mortality penalty in figure 6a is associated with level 2 vice presidents, I also report results in table 4b from regressions dropping these individuals as potential outliers. Panel c reports results dropping individuals in levels 5 and 6, where any effect of sample selection by level would be most pronounced. Panel d restricts the sample to those over 40 years old to capture permanent status, closer to the apex of a career in the hierarchy. To rationalize presentation of the results, I report main coefficients only, suppressing the coefficients on the controls.

Across the OLS specifications in panel a, I find a negative relationship between lifespan and status in the managerial hierarchy of between 3 and 5 years for individuals in upper management positions. The largest mortality penalty is estimated in the most stringent specifications in columns 5 and 6 with SES controls and fixed effects for birth place, GE department, and birth year (column 5) or birth decade (column 6). Results from a median regression in column 7 produce a slightly larger mortality penalty at around 6 years. In column 8 the hazard ratio from the Cox model indicates that the hazard of death for upper management is 1.3 times that of lower-level employees.

In panel b, dropping level 2 vice presidents does nullify some of the estimates of lifespan differences. The OLS estimates in columns 1–4 become statistically insignificant, as does the hazard ratio from the Cox model in column 8. However, in column 5 – the most demanding specification

[83] Cesarini et al., 'Wealth, health, and child development'.

TABLE 4 Upper management relative to lower levels

	[1] OLS	[2] OLS	[3] OLS	[4] OLS	[5] OLS	[6] OLS	[7] Median	[8] Cox
	Panel a: all levels included							
Upper levels	−3.19**	−3.04**	−3.62**	−3.96***	−4.53***	−4.85***	−5.84***	1.32*
	(1.46)	(1.47)	(1.54)	(1.53)	(1.70)	(1.66)	(2.00)	[1.94]
Observations	1024	1024	1024	1024	1024	1024	1024	1024
R^2	0.05	0.05	0.06	0.06	0.08	0.05		
Mean of dependent variable	77.43	77.43	77.43	77.43	77.43	77.43	77.43	
	Panel b: dropping level 2							
Upper levels	−1.83	−1.62	−2.19	−2.55	−3.08*	−3.55**	−3.60**	1.18
	(1.53)	(1.54)	(1.59)	(1.57)	(1.71)	(1.69)	(1.78)	[1.13]
Observations	1009	1009	1009	1009	1009	1009	1009	1009
R^2	0.05	0.05	0.06	0.06	0.09	0.05		
Mean of dependent variable	77.53	77.53	77.53	77.53	77.53	77.53	77.53	
	Panel c: dropping levels 5 and 6							
Upper levels	−2.72	−3.29*	−2.95*	−3.15*	−2.97	−4.24**	−2.41	1.19
	(1.72)	(1.75)	(1.72)	(1.71)	(2.09)	(1.89)	(3.33)	[0.81]
Observations	256	256	256	256	256	256	256	256
R^2	0.23	0.24	0.24	0.25	0.34	0.15		
Mean of dependent variable	78.22	78.22	78.22	78.22	78.22	78.22	78.22	
	Panel d: over 40 years in 1930							
Upper levels	−4.02**	−4.01**	−2.73	−2.70	−3.11	−3.31*	−4.53**	1.26
	(1.65)	(1.67)	(1.74)	(1.77)	(1.92)	(1.86)	(2.27)	[1.23]
Observations	533	533	533	533	533	533	533	533
R^2	0.07	0.08	0.09	0.10	0.13	0.08		
Mean of dependent variable	78.35	78.35	78.35	78.35	78.35	78.35	78.35	
Birth year FE	Y	Y	Y	Y	Y	N	Y	Y
Birth decade FE	N	N	N	N	N	Y	N	N
Adult SES controls	N	Y	Y	Y	Y	Y	Y	Y
Youth SES controls	N	N	Y	Y	Y	Y	Y	Y
Birth place FE	N	N	N	Y	Y	Y	Y	Y
Department FE	N	N	N	N	Y	Y	Y	Y

Notes: Columns 1–6 are OLS estimates, and column 7 is an estimate from a median regression with robust standard errors in parentheses where the dependent variable is lifespan in years. Column 8 reports hazard ratios from a Cox model, with z-statistics in square brackets. Upper levels are a dummy variable coded 1 for levels 1, 2, and 3 in the managerial hierarchy and 0 for levels 4, 5, and 6. Panel a uses the full sample. Panel b drops individuals in level 2 of the hierarchy. Panel c drops individuals in levels 5 and 6 of the hierarchy. Panel d restricts the sample to those over 40 years of age in 1930 as a measure of permanent status in the hierarchy. $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.
Source: Author's own creation.

– the estimate implies about a 3-year-shorter average lifespan for individuals in upper-level positions, while the estimates in column 6 with birth-decade fixed effects implies a 3.6-year-shorter average lifespan, about the same as the median estimate in column 7. In panels c and d, dropping levels 5 and 6 individuals, or estimating on a sub-sample of individuals above 40 years who would have reached a more permanent position in the hierarchy by 1930, leads to a loss of sample size and power. But a statistically significant mortality penalty for upper-level leaders at GE is still evident in several specifications, again with a magnitude of 3–5 years.

As noted in section IV, estimates of lifespan differences in the hierarchy will be biased if individuals with death records are non-randomly selected by status rank. Dropping from the sample the lowest levels in the hierarchy (levels 5 and 6) where sample selection is most evident (see the distributions in figure 5) provides one adjustment (panel c of table 4). I present two further approaches: Heckman selection models and 10-year survival probabilities.

Starting with the Heckman approach, I use a by-product of the data collection exercise where I am more likely to observe death records for individuals who stayed locally to estimate selection models with an exclusion restriction. Specifically, I estimate a first-stage equation to predict selection with all the variables and fixed effects used in table 3 with an outcome variable coded 1 if the observation is only in the death records sample and 0 if it is in the sample linked to the 1930 census. The fitted inverse Mills ratio for each individual is then used in the second-stage model to correct for any sample selection bias from observing death years for some individuals but not others.

Identification requires a variable being added to the first stage that predicts selection into the sample but not lifespan (the exclusion restriction). I use a dummy variable set to 1 if an individual is listed in both the 1930 and 1940 GE directories and 0 otherwise because this variable predicts selection into the death records sample based on the results in table 2, but it is arguably unrelated to an individual's life expectancy. I assume that 'stayers' at GE could be positively or negatively selected on health, but remaining at the firm and in the local geographic area made their death records systematically more likely to be found in GE's archives or in the Schenectady cemetery records, for example. Although being listed across the directories may be associated with career progression – which would violate the exclusion restriction if promotion affects lifespan – I show promotion does not explain differences in longevity in the discussion of table 7, panel b below.

Table 5 reports the results using Heckman's two-step estimator. The first-stage selection equations are presented in appendix table A1. In these specifications, rho – the correlation coefficient between the error terms in the first- and second-stage equations – is negative, suggesting that the unobservables associated with an individual being included in the death records are negatively correlated with longevity. Several mechanisms could help to explain this result. Individuals with more tenacity, for example, might be healthier, more likely to live longer and leave the firm in the long-run, lessening the likelihood of being traced. Equally, less-healthy risk-averse individuals with a higher mortality risk may have stayed in the local labour market.

Sample selection means the OLS estimates in table 4 will produce downward (towards zero) biased estimates of the relationship between status and lifespan. The estimates in columns 1–5 of table 5, which correct for bias due to sample selection, imply that upper-level managers experienced about 7–9 fewer years of life relative to those in lower-level positions.[84] While this approach relies on strong assumptions for addressing sample-selection bias through the

[84] As an additional robustness check, I also re-estimated the model in column 4, dropping vice presidents in Level 2 of the hierarchy, leading to an estimate of the coefficient on the upper level dummy variable of −6.54 (z-statistic=2.25), or a shorter lifespan of 6.5 years.

TABLE 5 Selection models

	[1]	[2]	[3]	[4]	[5]
Upper levels	−7.58***	−7.43***	−8.12***	−8.42***	−8.73***
	(2.07)	**(2.08)**	**(2.08)**	**(2.23)**	**(2.19)**
Birth year FE	Y	Y	Y	Y	N
Birth decade FE	N	N	N	N	Y
Adult SES controls	N	Y	Y	Y	Y
Birth place FE	N	N	Y	Y	Y
Department FE	N	N	N	Y	Y
Observations	1519	1519	1519	1519	1519
Mean of dependent variable	77.43	77.43	77.43	77.43	77.43
Rho	−0.948	−0.952	−0.956	−0.917	−0.903

Notes: This table reports Heckman two-step selection models where the dependent variable in the second stage is lifespan in years. Upper levels are a dummy variable coded 1 for levels 1, 2, and 3 in the managerial hierarchy and 0 for levels 4, 5, and 6. The first-stage selection equation models selection into the death records sample ($n = 1024$) from the census link sample ($n = 1519$) (see appendix table A1 for the first-stage estimates). A dummy variable coded 1 for being in the 1940 GE directory and 0 otherwise is the excludable from the second-stage regression in all columns. Rho is the estimated correlation coefficient between the error terms in the first and second stage. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.
Source: Author's own creation.

exclusion restriction, the results are consistent with a large mortality penalty for upper-level managers and executives relative to those lower in the hierarchy.

As a second approach to addressing sample selection, I maximize use of the set of individuals linked to the 1930 census for whom I observe close matching rates by status level in the hierarchy (figure 5b), and therefore more limited sample selection bias by level. I estimate linear probability models for survival to 1940 using a proxy for survival: being traced between the 1930 and 1940 census under the assumption that those who could *not* be traced experienced death during the 1930–1940 interval. An individual is coded 1 for surviving if they can be linked in the censuses across time and 0 otherwise (figure 5a). I provide additional results where individuals who appear in the death records having died post-1940 are added to the code 1 group (figure 5b).

The mean of the dependent variable in columns 1–5 of table 6 panel a shows a baseline probability of survival of 0.399. That is around 40 per cent of the 1519 individuals in the 1930 *Organization Directory* who could be traced in the 1930 census 'survived' until 1940. The probability of survival for individuals in upper-level positions is lower by about 8 per cent to 15 per cent in columns 1–5 with various controls and fixed effects, with statistically significant coefficients in three out of the five regressions. For the remaining models, the probability of survival in the upper levels of the hierarchy is 15 per cent lower when dropping individuals in level 2 (column 6), 23 per cent lower when dropping individuals in levels 5 and 6 (column 7), and 13 per cent lower when restricting the sample to individuals who were above 40 years of age in 1930 (column 8).

Panel b shows results using the expanded definition of survival incorporating information from the death records as well as a dummy variable to capture these individuals. The baseline probability of 10-year survival is now 77 per cent, and it is significantly lower for individuals in upper levels of the hierarchy across all of the specifications. This set of results aligns with the main findings on the inverse relationship between status and lifespan reported in tables 4 and 5.

I now use the aggregated status indicator to estimate survival probabilities over the life cycle. The Whitehall studies found that the status mortality gradient flattened from pre- to

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TABLE 6 Survival to 1940

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
	Panel a: linked to 1940 census							
Upper levels	−0.087	−0.106**	−0.075	−0.152**	−0.148***	−0.148**	−0.225***	−0.130*
	(0.053)	(0.054)	(0.058)	(0.061)	(0.056)	(0.062)	(0.082)	(0.071)
Observations	1519	1519	1519	1519	1519	1503	333	791
R^2	0.041	0.058	0.131	0.077	0.053	0.077	0.248	0.075
Mean of dependent variable	0.399	0.399	0.399	0.399	0.399	0.401	0.345	0.350
	Panel b: linked to 1940 census and known death after 1940							
Upper levels	−0.127***	−0.132***	−0.104**	−0.139***	−0.135***	−0.113**	−0.113**	−0.140**
	(0.046)	(0.046)	(0.048)	(0.049)	(0.047)	(0.049)	(0.055)	(0.060)
In death records	0.540***	0.538***	0.552***	0.538***	0.540***	0.544***	0.510***	0.564***
	(0.023)	(0.024)	(0.025)	(0.024)	(0.023)	(0.024)	(0.065)	(0.034)
Observations	1519	1519	1519	1519	1519	1503	333	791
R^2	0.409	0.411	0.470	0.416	0.393	0.423	0.431	0.407
Mean of dependent variable	0.768	0.768	0.768	0.768	0.768	0.770	0.748	0.716
Birth year FE	Y	Y	Y	Y	N	Y	Y	Y
Birth decade FE	N	N	N	N	Y	N	N	N
Adult SES controls	N	Y	Y	Y	Y	Y	Y	Y
Birth place FE	N	N	Y	Y	Y	Y	Y	Y
Department FE	N	N	N	Y	Y	Y	Y	Y

Notes: This table reports coefficients from linear probability regressions where the dependent variable is coded 1 if an individual could be traced across the 1930 and 1940 censuses and 0 otherwise (panel a) or if an individual could be traced across the 1930 and 1940 censuses and had a date of death later than 1940, and 0 otherwise (panel b). Panel b includes a variable coded 1 for being in the death records and 0 otherwise. Columns 1–5 include all individuals, column 6 drops individuals in level 2 of the hierarchy, column 7 drops individuals in levels 5 and 6, and column 8 restricts the sample to those over 40 years of age in 1930. Robust standard errors are in parentheses. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.
Source: Author's own creation.

post-retirement, suggesting work-based factors such as self-esteem – which would impact individuals more during their working age – were driving adverse health outcomes for lower-ranked employees. Marmot and Shipley documented that the mortality rate for the lowest-grade employees was 3.12 times the rate for the highest grade in the civil service between 40 and 64 years of age, but this rate fell to 1.86 in post-retirement years (figure A2a).[85] Studies have generally found that health disparities by SES flatten after age 50 or 60 years.[86]

I estimate linear probability models of survival to age X following an estimation approach from the labour literature.[87] Specifically, I set X in Equation (2) to be between ages 50 and 100 years and restructure the dataset into a panel so that each individual is associated with 51 observations, one for each age-year inclusive. I then cluster the standard errors by person. Survival for individual i is coded 1 for survival to age X and 0 after. I use the same covariates and fixed effects from

[85] Marmot et al., 'Employment grade'.

[86] Galama and van Kippersluis, 'A theory of socio-economic disparities'.

[87] Clark and Royer, 'The effect of education'.

Equation (1). If those higher up experience greater longevity, a graph of the λ's for upper- relative to lower-level employees should produce an inverted-U shape over the life cycle of ages starting at zero and finishing at zero. With a mortality penalty at upper levels of the hierarchy, as suggested by the results discussed above, the estimates will be U-shaped.

$$\text{Survival}_i = \eta + \lambda_X \text{Upper Level}_i + \gamma \text{Youth SES}_i + \delta \text{Adult SES}_i + \phi D_i^{\text{BIRTH}} + \kappa D_i^{\text{BPLACE}} + \nu D_i^{\text{DEPT}} + \epsilon_i \quad (2)$$

Figure 7 plots the coefficients and 95 per cent confidence intervals of survival probabilities using the variables in the specifications in column 5 of table 4. That is, the survival probabilities are estimated conditional on a full set of SES controls and fixed effects (figure 7a) and are estimated dropping vice presidents in level 2 (figure 7b) and individuals at levels 5 and 6 (figure 7c). All display a U shape over the life cycle. Stress exposure can have immediate and long-term effects on health by impacting cardiovascular fitness, responses to autoimmune diseases, and psychiatric well-being, for example, making the link between life events and longevity challenging to identify temporally. These plots show a declining probability of survival at working ages from around the mid-to-late 50s, with the main driver of the negative lifespan effect occurring largely in post-retirement years.

I now turn to results using alternative measures of status based on the data from GE's camps and promotions. These results are important in what they reveal about the type of workplace mechanisms that might be associated with the mortality penalty. Camp General attendees are coded 1, and those who did not attend are coded 0, with promotions also specified as a categorical variable, with advancement in the hierarchy coded 1 and 0 otherwise. The correlation between these variables and the categorical variable measuring upper- versus lower-level positions is 0.40 and 0.07 for the camp and promotions variables, respectively, confirming the multidimensional nature of status, as well as raising the possibility that different status measures may give different results.

In table 7, panel a, I find a weak and statistically insignificant relationship between attendance at these prestigious networking and management training events and lifespan across the same set of specifications as used in table 4, panel a. Although the OLS and median regression point estimates are negative and the Cox model implies a higher hazard of death for camp attendees relative to non-attendees, the confidence intervals are wide, including positive and negative mortality effects.[88] Table 7, panel b shows that the relationship between promotions and lifespan is also statistically insignificant across these specifications. Although these regressions are estimated using all observations in the dataset – so they do not account for employment attrition – estimating only on the sample of individuals who stayed at GE does not lead to substantively different results. Replicating the specification in column 5 of panel b including only individuals in both the 1930 and 1940 *Organization Directory* ($n = 623$) produces a point estimate for the change in lifespan of those promoted of −1.72 years with a 95 per cent confidence interval of −5.42–1.98 years. Promotions would tend to correlate with unobservable attributes such as skill and cognition.

[88] I also exploit further variation in the Camp General data because employees could attend multiple camps as a symbol of their status at the firm; those with particularly high status, who attended the most camps, may have lived longer. Figure A5a plots OLS point estimates and 95 per cent confidence intervals at variable frequencies of attendance. All the confidence intervals overlap with zero. Figure A5b illustrates the same substantive finding using Cox models. Both sets of estimates indicate statistically insignificant lifespan differences by frequency of Camp General attendance.

THE ECONOMIC HISTORY REVIEW

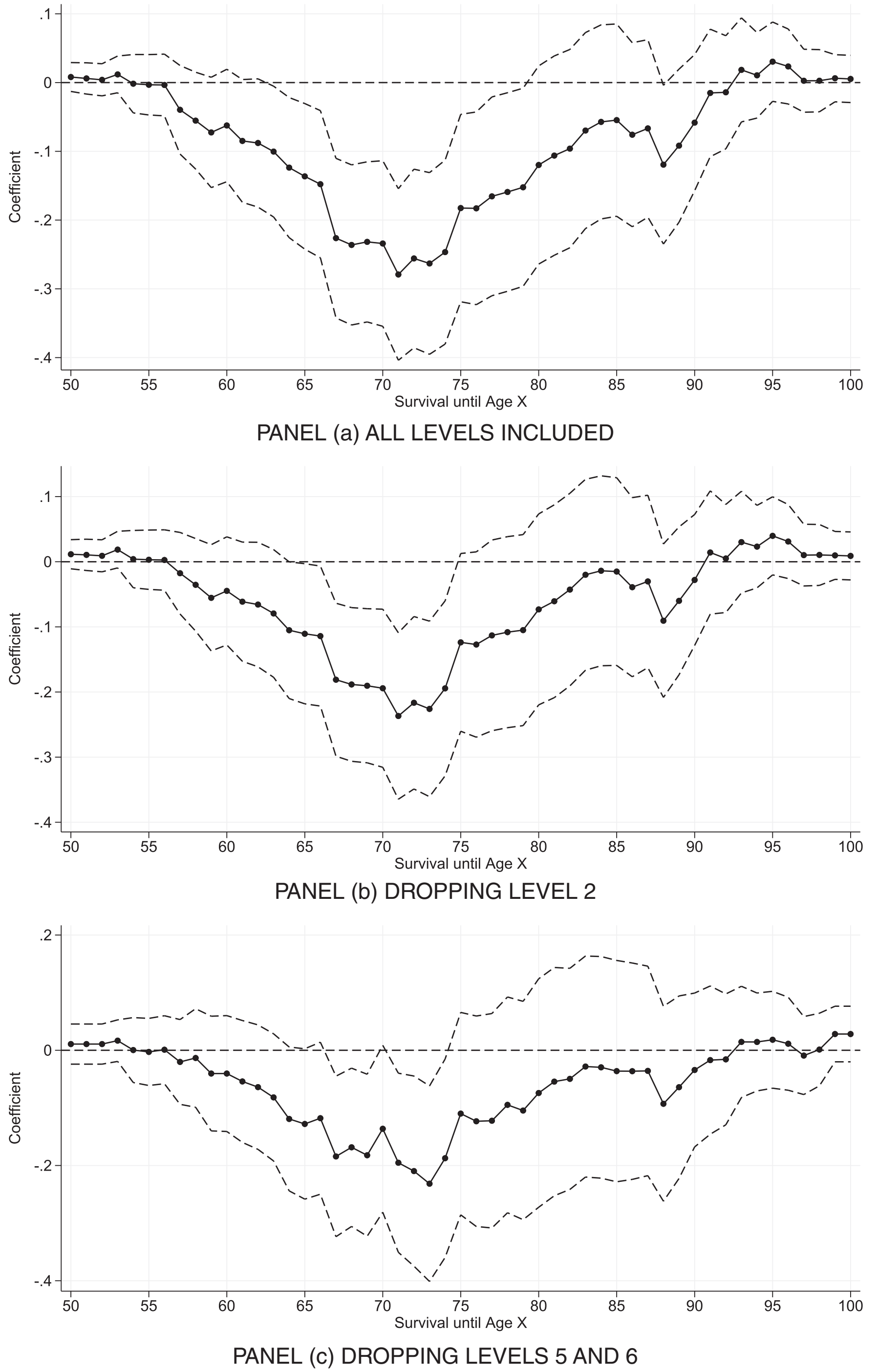

FIGURE 7 Survival probabilities: upper relative to lower levels of the hierarchy. *Notes*: These figures show the relationship between status and the probability of survival to a given age in a panel where each individual is associated with 51 observations, one for each age-year. Status is measured as a dichotomous variable for upper (levels 1, 2, and 3) relative to lower (levels 4, 5 and 6) positions in the hierarchy. Specifications use SES controls and fixed effects for birth year, birth place, and GE department. Standard errors are clustered by individual.
Source: Author's own creation.

TABLE 7 Camp General and promotions

	[1] OLS	[2] OLS	[3] OLS	[4] OLS	[5] OLS	[6] OLS	[7] Median	[8] Cox
	Panel a: Camp General							
Camp General	−0.37	−0.24	−0.54	−1.07	−0.58	−0.37	−0.58	1.05
	(0.91)	(0.92)	(0.93)	(0.97)	(1.03)	(1.01)	(1.01)	[0.60]
R^2	0.05	0.05	0.05	0.06	0.08	0.04	–	–
	Panel b: promotions							
Promotion	0.35	0.41	0.35	0.17	0.70	0.55	−0.63	1.02
	(1.75)	(1.74)	(1.74)	(1.77)	(1.81)	(1.70)	(2.41)	[0.15]
R^2	0.05	0.05	0.05	0.06	0.08	0.04	–	–
	Panel c: all status variables							
Upper levels	−3.72**	−3.63**	−3.99**	−3.96**	−4.71***	−5.17***	−5.60***	1.32*
	(1.64)	(1.65)	(1.71)	(1.68)	(1.79)	(1.74)	(2.13)	[1.83]
Camp General	0.67	0.76	0.48	−0.06	0.28	0.61	1.14	1.00
	(1.02)	(1.03)	(1.02)	(1.06)	(1.08)	(1.06)	(1.12)	[−0.02]
Promotions	0.80	0.85	0.80	0.58	1.02	0.84	−0.12	1.01
	(1.78)	(1.78)	(1.77)	(1.81)	(1.80)	(1.70)	(2.61)	[0.09]
R^2	0.05	0.05	0.06	0.06	0.08	0.05	–	–
Birth year FE	Y	Y	Y	Y	Y	N	Y	Y
Birth decade FE	N	N	N	N	N	Y	N	N
Adult SES controls	N	Y	Y	Y	Y	Y	Y	Y
Youth SES controls	N	N	Y	Y	Y	Y	Y	Y
Birth place FE	N	N	N	Y	Y	Y	Y	Y
Department FE	N	N	N	N	Y	Y	Y	Y
Observations	1024	1024	1024	1024	1024	1024	1024	1024
Mean of dependent variable	77.43	77.43	77.43	77.43	77.43	77.43	77.43	–

Notes: Columns 1–5 are OLS estimates, and column 6 is an estimate from a median regression with robust standard errors in parentheses where the dependent variable is lifespan in years. Column 7 reports hazard ratios from a Cox model, with z-statistics in square brackets. The Camp General variable is coded 1 if an employee attended one of General Electric's management training camps and 0 otherwise. The 'Promotion' variable is coded 1 if an employee was promoted to a higher level at General Electric between 1930 and 1940. Upper levels are a dummy variable coded 1 for levels 1, 2, and 3 in the managerial hierarchy and 0 for levels 4, 5, and 6. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.
Source: Author's own creation.

Promotion movements throughout the hierarchy from one level to the next are not explaining the link between status and lifespan.

Finally, panel c uses all three status measures – upper versus lower positions in the managerial hierarchy, Camp General attendance and promotions – in the same 'horse race' regression. Both the Camp General and promotion effects remain imprecisely estimated, as would be expected based on the results in panels a and b. The estimated mortality penalties associated with being in the upper echelons of GE management are of a similar magnitude to those estimated in table 4, panel a. The persistence of this mortality penalty, when controlling for alternative measures of status, suggests the factors driving the relationship between mortality and rank operated principally through the distinction between upper and lower levels of the managerial hierarchy.

V | DISCUSSION AND POTENTIAL EXPLANATIONS

Across a wide range of specifications, I find that top-level managers in the hierarchy at GE lived relatively shorter lives than their lower-ranked counterparts. The effects are non-monotonic with a particularly large mortality penalty in the second tier of the managerial hierarchy (figure 6a), which generalizes across US corporations (figure 6b). This contrasts with the famous Whitehall studies, where mortality risk declined systematically with higher status. I focus on three potential explanations for these counter-intuitive results: country-specific differences in the gradient in health, occupational sorting and the structure of hierarchies, and stress-related theories of lifespan.

One explanation for these contrasting findings is that different country contexts drive differences in mortality outcomes. Yet, both the United States and United Kingdom have experienced common trends in the social gradient in health over the long run, so it is unlikely that country-specific differences would matter. The coronary heart disease epidemic, driven by smoking and dietary shifts towards foods high in processed carbohydrates and sugars, peaked in both countries between 1960 and 1970. Although professional workers in the United States by the mid-twentieth century had relatively low mortality rates compared with their UK counterparts, in other ways overall mortality profiles were strikingly similar across these two countries.[89] Rates of occupational mobility in the United States had also converged on UK rates around this time.[90]

Another explanation would be differences in occupational sorting and the structure of the respective hierarchies. Bureaucracies tend to be characterized by different career incentives to private organizations.[91] As such, the recruitment of top civil servants in the United Kingdom was rife with patronage and privilege, whereas a private firm like GE would have operated more as a meritocracy. Institutions like Whitehall may be driven by relational hierarchies, whereas market-based competition in corporations may invert the connection between status and mortality. Following controversial insights in the biology literature discussed in section I, stable dominant hierarchies – such as the civil service – tend to place less strain on those at the top, as their positions are less likely to be under threat from those lower down. Corporate hierarchies, by contrast, are inherently more unstable, as individuals face intense competition for positional rewards. In that sense, we may not expect the Whitehall effect to generalize to this setting because the structure of the hierarchies was so fundamentally different. If the structure of the hierarchy does matter, the causal relationship between status and job strain may be insufficient to explain the socioeconomic gradient in health.

Indeed, the changing mortality penalty by type of hierarchy – business versus political – shown in figure 6 is particularly informative in this regard. There is limited evidence of lifespan differences by status orderings for US senators (Figure 6c), but stronger evidence of differences by rank for top executives in corporate hierarchies (figure 6b). Unlike in the GE data, I do not observe individuals lower down in the hierarchy in this broader corporate data, but the large dip in estimated longevity for vice presidents is suggestive about the non-monotonic psychosocial drivers of lifespan differences among top-level executives. Research on the psychology of emotional response by Medvec et al. using evidence from Olympic contests illuminates potential mechanisms,

[89] Kitagawa and Hauser, *Differential mortality*.

[90] Long and Ferrie, 'Intergenerational occupational mobility'.

[91] Bertrand et al., 'The glittering prizes'.

showing that bronze medallists are much happier than silver medallists.[92] For a bronze medallist, the reference point is no medal at all, whereas for a silver medallist the emotional burden is much higher, as the cost of a gold medal foregone. By the same token, vice presidents lost out in the contest for career progression, being situated in the hierarchy a layer below the top.

Modern-day studies suggest that senior executives face taxing work schedules and that stress loads can significantly curtail lifespan.[93] Although my findings do not pinpoint causal pathways given all the complex interrelationships between SES factors and health and between stressful life circumstances and mortality, they are consistent with stress-related theories of lifespan in corporations. Hierarchies allow able managers at the top to conserve effort on routine tasks by exploiting the time of less able agents lower down.[94] At GE, however, upper-level managers occupied particularly testing positions. Executives were said to 'put in all kinds of hours ... come in at night, come in in the morning, come in at the weekends ... in their attempt to climb the hierarchy of GE management'.[95] Social connectedness, family support, or membership of alternative social hierarchies can provide protection from stress-related diseases, but opportunities for avoidance strategies were limited because the corporate hierarchy was so instrumental to societal rank at this time. In William Whyte's influential 1956 book on life and the demands of American firms – *The Organization Man* – managers and executives are so dedicated that they sell their souls to the corporation.

Top executives at GE faced managerial stress caused by factors such as stock market volatility and uncertainty associated with the Great Depression, union demands, antitrust, and dislocations due to the Second World War. The health literature indicates that psychological stress can have detrimental causal effects on cardiovascular and immune-system health, so it would be natural to expect a correlation between job stress and mortality at GE in this context. In the influential Karasek model of 'job demand-control' in the organizational behaviour literature, workers face negative well-being consequences if their tasks are demanding but they lack decision authority.[96] Vice presidents at GE were exposed to severe occupational stress and diminished control. I estimate the largest mortality penalty for these individuals in table 3, implying the possibility of negative health effects in upper tiers of the hierarchy.

VI | CONCLUSION

This paper has explored the link between status and mortality using novel data that can replicate in a leading US firm many of the characteristics of the famous Whitehall studies of mortality risk by rank. Managerial hierarchies had diffused widely during the early twentieth century, leading to stratification of employees by level. Consequently, I can systematically group white-collar workers at GE by their occupational positions. Despite similarities with Whitehall civil servants in terms of race, lifestyle, education, work environments, low employment turnover rates, and access to health care, I find results that contrast with the positive relationship between status and lifespan in Whitehall. Higher-ranked employees at GE were more susceptible to a shorter

[92] Medvec et al., 'When less is more'.

[93] Bandiera et al., 'CEO behavior'; Borgschulte et al., 'CEO stress and life expectancy'.

[94] Garicano and Rossi-Hansberg, 'Organization and inequality'.

[95] Schatz, *The electrical workers*, p. 237.

[96] Karasek 'Job demands'.

lifespan with a striking non-monotonicity in the mortality gradient in the second tier of the organizational structure. With numerous SES controls and fixed effects constructed from the census and from GE's archives, the estimates attempt to isolate the relationship between workplace status and lifespan. The findings are consistent with explanations linking mortality to the concentration of stress-levels in layers of the managerial hierarchy. Limitations of the analysis include a lack of information on health and behavioural indicators such as differences in smoking rates that may interact with occupational stress and influence mortality. SES tended be inversely associated with smoking at this time, but with a moderated gradient for heavy smokers.[97] Unobservables such as genetics and the presence, or absence, of coping mechanisms may also be correlated with selection into rank and health outcomes. I have not modelled this form of selection, which would be necessary to make causal inferences.

The results therefore provide a basis for further economic history research in the wider arena of overall mortality reductions in the United States during the twentieth century. Most of the literature, so far, has focused on improving our understanding of the impact of factors such as health shocks or nutrition and disease on resource constrained groups.[98] This study has shown that individuals well above the poverty threshold, but lower down in the organizational structure of GE, experienced surprisingly positive trends in their life expectancy relative to the mortality penalty experienced by those higher up. Given the growing availability of digitized personnel records and historical census data, it would be interesting to explore the way in which social status affects health in other corporate hierarchies, and the extent to which Whitehall-like gradients might be more likely to be observed in bureaucracies.

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[97] Haenszel et al., *Tobacco smoking*.

[98] Costa, 'Health and the economy'; Schneider, 'Fetal health stagnation'; Shaw-Taylor, 'An introduction to the history of infectious diseases'.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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