Hierarchies or Markets?
The Survival of POWs during WWII

Clifford G. Holderness*

Jeffrey Pontiff*

December 2008

Using a database of virtually all American prisoners of war (POWs) during World War II, we examine for the first time how hierarchy affects success. We find that survival declines as the hierarchy of a prisoner's group more closely matches the military population and as it becomes steeper. Those in the most hierarchical groups were 20% less likely to survive than those in the least hierarchical groups. This holds for alternative groupings of prisoners and for both Germany and Japan, even though prisoners of Japan were far more likely to die. One explanation consistent with survivors' accounts is that trading among prisoners was beneficial, but the military's hierarchy impeded markets.

JEL Classification: D23

Keywords: Hierarchy, centralization, decentralization, markets

---

* Boston College (clifford.holderness.1@bc.edu and pontiff@bc.edu). We thank Justin Martin for research assistance. This paper has benefited from the comments of Bruce Kennedy, Alan Marcus, Harold Mulherin, Matthew Rhodes-Kroph, Edward Rice, Dennis Sheehan, and seminar participants at Boston College, Hanken School of Economics, Harvard Business School, Helsinki School of Economics, SIFR, University of Toronto, and William & Mary.

December 2008

Hierarchies or Markets?
The Survival of POWs during WWII

I. Introduction

In a world of scarcity some means must be found to allocate resources. Although economists have traditionally focused on the price mechanism, it is not the only way to allocate resources. Coase's (1937) seminal insight is that at times production through organizations will be more efficient than production through markets. Organizational production involves the coordination of individuals through a hierarchy. Commands, not market prices, are the dynamic forces of hierarchies.

Hierarchical organizations, of course, extend far beyond for-profit companies. They range from churches to charities; from government agencies to religious orders; from universities to armies. Given the importance of hierarchies, economists are studying them with increasing frequency, but almost always from a theoretical perspective. As Rajan and Wulf (2006, p. 759) report, there are but a handful of empirical investigations of hierarchies.[1]

In this paper we provide the first systematic evidence of the impact of hierarchies on success. Using database of virtually all American soldiers, sailors, and Marines held prisoner during World War II, we investigate how the hierarchy of a prisoner's group affected the probability of his survival. Military data is well-suited for studying hierarchies, both because the rank of each soldier is unambiguous and because the protocol for interaction among soldiers is well established. For many other types of organizations, in contrast, it is often unclear who takes orders from whom. We know the ranks of virtually all 120,000 prisoners, and POW camps during World War II were

[1] Among the prominent theoretical papers on hierarchies are Aghion and Tirole (1997), Bolton and Farrell (1990), Calvo and Wellisz (1979), Garicano (2000), Hart and Moore (2005), Radner (1992), Rajan and Zingales (2001), Sah and Stiglitz (1986), and Williamson (1967).

organized hierarchically. If a soldier disobeys the lawful commands of his superiors, even in captivity, the consequences can be severe. For these reasons, the survival of POWs presents a well-situated, high-stakes natural experiment on the value of hierarchy.

A wide range of empirical investigations points to an unambiguous and, on the surface, surprising conclusion—the survival of American POWs during WWII was not enhanced by hierarchy. Indeed, many investigations imply that more complete and steeper hierarchies were associated with lower survival rates. This holds both for Japan and Germany, even though the unconditional probability of an American dying in Japan was twelve times greater than the probability of dying in Germany. It also holds for different aspects of hierarchies; different measures of the same aspect of a hierarchy; different groupings of prisoners; and for a group of prisoners that were effectively randomly captured and assigned to POW camps, airmen shot down over occupied Europe.

We explore three possible explanations for the negative relation between hierarchies and survival. The data reject the hypothesis that although hierarchies may have been detrimental to POWs on average, they were beneficial with those groups where hierarchies should be most beneficial, namely with larger groups. In fact, hierarchies had a more negative effect in larger groups than in smaller groups. The data likewise reject the hypothesis that the military's hierarchy focused on the survival of officers, not on the survival of men in general. In fact, the survival rate of officers was lower than the survival rate of enlisted men.

The accounts of survivors of the POW camps, however, suggest a third explanation that is consistent both with the evidence and with several existing theories of hierarchies. Prisoners often sought to trade amongst themselves and occasionally with guards and the local population. Some superior officers sought to suppress these trades, at times on the grounds that they were not in the prisoners' best interests and at times on the grounds that they subverted military protocol. The more complete was the military's hierarchy, the more effective this suppression apparently became, and the

lower was the prisoners' survival rate. In sum, the military's centralized hierarchy appeared too inflexible to permit the decentralization necessary for markets to function. This interpretation is consistent with the theoretical conjectures of Sah and Stiglitz (1985) and Stiglitz (1991) that hierarchies developed for one purpose (fighting battles, in our case) are often too inflexible to adapt for another purpose calling for a more decentralized structure (surviving captivity).

Our paper offers several contributions. It is the first paper to examine the relationship between hierarchies and success, and it is the first paper to compare hierarchies of widely different group sizes. To conduct these investigations, we develop two measures of hierarchies which can be used to measure the shape and steepness of hierarchies in other settings. We also join Costa and Kahn (2007) as the only economic studies of POW survival. Costa and Kahn do not study hierarchies but rather how social networks affected the survival of Union prisoners during the American Civil War. Finally, we offer some of the first systematic evidence for theoretical considerations proposed in the literature relating hierarchies to the speed of decision-making, the nature of organizational information, and the type of agency problems.

II. American Prisoners of War during World War II

Approximately 120,000 Americans were held as prisoners of war during the Second World War. This represents over 90% of the Americans who were POWs at any point during the Twentieth Century. In contrast, only 725 American were held prisoner during the Vietnam War.[2] The fate of an American prisoner during World War II depended very much on whether he was held by Germany or by Japan.[3]

---

[2] U.S. Department of Veterans Affairs, Office of the Assistant Secretary for Policy, Planning, and Preparedness, *Former American Prisoners of War* (POWs), April 2005.

[3] We use the masculine pronoun throughout the paper because essentially all POWs were male.

A. Germany

The United States declared war on Germany on December 11, 1941, an act that was in question until Germany, somewhat unexpectedly, first declared war on the United States. Initially, there were few prisoners because there was little military action between the two countries. The first U.S. air raid in Europe occurred on July 4, 1942. Most of the early prisoners were airmen who were shot down over occupied Europe. The number of prisoners increased once the United States and its allies invaded North Africa in November 1942 (Operation Torch). The first major action of Operation Torch was the Battle of Kasserine Pass in February and March of 1943, where the untested American forces were no match for the veteran Afrika Korps led by Field Marshall Erwin Rommel; a large number of Americans were captured as a consequence. This can be seen in **Figure 1**, which is a timeline of the capture of American soldiers by Germany.

The number of POWs increased again with the Allied invasion of Sicily in July 1943, followed two months later by the invasion of the Italian mainland. The number of prisoners further increased with the Allied invasion of France on D-Day, June 6, 1944. The largest capture of Americans in the European Theater occurred during the Battle of the Bulge, which was fought in the Ardennes area of Belgium from mid-December 1944 to late January 1945. Two of the three regiments of the 106th Infantry Division surrendered early in the battle after being surprised by the German attack. Among the thousands of prisoners from this battle was perhaps the most famous American POW of the war, at least in retrospect, Kurt Vonnegut (who is in our database). By the end of the war almost 100,000 U.S. soldiers were held by Germany.

Throughout the war the processing of American POWs (and other Western soldiers) by Germany remained the same.[4] Immediately following capture, the prisoner was sent back by the capturing combat unit, first to a gathering center, next to a transit

[4] For a review of the German processing of American prisoners, see Spiller (1998) or Vourkoutiotis (2003).

camp (Dulag), and eventually to a POW camp (Stalag). Downed airmen were first held by the capturing military body or local police and then transferred to interrogation centers run by the German Air Force, the Luftwaffe. Eventually, they too were transferred to POW camps, although these camps were run by the Luftwaffe and not the German Army (the Wehrmacht). There were 188 camps that held Americans. The largest held 8,418 Americans; the smallest held a single American. Most of the camps and the vast majority of the prisoners were in Germany proper (pre-1939 borders). The camps were spread throughout the country in accordance with pre-war German military districts. Prisoners generally were assigned to the camp closest to the point of their capture. Thus, for example, those captured in Italy were generally assigned to camps in Southern Germany. Airmen were assigned to the camp that was closest to where their planes crashed.

The camps were under the ultimate authority of the German High Command (OKW) but were administered for most of the war by the Reserve Army Command. This branch of the German Army consisted mostly of older soldiers and replacement soldiers for combat units. In addition to their duties at the POW camps, they were active in air defense and testing new weapons. Members of the Reserve Army played a central role in the July 20, 1944 attempt to assassinate Adolf Hitler. One of its officers, Claus von Stauffenberg, planted the bomb that nearly killed Hitler. A general of the Reserve Army, Friedrich Olbricht, was a key organizer of the conspiracy. Both Stauffenberg and Olbricht were hanged within hours of their ill-fated attempt. A key part of the conspiracy was to mobilize the Reserve Army. Eventually, Friedrich Fromm, head of the Reserve Army, was executed for his failure to uncover the conspiracy even though in an apparent effort to save himself he ordered the executions of Stauffenberg and Olbricht. The failed plot had implications for American POWs as well. Because of the deep involvement of the Reserve Army in the attempted coup, in September 1944 Adolf Hitler transferred control of all POW camps to the Schutzstaffel. The Schutzstaffel, or SS as it was widely known, also controlled the concentration camps, in this case from their inception in the 1930s.

Although historians have concluded that American POWs were treated relatively well by Germany, it was nevertheless a precarious situation.[5] For instance, even though the Geneva Convention (which was signed and ratified by both Germany and the United States) requires that "the food ration of prisoners of war shall be equal in quantity and quality to that of troops [of the detaining power] at base camps," food rations for Western prisoners, nevertheless, were reduced by one-third starting in December 1941.[6] There are also documentations of Hitler personally lobbying for harsh treatment for Allied POWs, typically execution. For instance, it was revealed at the Nuremberg Trials that the SS at the personal behest of Hitler executed 47 re-captured escapees from the "Great Escape."[7] This occurred before the July 20th assassination attempt; the threat to American POWs increased further once the SS took control of the camps.[8] Approximately 3% of the American POWs held by Germany died before being liberated by the advancing Allied armies in late April and early May 1945. The number of deaths, 2,402, exceeds the American deaths at either Pearl Harbor or on D-Day.

B. Japan

The situation with Americans held prisoner by Japan was different from the situation in Germany in several dimensions. First, as seen in **Figure 2**, most of the

---

[5] Vourkoutiotis (2003) is perhaps the most exhaustive scholarly work. He concludes that Germany largely followed the Geneva conventions with respect to Western prisoners. In contrast, German treatment of Soviet prisoners was brutal. It is estimated that over half of all Soviet prisoners died during German captivity; in contrast, only 5% of the Anglo-Americans prisoners died. Schulte (1990, p. 181).

[6] Vourkoutiotis (2003) p. 55.

[7] See Keitel and Jodl testimony in International Military Tribunal, Trial of the German Major War Criminals (Nuremberg, 1946-1949) 11, 34-38. Field Marshall Wilhelm Keitel was Chief of the High Command of the German Armed Forces during the war. Alfred Jodl was Chief of the Operations Staff of the Armed Forces High Command during the war. Both were hanged as war criminals at Nuremberg.

[8] For instance, Joseph Goebbels, Hitler's propaganda minister, suggested to Hitler in February 1945 that Allied POWs be executed in equal numbers to the German civilians who died in the fire bombing of Dresden. Approximately 100,000 civilians died in that raid. Hitler did not accede to that recommendation, but in March 1945 he did order that downed airmen be shot upon capture. The SS officer charged with enforcing this order, Ernst Kaltenbrunner, did not enforce it, apparently because the war was almost over. MacKenzie (1994) pp. 494-495.

prisoners were captured early in the war. On the same day that Japan bombed Pearl Harbor, it also invaded the Philippines, a key military base for the United States since the Spanish American War.[9] The Japanese invading force quickly over-ran the north of the country, and General MacArthur concentrated his forces on the Bataan Peninsula in Manila Bay. After a spirited defense, the U.S. troops in the Philippines surrendered in March and April of 1942. An estimated 90,000 to 100,000 U.S. and Filipino troops began their forced marched to a series of POW camps throughout the Philippines and beyond. This became known as the Bataan Death March. Approximately 80% of the American POWs held by Japan were in the Bataan Death March.

Americans and other Western soldiers held by Japan during World War II were treated with extreme brutality. Some attribute this to the Japanese military ethic based on a Bushido tradition which demanded absolute devotion of all soldiers and viewed surrender, whether by its own troops or those of its enemies, as an extreme disgrace. The growing xenophobia in Japan prior to the war apparently exacerbated this tradition. Moreover, although Japan signed the Geneva Convention, it never ratified it. In any event, General Hideki Tojo (war minister and premier) announced in April 1942 that the Allied prisoners would be made to "share" in the sufferings of the Japanese people through forced labor. Tojo told his POW camp commanders that "we have our own ideology concerning prisoners-of-war which should naturally make their treatment more or less different from that in Europe and America."[10] Whatever may have been the origins of the treatment of the POWs, there is wide agreement that "for the hundreds of thousands of Allied POWs in camps throughout Asia, this attitude,

---

[9] The attack on Pearl Harbor, of course, occurred on December 7th, while the invasion of the Philippines occurred on December 8th. Both attacks occurred at the same time, however, because the Philippines is on the other side of the International Date Line.

[10] Quoted in MacKenzie (1994) p. 514. After the war Tojo was found guilty of (among other charges) "ordering, authorizing, and permitting the inhumane treatment of Prisoners of War (POWs) and others." He was executed in 1948.

when coupled with the prevailing Japanese contemptuousness toward surrender and the rigors of the captors' disciplinary code, resulted in an existence that varied from the harsh to the intolerable."[11]

C. Hierarchies and POWs

Some readers may imagine POWs being held in small cells and permitted only limited contact with others, like high-security civilian prisons today. Although this may describe how Americans were held during the Vietnam War, it does not describe how POWs have traditionally been held and it certainly does not describe how Americans were held during the Second World War. During the Second World War most Americans were held in camps surrounded by barbed wire and armed guards. The organization of the prisoners, however, was largely delegated by the detaining power to the U.S. military, with enlisted men and officers being held in the same camps.[12]

Although conditions of the prisons differed between Germany and Japan on several accounts, one similarity was the importance of maintaining the military's hierarchy among the prisoners. The Code of the U.S. Fighting Force makes this chain-of-command clear: "If I become a prisoner of war, I will keep faith with my fellow prisoners. I will give no information or take part in any action which might be harmful to my comrades. If I am senior, I will take command. If not, I will obey the lawful orders of those appointed over me and will back them up in every way."[13] One reason for this chain-of-command approach was to help ensure that the prisoners would survive captivity to fight another day.

The military's hierarchy figures in the accounts of many former POWs. As one POW of the Germans writes, "our senior officer was [a colonel]. His duties were to run

---

[11] MacKenzie (1994) p. 515.

[12] Only 3% of the POWs in our database were in camps without any officers; even fewer prisoners (less than 1%) were in camps with only officers.

the compound and he was our contact with the German Luftwaffe, who ran the camp. … The camp was operated like a military base."[14] A prisoner from another camp similarly writes, "if the Germans wanted something changed in the POW camp, they would issue an order to Colonel Packer [the senior American officer in the camp]. If it was reasonable, he would issue orders down the line and get the change made. If he thought it was unreasonable, he would refuse, and they would put him in solitary confinement. That's where he stayed most of the time."[15]

Because of the way soldiers were captured by the Japanese, the initial organization of prisoners was chaotic. As one survivor of the Bataan Death March remembers, "We were all mixed up—privates, officers … just a jumbled mass of humanity."[16] Those who made it to a camp found the beginning of the re-emergence of the military's hierarchy: "The place [Camp O'Donnell in the Philippines] was organized very simply. You picked where you wanted to lie down and that became yours. Officers or senior noncoms selected the men for work details."[17] Eventually, the situation reverted to the established hierarchy: "At Davo [a POW camp in the Philippines] we lived in eight long one-story bungalows or barracks. … Each barracks had a ranking officer in charge, maybe a lieutenant colonel, and each bay had a bay leader, the ranking guy who would be in charge of the seven others in the bay."[18]

---

[13] Code of U.S. Fighting Force, Section IV (a). The Code formalizes long-standing policies of the U.S. military. It was signed into law by President Eisenhower.

[14] Reminisces of Technical Sergeant Gordon K. Butts (POW from April 17, 1944 to May 7, 1945) in Spiller (1998).

[15] Reminisces of 2nd Lieutenant Carl W. Remy (POW from September 28, 1944 to May 1, 1945) in Spiller (1998).

[16] Reminisces of Captain Mark M. Wohlfeld (POW from April 1944 to August 1945) in Knox (1998), p. 127.

[17] Reminisces of Private Jack Brady (POW from April 1944 to August 1945) in Knox (1998), p. 161.

[18] Reminisces of Lieutenant Hadley Watson (POW from April 1944 to August 1945) in Knox (1998), p. 252.

III. Data and Summary Statistics

A. Data

The core data for our analyses come from the World War II Prisoners of War Data File, which is available from the National Archives of the United States.[19] This electronic database contains information on U.S. military and civilians who were held captive by other governments at any point between December 7, 1941 and November 19, 1946. The database contains records on approximately 129,000 American POWs. This appears to encompass the vast majority of American POWs during World War II. We know of no other database of comparable size, electronic or otherwise, of POWs from any nation from any conflict.

Details of how the data were originally collected influence our empirical investigations and what inferences we are able to make; as such, the collection of the data merits some discussion at this point. Reports on individual POWs originated when the U.S. government learned that one of its citizens was being held by a foreign power. The report usually came from the International Committee of the Red Cross, which during the war routinely sent lists of POWs to the Office of the Provost Marshall General of the Department of War. (The Department of War was the predecessor to the Department of Defense.) Occasionally, the initial reports came directly from the detaining government or from the U.S. military's interception and decoding of enemy communications.

The Office of the Provost Marshall General (Prisoner of War Information Bureau) would then notify the POW's next-of-kin and pass what information it had along to the Office of the Adjutant General, Machine Records Branch. This top-secret unit, which was also part of the Department of War, was charged with the task of keeping accurate personnel records during the Second World War. During the First World War, the U.S. military had a poor estimate of its troop strength and almost no reliable data on the

[19] http://aad.archives.gov/aad/series-description.jsp?s=644.

location or status of its troops. The Machine Records Branch was the response to this problem. Punched card work done by the Machine Records Branch is widely considered to be pivotal in the development of the modern computer.[20] As one observer remarks, "the procedures and processes used by modern computers are much the same as those in the old punch card systems."[21]

The Machine Records Branch would take the information it received on the captured American and combine it with tabulated information it already had on the individual. This latter information was part of the Machine Records Branch's broader effort to generate monthly reports on the personnel strength of the U.S. armed services worldwide. The records that survive and which we use in this research generally

---

[20] The history of the POW data used in this paper is fascinating. Its history arguably begins with the U.S. Census of 1880. At that time, there were no tabulation machines of any type (obviously there were no computers), so all data had to be hand tabulated. Information from the 1880 census had taken eight years to tabulate. With the rapid growth in U.S. population at this time, there was an understandable fear that the 1890 census would take more than ten years to process, which would present practical problems given the role of the census under the U.S. Constitution for allocating seats among the states to the House of Representatives. A young worker at the Census Bureau, Herman Hollerith, was charged with addressing this problem. His superior suggested that the census information be recorded numerically. Hollerith's key insight was that if numerical information could be punched in specific locations on stiff cards, the cards could then be sorted and counted mechanically. Accordingly, Hollerith borrowed J. M. Jacquard's 1804 pasteboard method for automatic weaving and adapted it to create what was then known as a tabulator but has since become known as key punch entry of data. This method of data entry will be familiar to readers of a certain vintage. Hollerith received a patent for this machine in 1889. With this machine, initial results of the 1890 Census were available after only six weeks, even though the country's population had increased from 50 million to 62 million. Complete processing of the data took a mere three years. Hollerith left the Census Bureau to start a company to commercialize his machine. Eventually, his company was renamed as the International Business Machine Corporation.

In spite of the great success of the tabulation machine in processing census data, the government, in general, and the military, in specific, was slow to adopt it in other settings. As late as April 1940 the entire military had only one punch-card machine. Eventually, the military undertook a crash effort to remedy this situation so it could have accurate records on the status and location of what it expected to be a large number of soldiers. By July 1942 there were forty-four punch-card machines. Eventually, mobile units were formed that followed the troops into battle. They were essential to the monthly production of *Analysis of the Present Status of the War Department*. These reports, which included the POW data we use, were classified as "Top Secret"; only 86 copies were printed for distribution. For more on this history, see Gladwin (2000).

[21] Province (2008).

contain the following information: the individual's name, his serial number, rank at the time of capture, arm of service (Army, Navy, Marine, Merchant Marine, civilian, or war correspondent), unit, date of capture, place of detention (typically a POW camp), the prisoner's state of residence, his race, and whether he survived captivity.

We add information from another, much larger National Archives electronic database, the World War II Army Enlistment Records.[22] This database contains information on 9.2 million enlisted personnel who joined the United States Army between 1938 and 1946. Typically, these records contain the following information: the individual's name, his serial number (which is how we merge it with the POW database), state of residency, place of enlistment, country of birth, age, race, civilian occupation, years of education, whether the enlistee has dependents, and his height and weight.

Our database has its pluses and minuses. On the plus side, the database is large, seemingly encompassing virtually all American POWs during World War II. These records were crucial to the war effort, hence considerable resources were devoted at the time to ensure their accuracy. An archivist who has worked with the records writes, "the value of IBM machines to the war effort was clearly proven each and every time the troop basis or analysis was printed. These machines allowed the Office of the Chiefs of Staff to plan and to direct men and material where they were needed, when they were needed. The Machine Records Units and their machines won the logistical battles that helped win World War II."[23] Today, the records are extensively used by veterans and their families for genealogical research. We cross-checked the accounts of individual POWs (some of which we have already quoted) with our database and found the database in most instances to be in accordance with the POWs' own, post-war accounts.

---

[22] http://aad.archives.gov/aad/series-description.jsp?s=3360&cat=GP23&bc=sl.

[23] Gladwin (2000).

There are, however, some limitations. The most prominent is that the Enlistment Database is limited to enlisted personnel in the Army who joined between 1938 and 1945. Accordingly, it does not include individuals who joined the service as officers, all sailors and Marines, and those who joined the Army prior to 1938.[24] (During World War II the Air Force was part of the Army.) The Enlistment Database does, however, include both those who joined voluntarily and those who were drafted.[25] We are able to match approximately 55% of the POWs with the Enlistment Database. (There were approximately 16 million individuals in the armed services during this period; the Enlisted Database encompasses 9.2 million individuals.) The enlistment data provides useful independent variables for understanding POW survivorship, yet we do not want to restrict our analyses to POWs who are in the enlistment database. Using the same method employed by Costa and Kahn (2007) and Pontiff and Woodgate (2008), we assign missing independent variables as having a value of zero and create dummy variables that take the value of one if the associated variable is missing. This allows us to use all of the data without distorting the slope coefficients of the independent variables.

An additional limitation is that we do not know if a POW was wounded at the time of capture. If a POW died during captivity, we do not know when he died. Although we know the first camp where a POW was held, we do not know if he was subsequently moved to another camp. POWs who died before entering a camp are not in our database. Thus, our database does not include POWs who were summarily executed on the battlefield or who died during the Bataan Death March.[26]

---

[24] It does, however, include six individuals who joined as enlisted men but later became officers.

[25] E-mail from Lee A. Gladwin of the National Achieves, April 14, 2008.

[26] It is doubtful better data will become available. A 1973 fire at the National Archives in St. Louis destroyed an estimated 80% of the Army's personnel records for those discharged between 1912 and 1960. The fire also destroyed many Navy and Marine personnel records. The National Achieves reports that "no duplicate copies of the records that were destroyed in the fire were maintained, nor was a microfilm copy ever produced. There were no indexes created prior to the fire."

(footnote continues next page …)

Because we are interested in the impact of hierarchies on survival, we impose several filters. We exclude from our analyses civilians (779), those detained by neutral powers (2,132) or by unidentified powers (3,204), and those for whom it is not known if they survived captivity (269). The final sample consists of 122,765 POWs, 93,666 of whom were held by Germany and 29,099 held by Japan.

B. Summary Statistics

Table 1 reports summary statistics, first for all prisoners and then broken out by Germany and Japan. (All data items in the paper are defined in **Table 2**.) Prisoners' age, height, and weight are similar between Germany and Japan. The differences between Germany and Japan stem largely from the fact that most of the Japanese prisoners were captured early in the war with the rapid fall of the Philippines (Figure 2), one of the few overseas bases of the U.S. military. Many of these POWs were career military and thus less likely to be married than those who joined later and were captured by the Germans. The fall of the Philippines also explains why a greater percent of prisoners were held outside of Japan proper, although some of those captured outside of Japan (including some captured in the Philippines) were assigned to camps inside of Japan. The most striking differences are the table's first two statistics. The unconditional probability of dying while being held by Japan was twelve times the probability of dying while being held by Germany. The execution rate speaks for itself.

IV. Four Issues with Hierarchies

Hierarchy determines how decision rights are partitioned among individuals in an organization. Some individuals, for instance, initiate proposals, while others ratify or veto proposals (Fama and Jensen 1983). Coordinators are often senior to specialists (Hart and Moore 2005). The price mechanism plays a limited role with hierarchies

---

http://www.archives.gov/st-louis/military-personnel/fire-1973.html. The Enlistment Database was pieced together by the National Archives from a variety of records as a response to the St. Louis fire.

(Jensen and Meckling 1992). Resources are instead allocated largely by command and control. We have found it helpful to frame the analysis of hierarchies through four separate yet related issues.

A. Shape of a Hierarchy

One issue with hierarchies is the configuration or shape of how decision rights are allocated among individuals in an organization. The simplest hierarchy has only two levels. Much of the theoretical literature addresses such a hierarchy by adopting a principal-agent framework. But most hierarchies have more than two levels; with these hierarchies, the shape of the hierarchy becomes a relevant issue. Often a hierarchy is pyramidal, as with most armies or the Roman Catholic Church. Hierarchies do not have to be pyramidal, however. For instance, an hour-glass hierarchy would have a committee at the top which delegates implementation of its orders, first to a single administrator and then to lower-level subordinates.

B. Steepness of a Hierarchy

When a hierarchy is pyramidal, as with the case of the military, we can analyze its steepness (flatness). A pyramidal hierarchy typically means that those higher in the hierarchy have the right to control certain actions of those lower in the hierarchy. The few existing empirical studies of hierarchies focus on whether the pyramidal hierarchies at select firms have become steeper or flatter over time (Rajan and Wulf 2006 and Scott et al 1996).

C. Allocation of Decision Rights

Organizations can have the same shaped hierarchy but a different allocation of decision rights. A comparison of the U.S. Army with the Soviet Red Army during the Second World War illustrates this point. Assume that the U.S. and Red Armies had the same percent of generals, colonels, privates, etc. In other words, assume that the two armies had hierarchies with the same (pyramidal) shape and steepness. In the U.S. Army, most decision rights were delegated by those at the top of the hierarchy to those lower in the hierarchy. Thus, President Roosevelt ordered General Eisenhower to defeat Germany, but the details on how to accomplish this were delegated to him. Eisenhower

subsequently delegated most of these decision rights down the chain of command. Stalin, in contrast, reserved more of the key decision rights for himself. For instance, as the Red Army fought its way into Berlin in the spring of 1945, Stalin prohibited one of his two armies from getting any closer than 300 yards from the Reichstag building. The prize of capturing the symbolic heart of the Third Reich was allocated at the last minute by Stalin to Marshall Zhukov.

D. Punishment and Reward System

Hierarchies can have the same allocation of decision rights, but a different punishment and reward system. Again, a comparison of the U.S. Army with the Red Army illustrates the point. The U.S. military executed only one of its own during the Second World War (and this was the first military execution since the Civil War). Beevor (1998, p. ii) reports that the Red Army executed approximately 13,000 of its own soldiers during the Battle of Stalingrad alone. Scholars estimate that over 150,000 Soviet soldiers were executed for dereliction of duty during the Second World War. Obviously, the U.S. and Red Armies had very different punishment systems.[27]

V. Core Empirical Analyses

A. Two Measures of Hierarchy

Our data enables us to address two of the four issues associated with hierarchies: the shape of a hierarchy and, given that the military's hierarchy is pyramidal, the steepness (flatness) of a hierarchy. Existing research offers little guidance on measuring these features; in part, because there has been so little empirical research on hierarchies, and in part because the few existing studies focus on changes in the steepness of the upper levels of a hierarchy at the same organization.

---

[27] It is little wonder that Marshall Georgy Zhukov, victor of Stalingrad and conqueror of Berlin, observed, "It takes a very brave man to be a coward in the Red Army."

This can be illustrated with the three of the few empirical papers on hierarchy, Rajan and Wulf (2006), Guadalupe and Wulf (2008), and Scott, O'Shaughnessy, and Cappelli (1996). All three papers use survey data from management consulting firms to study whether the steepness of the hierarchies has changed over time. From a sample of 300 large firms, Rajan and Wulf show that the number of managers who report directly to the CEO has increased over time, but the number of positions between the CEO and the division heads has decreased over the same period. Guadalupe and Wulf (2008) use the same data and measures of hierarchy; they conclude that hierarchies have flattened over time in part because of trade liberalization. Scott et al. study four levels of employees at 11 insurance companies. Like Rajan and Wulf, they document that the hierarchy of these firms has flattened over time, although they do not offer an explanation as to why. Given that all three papers study pyramidal hierarchies, their inquiries make sense. (They would make no sense if the firms, say, had hour-glass hierarchies.) Because most of their firms had not changed substantially in size over the period of their analysis, these studies did not have to address the relationship between organizational size and the steepness of a hierarchy. In contrast, our groups range from a single soldier to almost 9,000 soldiers. Rajan and Wulf, Guadalupe and Wulf, and Scott et al. only study a portion of each firm's employees. Rajan and Wulf as well as Guadalupe and Wulf limit their analysis to the higher levels of a firm's hierarchy, whereas Scott et al. place employees into four categories. We, on the other hand, want to analyze a group's hierarchy from top to bottom.

We develop two measures, *Relative Hierarchy*, which measures the shape of a hierarchy, and *Absolute Hierarchy*, which measures the steepness of a hierarchy. During the war, the U.S. military established a hierarchy it thought best for winning the war. We report the shape of this hierarchy (and the survival rate of each rank) in **Table 3**. Presumably, the shape of this hierarchy reflected both the military's assessment of the optimal organization of troops and its assessment of each soldier's qualifications to carry out the responsibilities associated with his rank. *Relative Hierarchy* measures the squared deviation of a group of POWs relative to the shape of this established

hierarchy.[28] We re-scale this measure for two reasons. First, for ease of interpretation of regression results, we want an increase in the index to represent a movement toward the established hierarchy. Second, to facilitate comparisons, we scale this index to be consistent with the scale of our other hierarchy index, namely a range of one unit. The following measure ensures these properties:

$$Relative\,Hierarchy = 1 - \left(\frac{1}{1.319}\right)\sum_{Rank=1}^{9}\left(Group\,Fraction - Population\,Fraction\right)^2$$

Relative Hierarchy has a maximum value of 1, which occurs for a group of prisoners with the same proportion of each rank as is found in the military at large. *Relative Hierarchy* has a minimum value of 0, which occurs for a group of prisoners comprised entirely of generals.

Our second measure, *Absolute Hierarchy*, uses the Gini index to assess the inequality in ranks among a group of prisoners. *Absolute Hierarchy* measures the steepness (flatness) of a hierarchy. Such an inquiry makes sense in our case because the prisoners' hierarchies were basically pyramidal. Each soldier in a group of n men is indexed by *indiv*, which is in non-descending order of rank. $Rank_{indiv}$ is the rank value of the soldier, where privates are assigned a value of 1, corporals a value of 2, and so on up to generals who are assigned a value of 9.[29]

$$Absolute\,Hierarchy = 1 + \frac{1}{n} - \left(\frac{2\sum_{indiv=1}^{n}\left(n+1-indiv\right)Rank_{indiv}}{n\sum_{indiv=1}^{n}Rank_{indiv}}\right)$$

A group of prisoners of the same rank would have no hierarchy, that is no steepness, and hence an *Absolute Hierarchy* of 0. As a group becomes more hierarchical because more ranks are represented, that is as the hierarchy becomes steeper, the index

---

[28] Ideally for this relative measure, we would use the percentage of soldiers in each rank from the population of American troops during World War II. We have been unable to find this data, so instead we use the percentage of soldiers in each rank from the population of American POWs during World War II.

[29] In robustness tests we instead use pay grades to assign weights.

increases. The most hierarchical group would have an *Absolute Hierarchy* of 1. This would occur with a group of one general commanding an infinite number of privates.

Relative Hierarchy and *Absolute Hierarchy* share two desirable features. First, both can compare hierarchies of different sizes. Second, both consider the complete hierarchy of an organization. Because of these features, we believe the two indices can be used to study hierarchies in other settings.[30] **Table 4** reports the *Relative* and *Absolute Hierarchies* of six hypothetical groups of prisoners.

B. Hierarchical Groups

We must select a group of prisoners to measure its hierarchy. Here again because of the paucity of empirical research on hierarchies, there is no obvious choice. Our first choice is a prisoner's cohort, which we define as those prisoners who enter a given POW camp during the same month. We make this choice because Costa and Kahn's (2007) evidence from the Civil War, as well as WWII survivors' accounts, indicate that those who enter a camp at the same time sometimes have a pre-existing relationship which continues through captivity. When there is no pre-existing relationship, those who enter a camp together often ended-up associating together, much as those who enter college together often end-up associating together. Our second choice for a hierarchical group is a POW's camp. Although a POW's closest relationships may often be within his cohort, the chain of command runs to the senior POW in the camp. In robustness tests we consider hierarchical groups that incorporate prisoners' pre-capture military units.

Table 5 summarizes the *Relative Hierarchy* and *Absolute Hierarchy* for the prisoners' cohorts and camps. The (unreported) correlation coefficient between the two hierarchy measures, for either cohorts or camps, is approximately 0.85, with the correlations being

[30] Indeed, Weiner and Solbrig (1984) recommend that biologists use the Gini Index (the basis of our *Absolute Hierarchy*) to compare size hierarchies among plant populations.

somewhat higher for Germany than for Japan. The lowest correlation coefficient, 0.73, is between *Relative* and *Absolute Hierarchies* for the Japanese camps.

C. Controls

In regressions we control for non-hierarchical factors that are likely to affect survival. The most obvious control is whether a prisoner is held by Germany or Japan. Initially, we use a dummy variable for this control; later we conduct regression analyses separately for Germany and Japan. Other controls account for cohort, camp, and POW characteristics. These include the number of individuals in the camp, the number of individuals in the cohort (when appropriate), the distance from the camp to the relevant national capital (Berlin or Tokyo), the date of the prisoner's capture, his height, age, years of education, whether he has dependents, and finally whether he was an officer at the time of capture. In robustness tests we control for additional individual characteristics. All control variables are defined in Table 2.

D. Key Empirical Results

We use the following probit model to estimate the probability of a prisoner's survival:

$$Pr_i\ (S = 1) = \Phi\ (\beta_1 H_i + \beta_2 C_i + \beta_3 I_i + Japan_i + \varepsilon_i)$$

where *Pr* is the probability that prisoner *i* survives captivity; *H* measures prisoner *i*'s hierarchy using either *Relative Hierarchy* or *Absolute Hierarchy*; *C* is a vector of prisoner *i*'s cohort or camp (such as the size of his cohort or the location of his camp); *I* is a vector of individual-level variables applicable to prisoner *i* (such as his height and age); *Japan* is a dummy variable that takes a value of one if the prisoner is held by Japan and zero otherwise; and ε_i is an error term.[31] In all instances we report the marginal effects of a probit regression at the means of the independent variables. Because error terms tend to

[31] Remember that if a prisoner dies in captivity, our data do not record when he dies. Thus, we are unable to estimate any type of hazard model.

be correlated by camp (perhaps reflecting an unmeasured camp-level influence such as the harshness of the camp commander or the availability of food), all regressions use heteroscedastic robust standard errors that are calculated by clustering observations by camp.

Table 6 presents the key empirical findings of the paper. There are eight regressions: four measure a prisoner's hierarchy relative to the hierarchy established by the U.S. military during WWII (*Relative Hierarchy*), and four measure the steepness of a prisoner's hierarchy (*Absolute Hierarchy*). For each of these measures, in turn, we alternatively examine the impact of the hierarchy of a POW's cohort and camp on his survival. Finally, for each of these categories, we present both a parsimonious specification (with only a Japan dummy as a control) and a more complicated specification with additional controls.

The hierarchy coefficients are negative and significant in all eight specifications in Table 6. At the highest level, these findings imply that the probability of survival declines as the hierarchy of a POW's group gets closer to the shape of the hierarchy established by the U.S. military or as the POW's hierarchy becomes steeper. These findings are not only statistically significant, but practically important as well. For instance, a prisoner in a cohort with a *Relative Hierarchy* that is in the top quartile of all cohorts is 26% less likely to survive than a prisoner in a cohort with a *Relative Hierarchy* that is in the bottom quartile. A prisoner from a camp that is in the top quartile in *Absolute Hierarchy* is 25% less likely to survive than one from the bottom quartile.[32]

Although the findings on the non-hierarchical, control variables are ancillary to our primary focus, several are worthy of note. The most salient finding, of course, is that a prisoner held by Japan is far less likely to survive than one held by Germany, from ten to twenty-seven percentage points depending on the specification. This means that a

[32] These are the implied probabilities from second and eighth regressions of Table 6, respectively.

prisoner held by the Japanese was eight to twelve times more likely to die than a prisoner held by the Germans. Survival also decreases with the distance of the prisoner's camp from the detaining power's national capital (perhaps reflecting an agency problem in controlling the camp commanders), his age, and surprisingly with his education.[33] Conversely, survival increases when a prisoner had dependents. One interpretation is that men who marry are healthier and thus more likely to survive captivity. Another and not mutually exclusive interpretation is that prisoners with dependents are more motivated to survive.

VI. Alternative Explanations, Robustness Tests, and Extensions

A. Germany and Japan Separately

Our previous regressions use a dummy variable to distinguish Germany from Japan. It is possible that this does not fully capture the difference between the two countries, especially in light of the very different survival rates (97% versus 64%). Accordingly, we start our robustness tests in **Table 7** and **Table 8** by replicating the previous analyses separately for Germany and Japan. This division of the data offers no evidence that hierarchy aids survival. The hierarchy coefficients in Table 7 and Table 8 remain universally negative. They are always statistically significant with Germany. The hierarchy coefficient is also negative and significant for Japan with probably the most telling specification, the multiple regression involving the *Relative Hierarchy* of a prisoner's cohort. This regression suggests that soldiers held by the Japanese in the most hierarchical cohorts are three percentage points more likely to die than soldiers held in the least hierarchical cohorts (when calculating the implied probabilities from the top and bottom quartiles of hierarchies).

In unreported analyses, we are unable to reject the hypothesis that either the shape or the steepness of a hierarchy had a more beneficial effect on survival in Japan than in

---

[33] Some survivors speculate that a tough upbringing, which is likely to be negatively correlated with years of education, helped in the battle for survival. Hasting (2007) p. 367.

Germany. This is noteworthy in that several theories posit that hierarchies become more valuable as emergencies intensify, and the situation with Japan was obviously more dire than it was with Germany.[34]

B. Air Force POWs in Germany

Our analyses to this point do not address soldiers who were captured randomly or assigned to cohorts and camps randomly. Consequently, it is possible that we have overlooked endogenous factors that bias our results. For instance, it is possible that units with weaker hierarchies are more likely to surrender early in battle and thus have fewer injuries than those units with stronger hierarchies that fight longer and thus suffer more injuries before surrendering. Similarly, it is possible that soldiers from stronger hierarchies are assigned to camps with tougher commandants, perhaps for security reasons. Both possibilities would explain the negative relation between hierarchies and survival, but in neither case would the lower survival rate result from hierarchies during captivity.

There is one group of American POWs during World War II, however, that although not captured and assigned to cohorts and camps randomly come close, airmen captured by Germany. Randomness enters in several ways. First, as documented in **Figure 3**, there was not the lumpiness in their capture as there was in the Pacific or in land battles in Europe (in particularly, the battles of Kasserine Pass and the Bulge).[35] More importantly, which planes in a formation happen to be attacked by fighter planes, hit by anti-aircraft shells, or experienced mechanical failures was largely random. As one airman wrote, "the flak gunners simply seemed to have our number."[36] Once a

---

[34] For example, Bolton and Farrell (1990) and Hart and Moore (2005).

[35] Captures of airmen peaked as the air war intensified with the preparation for D-Day. Thereafter, the extensive deployment of the technically superior P-51 Mustang overwhelmed the Luftwaffe's fighter force.

[36] Reminisces of 2nd Lieutenant Carl W. Remy (POW from September 28, 1944 to May 1, 1945) in Spiller (1998).

plane was hit, some crashed over their targets, while others would fly for hundreds of miles before crashing. Because of the regional nature of the German POW system, airmen were held where they happened to crash, not where their planes were initially hit. Thus, which airmen were captured and where they were held would both seem to be largely random.

Table 9 replicates our core analyses (two measures of hierarchy, two measures of a POW's group) using only U.S. Army Air Force personnel held by Germany. The results are remarkably similar to the full sample results. In all eight regressions the coefficient for hierarchy is negative and at least marginally significant. Given the random situation with these airmen, these results would seem to rule out unmeasured endogenous factors that influenced survival.

C. Hierarchies Based on Pre-Capture Units

To this point we group prisoners, alternatively, by when they enter a given POW camp (cohort) and by just the camp itself (camp). These groupings do not reflect the prisoners' units before their capture. Perhaps the pre-existing hierarchy from a unit continues into captivity, and it is this hierarchy that aides in survival. To explore this alternative explanation, we define two new groups: first, those POWs who are from the same unit and enter the same camp during the same month (a revision of Cohort); second those POWs who are from the same unit and are in the same camp regardless of when they enter the camp (a revision of Camp). We estimate the same regressions as in Table 6 for these two new groups and present the results in **Table 10**. The revised hierarchy coefficients are invariably negative and are statistically significant in all specifications save one.

D. Social Networks as an Alternative Explanation

Costa and Kahn (2007) is the one other paper to address the survival of POWs. They study the survival of Union soldiers held captive during the American Civil War. Their primary finding is that survival was enhanced by social networks, which they define as the number of other prisoners in the same camp from the same pre-capture unit (which they define as friends). Because Civil War regiments were typically formed on a state

basis, men often knew each other before the war. They view their findings as supportive of the social identity theory, which holds that one's welfare is advanced by associating with similar people.[37]

In order to assess whether our results are driven by the social network effect documented by Costa and Kahn, we first replicate (but do not report) the Table 6 regressions by substituting the number of friends (defined as the number of prisoners from the same pre-capture unit in the same camp) for the measure of hierarchy. In the parsimonious specification (with the only other control being a Japan dummy), the coefficient for friends is negative and insignificant. In the multiple regression, it is negative and significant (*p*-value of less than 0.01). We find the same thing when we use the natural log of the number of friends. When we break our results out by Germany and Japan, friends (measured either as logs or non-logs) is negative and highly significant in all regressions. Finally, to ascertain if our hierarchy results might be sensitive to inclusion of friends, we add friends to all Table 6 regressions. The hierarchy coefficient remains qualitatively unchanged in all instances. That is to say, social networks do not seem to enhance survival.

We are not sure what explains the difference between our findings on social networks and those of Costa and Kahn. Accounts of those who survived POW camps during the Second War World echo the accounts of those who survived POW camps during the Civil War on the importance of friends in the battle for survival. This is especially true of those held in Japanese camps.[38] The difference between the two wars may reflect that membership in the same company during the Civil War meant more than membership in the same unit during the Second World War, for two reasons. First, a Civil War company on average had only about 100 men. Second World War military

---

[37] For instance, Akerlof and Kranton (2000) (2005) or Alesina and LaFerrara (2000).

units were typically much larger. Anthropologists have found that once a group gets beyond 150 members, it begins to lose cohesion.[39] Second, as previously mentioned, during the Civil War most combat regiments were formed on a state basis: the 20th Maine, the 44th New York, the 83rd Pennsylvania (to cite just three Union regiments that were engaged in the Battle for Little Round Top at Gettysburg). Men often knew each other before enlisting; in fact, friends would often enlist together so they could stay together. The U.S. military had largely abandoned the practice of state or territorial units by the time of the Second World War. As a consequence U.S. soldiers in the Second World War were far less likely to have associations that pre-dated their military days than were their Civil War counterparts.

E. Additional Robustness Checks

Alternative Measures of Hierarchies. We calculate alternative versions of both of our hierarchy measures. For the *Alternative Relative Hierarchy*, we use the ratio of each rank (in a cohort or camp) divided by the ratio of the same rank as established by the military (Table 3):

$$Alternative\,\mathrm{Re}lativeHierarchy = 1 - \left(\frac{1}{10{,}000}\right)\sum_{Rank=1}^{9}\left(\frac{GroupFraction}{PopulationFraction} - 1\right)^2$$

Alternative Relative Hierarchy, like the original measure, attains a maximum value of one if each rank is represented with the same proportion as the entire armed forces. Compared with the original measure, however, the alternative measure places more

---

[38] As one survivor of the Bataan Death March said, "I was very fortunate in that I had a buddy. We helped each other." Reminisces of Sergeant Mel Madero (POW from April 1942 to September 1945) in Knox (1998), p. 129.

[39] The noted evolutionary anthropologist Robin Dunbar has theorized that 150 is the upper limit to the size of a human group in which each individual can maintain stable social relationships with all other members of the group. Dunbar (1993). This is known as Dunbar's number. Fox (1985) applies this concept to other areas, including the tragedy of the commons. The tragedy of the commons is the phenomenon of over-using and eventually destroying resources for which exclusionary rights have not been assigned, for which there is open access.

weight on hierarchical imbalances that are associated with higher-ranking officers. For the *Alternative Absolute Hierarchy*, we use the pay grade of the various ranks during World War II.

We re-estimate (but do not report) all relations in Table 6, Table 7, and Table 8 using these two alternative measures. The basic finding remains unchanged: hierarchy is never positive and significant; it is usually negative; and in some specifications it is negative and significant.[40]

Specification Checks. Finally, we conduct a variety of specification checks. We measure group size by non-logs instead of logs. We test for non-linearities in the impact of hierarchy on survival. We use dummies for all of the POWs' ranks instead of just an officer dummy, and we use pay instead of dummy variables to control for the rank of a prisoner. Finally, we exclude executions because a strong hierarchy could have an ambiguous impact on the frequency of executions. In the scores of robustness tests, the bottom line remains unchanged: There is no evidence that hierarchy aids the survival of POWs. There is, however, considerable evidence of the opposite.

VII. Hierarchies and Survival

We conclude by discussing why the survival of American POWs during the Second World War was not enhanced by the military's hierarchy. The three possibilities discussed below do not exhaust the possible explanations. Moreover, we lack the data to test the last explanation in any formal way. What follows should, therefore, be viewed as an exploratory analysis and as a guide for future research.

A. Hierarchies and Group Size

One explanation for our basic result could be that although hierarchies may have a negative impact on survival in general, hierarchies will be beneficial in large groups in

[40] The most noteworthy change is with Alternative Absolute Hierarchy. The coefficients change little with this measure, but the statistical significance usually declines, and results are often insignificant.

which the hierarchy is more complete. Hierarchies organize people; the more people there are, the more important the organization of those individuals should be.

In **Table 11** we add a term to all of our key regressions (Table 6) in which we interact the pertinent hierarchy variable with the (log of) number of men in either the cohort or camp. If this explanation is correct, a relatively complete hierarchy will be more beneficial in a large group of men than in a small group. In other words, the interactive term will be positive.

We find this not to be the case. The interactive term in Table 11 is always negative, and it is statistically significant with both cohort regressions involving *Relative Hierarchy*. When we separate the data between Germany and Japan (not reported), the interactive term is almost always negative. Whenever it is statistically significant, it is negative. When we do not use an interactive term but limit our analyses to cohorts or camps of at least (alternatively) 50 or 100 men (neither reported), the basic results (Table 6) involving hierarchy do not change qualitatively.

B. Hierarchies and the Survival of Officers

Another explanation for our basic result could be that the objective of the military's hierarchy during captivity is not to aid the survival of soldiers in general but to aid the survival of officers in particular. Such a policy could facilitate rebuilding of military units. This is why the Germans flew key officers out of the Stalingrad encirclement. Some of these officers played prominent roles later in the war; others were instrumental in building the Bundeswehr, the post-war West German army. Alternatively, preservation of the officer corps could simply reflect agency problems: officers using their authority to expropriate camp resources intended for lower-ranked men.

To investigate the relation between hierarchy and the survival of officers, we interact the hierarchy measures with the officer dummy in **Table 12**. The results are inconsistent with the theory that the military's hierarchy favors the survival of officers. To the contrary, the interactive term is always negative, suggesting that an officer's survival declines with either his *Relative* or *Absolute Hierarchy*. In several specifications, this relation is statistically significant.

Here as well we conduct robustness tests. Specifically, we interact a prisoner's pay (instead of the officer dummy) with the hierarchy measures. This should help identify if the military's hierarchy was intended to preserve non-commissioned officers as well as officers. We also conduct all of our tests for Germany and Japan separately. There is no evidence in any of these investigations that the military's hierarchy favored the survival of officers, but there is considerable evidence to the contrary.

C. Centralized Hierarchies and Decentralized Markets

Bolton and Farrell (1990) and Hart and Moore (2005) propose that hierarchies will be beneficial during times of emergency.[41] In their models, the steepness of the optimal hierarchy is a trade-off between the benefits of specific information possessed by the bottom rung versus the benefits of quick decision-making by the top rung. In emergencies, a steeper hierarchy becomes optimal because quick decision-making is more beneficial than the costs of not using all of the organization's information**.**

Although a steep hierarchy may be optimal on the battlefield, a more decentralized hierarchy may be optimal in a POW camp. One can imagine that individual soldiers might have more valuable specific information in a POW camp than on a battlefield. Likewise, coordination is likely to be more important on the battlefield than in a camp. It is difficult to imagine an uncoordinated battle succeeding. If hierarchies are flexible, then the change from battlefield to POW camp might not matter. But as noted by Sah and Stiglitz (1985) and Stiglitz (1991), organizations, especially centralized organizations, are often rigid and unable to adapt quickly by becoming decentralized. This rigidity may explain our central finding of a negative relation between survival and hierarchy.

---

[41] For example, Bolton and Farrell (1990, p. 821) write: "Although many Western societies laud the laissez-faire system in peacetime, in an emergency they change their tune. Of course, there are many possible reasons for this, and our model touches on only one. But it is the one identified by Milward and by Scitovsky et al. as the prime defect of a market system's response to large new opportunities or

(footnote continues next page …)

POWs in camps with less intact hierarchies have higher survival rates, perhaps because less intact hierarchies facilitate decentralization. This explanation is also consistent with our finding that hierarchy is more damaging in larger cohorts than in smaller cohorts (Table 11). Soldiers in smaller cohorts are likely to be more effective in disregarding an established hierarchy and creating an informal, decentralized, and adaptive organization. In such an environment they could use their specific knowledge to enhance their survival.[42]

Perhaps the most persuasive evidence of the rigidity of the military's hierarchy in responding to a new environment comes from reports of those who survived the POW camps. In particular, some survivors discuss the importance of trading among the prisoners and the conflicts this created with the existing hierarchy. Let us start with R. A. Radford's classic paper, "The Economic Organisation of a P.O.W. Camp." Radford, an economist, was serving as a soldier in the British Army in Italy who was captured in 1943. Eventually, he was interned in a POW camp in Southern Germany. He writes, "it would be wrong to underestimate the importance of economic activity. Everyone receives a roughly equal share of essentials; it is by trade that individual preferences are given expressions and comfort increased. All at some time, and most people regularly, make exchanges of one sort or another."[43] Prisoners would trade the food and other goods provided by the detaining power, articles from packages from home or from the International Red Cross; in some instances prisoners would even trade with guards or civilians who worked in the camps.

---

problems. It is also consistent with some organizational choices made when speed is important but there is no 'emergency.'"

[42] Hastings (2007, p. 350) writes of POWs held by the Japanese: "Most men agreed that the key to survival was adaptability."

[43] Radford (1945) pp. 189-190.

In theory, a hierarchy could facilitate trade, first by defining and assigning property rights and then by enforcing voluntary agreements among the prisoners.[44] Conversely, a hierarchy could impede trades by forbidding some exchanges on the grounds of being "unfair" or contrary to military regulations. The military could also take the position that a soldier's food in captivity is like his rifle: It belongs to the military, not to the soldier.

Accounts of POWs often paint a picture of conflict between their trading and the military's hierarchy. The few mentions Radford makes of the military's hierarchy are of efforts by senior officers to prohibit specific exchanges. For instance, in his camp "the Medical Officer had long been anxious to control food sales, for fear of some people selling too much, to the detriment of their health. …The Shop, backed by the Senior British Officer, was now in a position to enforce price controls both inside and outside its walls."[45] After a period of success, "black market sales at unauthorized prices increased: eventually public opinion turned against the [controlled prices] and authority gave up the struggle. In the last few weeks, with unparalleled deflation, prices fell with alarming rapidity, no [controlled prices] existed, and supply and demand, alone and un-mellowed, determined prices."

Trade was likewise important in the Japanese camps. In a passage that is reminiscence of Radford's description of a German camp, a survivor of one of the most notorious Japanese camps, Camp Cabanatuan, writes, "Cigarettes were money. You could get almost anything if you had a pack of cigarettes."[46] Another prisoner writes,

---

[44] Reports by survivors, especially of the Japanese camps, highlight the demand for such services. For instance, Corporal Paul Reuter of the USAAF observed about his captivity at Hirahato, Japan: "Some people would steal, no matter how much they were punished. There was a lot of barter, then bitterness about people who reneged on the deals." Quoted in Hastings (2007) p. 356.

[45] Radford (1945) p. 198.

[46] Reminisces of Corporal Charles McCartin (POW from April 1942 to September 1945) in Knox (1998), p. 213.

"When I arrived, there was what you might call a black market operating. People were managing to get things in from the outside."

In many camps the Japanese authorities had decreed that there would be no trading by prisoners. Those who defied this edict were dealt with harshly. For instance, "it was at Yodogawa where Paul Edward Perry was beaten mercilessly for trading with Japanese civilians, probably for food or clothing."[47] Some allied officers saw it their duty to enforce the prohibition on trading. For instance, when J. J. Carter entered the Aomori POW camp near Yokohama, Japan, "the English camp commander, Abbott, said to me, 'See here, trading is not tolerated in this place.' I said to myself, 'Boy, you got a lot to learn.'"[48]

The conflict between the military's hierarchy and POW trading is the central theme in James Clavell's best seller *King Rat*. Although nominally a historic fiction about a Japanese POW camp, the book reflects Clavell's own three and one-half year imprisonment during the Second World War in the notorious Changi POW camp on the eastern end of Singapore Island. Clavell would later call Changi "his university." *King Rat* is the story of the struggle between an American corporal, the King, and Lieutenant Grey, the camp's provost marshal (the head of the camp's military police). The King discovers the way to survive this hellish camp is trade—to trade with his fellow prisoners, with the Korean guards, with the Japanese guards, and even with the local population. In a cat-and-mouse struggle, Grey is attempting to maintain military discipline by stopping the King from trading. It is a struggle between markets and hierarchies. Clavell attributed his own survival to the King's successful circumvention of the military's prohibition on trading. [49]

---

[47] http://www.evperry.com/canopus.html.

[48] Reminisces of J. J. Carter in Knox (1998), p. 415.

[49] Some have compared the character of the King to Ayn Rand's character Howard Roark from *The Fountainhead*. Clavell sent Ayn Rand a copy of another of his novels, *Noble House*, with the inscription:

(footnote continues next page …)

We would like to test the theory that the military's hierarchy impeded voluntary exchange among the prisoners. Given the current data, however, our options are limited. We do note that in virtually all of the regressions the coefficients for the size of the camp (the number of men in the camp) are positive and significant. This finding is consistent with a number of interpretations: larger camps received better medicine; larger camps received closer monitoring by the International Red Cross; larger camps offered greater possibilities for voluntary exchange among the prisoners. The latter interpretation fits with Adam Smith's legendary insight that the division of labor is limited by the extent of the market. Although he was talking about production, his insight applies equally to exchange. The negative coefficient on the interactive term of hierarchy and camp size (Table 11) suggests that the military's hierarchy was most harmful when exchange was potentially the most extensive and hence the most beneficial, in larger camps.

The International Red Cross distributed food and other basic material to many POW camps in Germany and Japan. These shipments play a central role in Radford (1945) and figure prominently in the accounts of other POWs. If we could obtain data on these shipments, it would be possible to investigate if the military's hierarchy impeded the trading of the contents of these parcels among the prisoners.[50] We have attempted to secure this data both from the International Red Cross in Geneva and the American Red Cross in Washington, D.C. but to no avail.[51]

"This is for Ayn Rand—one of the real, true talents on this earth for which many, many thanks. James C, New York, 2 Sept 81."

[50] Specifically, we would interact the camp's per capita food shipments with the camp's hierarchy. If the sign on this interactive term were negative in a probit regression with survival as the dependent measure (essentially, adding this interactive term and the per capita food shipments to the regressions of Table 6, Table 7, and Table 8), the finding would be consistent with the military's hierarchy impeding trading in a way that diminished survival.

[51] The most likely location of such data is with the International Red Cross in Switzerland. The International Red Cross has been widely criticized for restricting access to its WWII archives.

Thus, several findings raise the possibility that the reason there was a negative relation between hierarchy and survival in American POW camps during World War II was that the military's hierarchy impeded trading among the prisoners. First, this cause is not rejected by our data. Second, the cause is consistent with the accounts of many survivors from a wide array of camps in both the Pacific and European Theaters. We have read no accounts suggesting the military encouraged trading. Third and perhaps most telling, POWs in the Vietnam War were held in near isolation and had few opportunities to trade. Their accounts, in contrast to the POWs from WWII, seldom mention trading but instead extol the value of the military's hierarchy in their battle for survival.[52] Finally, although survival was enhanced by camp size, when hierarchy and camp size are interacted the result is negative. One interpretation is that hierarchies did the most harm in those environments where trading had the greatest potentially to be helpful, that is in the larger camps.

VIII. Summary of Findings and Relevance to Theoretical Literature

This paper addresses the relation between hierarchy and success in a high-stakes environment—American soldiers held captive during the Second World War. We find that the closer a prisoner's hierarchy was to the hierarchy established by the U.S. military or the steeper was his hierarchy, the lower was his survival rate. This finding is robust to how we group prisoners and to a wide variety of controls. It also holds for a group of prisoners that was essentially randomly captured and randomly assigned to camps, airmen shot down over occupied Europe. Finally, there is no evidence that hierarchy aided the survival of prisoners held by either Germany or Japan, even though prisoners of the Japanese were twelve times more likely to die.

---

[52] For example, Stockdale and Stockdale (1984). Senator John McCain was in solitary confinement for two years. This was virtually unheard of among American POWs during WWII. As such, there was little, if any, opportunity for trading among POWs in Vietnam.

Our primary finding that hierarchy did not promote the survival of POWs complements both empirical and theoretical research. The broadest and simplest interpretation is that the U.S. government did a poor job designing the military's hierarchy during WWII. Such a conclusion would be consistent with a body of literature (for instance Karpoff 2001) finding that government-funded activities are often less successful than similar, privately funded activities.

A second and narrower interpretation of our results is that a hierarchy developed for one purpose, winning battles, does not adapt well for a related but less urgent purpose, surviving captivity. Sah and Stiglitz (1985) and Stiglitz (1991) hypothesize that hierarchies respond slowly to changes in environment. Although decentralization may have been more effective in the POW camps, the rigidity of the military's long-standing hierarchy impeded such a transition.

This interpretation sheds insight into the factors that drive the relation between the environment and hierarchies. One theme that figures prominently in the theoretical literature is that steeper and more centralized hierarchies are superior to decentralization during emergencies. Both Bolton and Farrell (1990) and Hart and Moore (2005) argue that armies benefit from their hierarchical structure during times of war. They model hierarchies as involving a trade-off between the accuracy of information for decision making and the speed at which decisions are made. A more hierarchical structure leads to quicker decision making by higher-ups, albeit with less accurate information. A more decentralized structure leads to more accurate decisions by those lower in the organization, albeit at a slower pace. A centralized structure is thus likely to be most beneficial when quick decision-making is of the essence. This is more likely in battle than in prison.

Berger, Demsetz, and Strahan (1999) and Stein (2002) postulate that the nature of information is central in determining the benefits of hierarchy. Stein calls information that is easy to verify "hard" information and information that is difficult to verify "soft" information. Hierarchies are more effective with hard information because the quality of the information is largely preserved as it is transferred from lower to higher ranks.

On the other hand, decentralization is more effective with soft information because the information is not degraded through transfer; those that generate the (soft) information act upon it.

It is possible that hard information predominates on the battlefield while soft information is more important in POW camps. For instance, the positions and movements of the enemy, placement of weapons, and the like are all verifiable. This is hard information. In contrast, in POW camps the key information is likely to be about the well-being of individual prisoners. Escape or rebellion was seldom a realistic possibility. Nearly all POWs were subject to hunger, depression, and illness. These conditions were worse for some soldiers than others, making it difficult to verify the severity of a particular individual's condition. This is soft information. Given this, a POW and those closest to him were likely to do a better job assessing his condition and taking appropriate action than those higher in the hierarchy.

Another difference between a battlefield and a POW camp relates to agency considerations. Alonso, Dessein, and Matouschekz (2008) study the relation between incentive alignment and hierarchy. They show that even in organizations where coordination is important, decentralization can still be more effective if incentives are aligned. On the battlefield incentives are seldom aligned. Success of a combat unit, however, often requires that individual soldiers die. The situation in a POW camp is different. Here the success of the group roughly corresponds to the survival of individual soldiers. Consequently, in the camp environment decentralization is likely to dominate a centralized hierarchy. The apparent inflexibility of the U.S. military to make the transition to a more decentralized structure could explain why hierarchies were associated with tragic consequences for many of its soldiers held captive during WWII.

References

Aghion, Philippe and Jean Tirole, 1997, Formal and real authority in organizations, *Journal of Political Economy* 105, 1-29.

Akerlof, George A. and Rachel E. Kranton, 2000, Economics and identity, *Quarterly Journal of Economics* 115, 715-753.

Akerlof, George A. and Rachel E. Kranton, 2005, Identity and the economics of organizations, *Journal of Economic Perspectives* 19, 9-32.

Alesina, Alberto and Eliana La Ferrara, 2000, Participation in heterogeneous communications, *Quarterly Journal of Economics* 115, 847-904.

Alonso, Ricardo, Wouter Dessein, and Niko Matouschek, 2008, When does coordination require centralization?, *American Economic Review* 98, 145-179.

Beevor, Antony, 1998, *Stalingrad – The Fateful Siege: 1942-1943* (Penguin, New York).

Berger, Allen N, Rebecca S. Demsetz, and Philip E. Strahan, 1999, The consolidation of the financial services industry: Causes, consequences and implications for the future, *Journal of Banking and Finance* 23, 135-194.

Bolton, Patrick and Joseph Farrell, 1990, Decentralization, duplication, and delay, *Journal of Political Economy* 98, 803-826.

Calvo, Guillermo A. and Stanislaw Wellisz, 1979, Hierarchy, ability, and income distribution, *Journal of Political Economy* 87, 991-1010.

Clavell, James, 1962, *King Rat* (Dell Paperback edition 1986).

Coase, Ronald H., 1937, The nature of the firm, *Economica* 4, 386-405.

Costa, Dora L. and Matthew E. Kahn, 2007, Surviving Andersonville: The benefits of social networks in POW camps, *American Economics Review* 97, 1467-1487.

Dunbar, Robin I. M., 1993, Coevolution of neocortical size, group size and language in humans, *Behavioral and Brain Sciences* 16, 681-735.

Fama, Eugene F. and Michael C. Jensen, 1983, Separation of ownership and control, *Journal of Law & Economics* 26, 301-325.

Fox, Dennis R., 1985, Psychology, ideology, utopia, and the commons, *American Psychologist* 40, 48-58.

Garicano, Louis, 2000, Hierarchies and the organization of knowledge in production, *Journal of Political Economy*, 108, 879-903.

Gladwin, Lee A., 2000, Recovering and breaking the U.S. Army and Army Air Force order of battle codes, 1941-1945, *Prologue Magazine*, Fall 2000, Volume 32, Number 3.

Guadalupe, Maria and Julie Wulf, 2008, The flattening firm and product market competition: The effect of trade liberalization, unpublished working paper, National Bureau of Economic Research.

Hart, Oliver and John Moore, 2005, On the design of hierarchies: Coordination versus specialization, *Journal of Political Economy* 113, 675-702.

Hastings, Max, 2007, *Retribution: The Battle for Japan, 1944-45* (Alfred A. Knopf, New York).

Jensen, Michael C. and William H. Meckling, 1992, Specific and general knowledge and organizational structure, In *Contract Economics*, ed. Lars Werin and Hans Wijkander, 251-274 (Backwell, Oxford).

Karpoff, Jonathan M., 2001, Public versus private initiative in arctic exploration: The effects of incentives and organizational structure, *Journal of Political Economy* 109, 38-78.

Knox, Donald, 1981, *Death March: The Survivors of Bataan* (Harcourt, New York).

MacKenzie, S. P., 1994, The treatment of prisoners of war in World War II, *Journal of Modern History* 66, 487-520.

Pontiff, Jeffrey and Artemiza Woodgate, 2008, Share issuance and cross-sectional returns, *Journal of Finance* 66, 921-945.

Province, Charles M., 2008, IBM Punch Card Systems in the U.S. Army, http://www.pattonhq.com/ibm.html.

Radford, RA, 1945, The economic organisation of a P.O.W. camp, *Economica* 12, 189-201.

Radner, Roy, 1992, Hierarchy: The economics of management, *Journal of Economic Literature* 30, 1382-1415.

Rajan, Raghuram G. and Julie Wulf, 2006, The flattening firm: Evidence from panel data on the changing nature of corporate hierarchies, *The Review of Economics and Statistics* 88, 759-773.

Rajan, Raghuram G. and Luigi Zingales, 2001, The firm as dedicated hierarchy: A theory of the origins and growth of firms, *Quarterly Journal of Economics* 116, 805-851.

Sah, Raaj Kumar and Joseph E. Stiglitz, 1985, Human fallibility and economic organization, *American Economic Review Papers and Proceedings* 75, 292-297.

Schulte, Theodore J., 1989, *The German Army and Nazi Policies in Occupied Russia* (Oxford, Berg Publishing).

Scitovsky, Tibor, Edward Shaw, and Lorie Tarshis, 1951, *Mobilizing Resources for War: The Economic Alternatives* (McGraw Hill, New York).

Scott, Elizabeth D., K. C. O'Shaughnessy, and Peter Cappelli, 1996, Management jobs in the insurance industry: Organizational deskilling and rising pay inequity, in *Broken Ladders: Managerial Careers in the New Economy* (Paul Osterman, ed., Oxford University Press).

Spiller, Harry, 1998, *Prisoners of Nazis: Accounts of American POWs in World War II* (McFarland, Jefferson, NC).

Stein, Jeremy C., 2002, Information production and capital allocation: Decentralized versus hierarchical firms, *Journal of Finance* 57, 1891-1921.

Stiglitz, Joseph E., 1991, Symposium on organizations and economics, *Journal of Economic Perspectives* 5, 15-24.

Stockdale, James B. and Sybil B. Stockdale, 1984, *In Love and War* (Harper & Row, New York).

Vourkoutiosis, Vasilis, 2003, *Prisoners of War and the German High Command* (Palgrave Macmillan, New York).

Weiner, Jacob and Otto T. Solbrig, 1984, The meaning and measurement of size hierarchies in plant populations, *Oecologia* 61, 334-336.

Williamson, Oliver E., 1967, Hierarchical control and optimum firm size, *Journal of Political Economy* 75, 123-138.

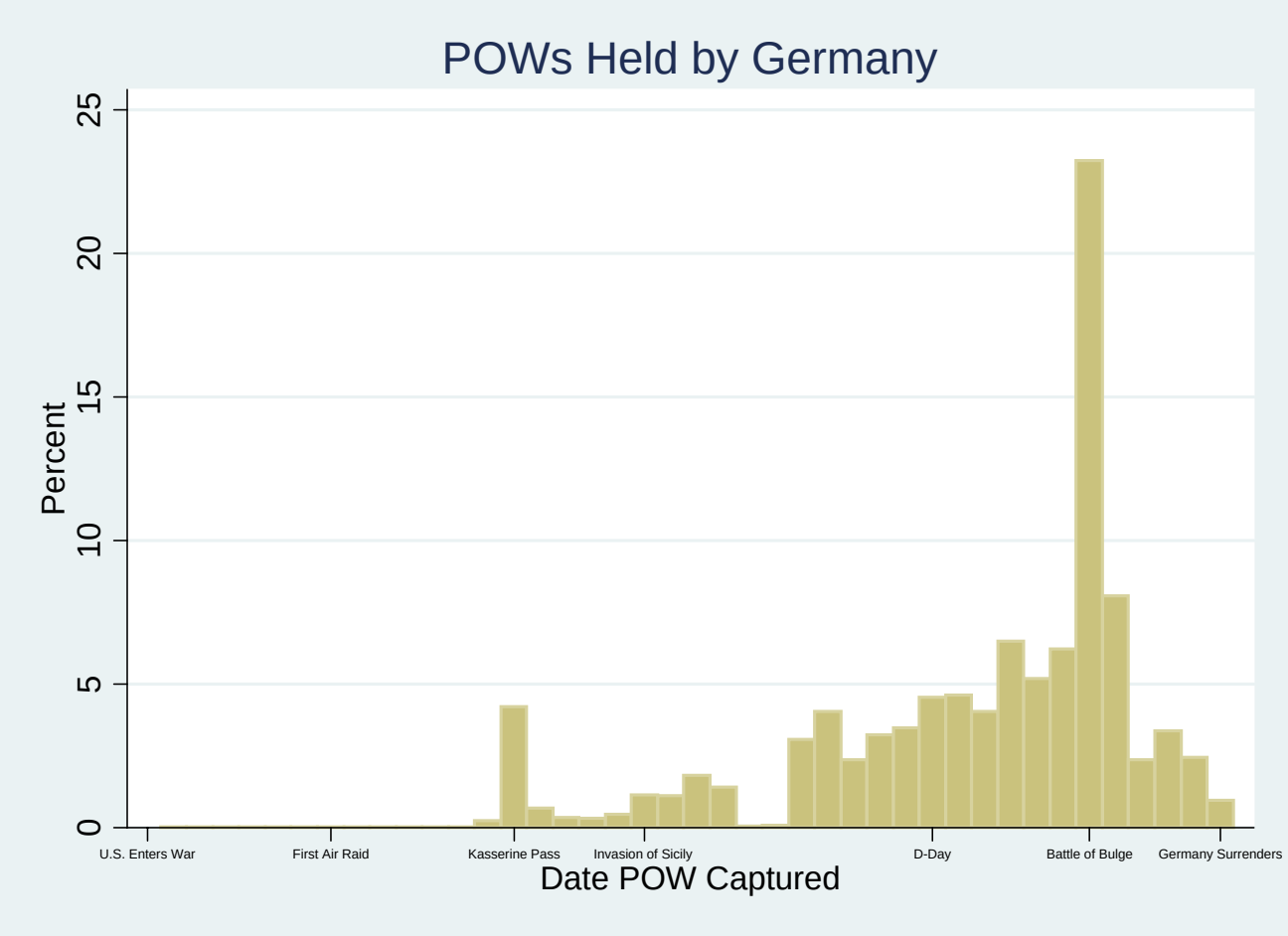

Figure 1. Histogram of when American military personnel were captured by Germany during World War II. There are 93,666 POWs represented in this histogram. Data come from the World War II Prisoners of War Data File (National Archives of the United States).

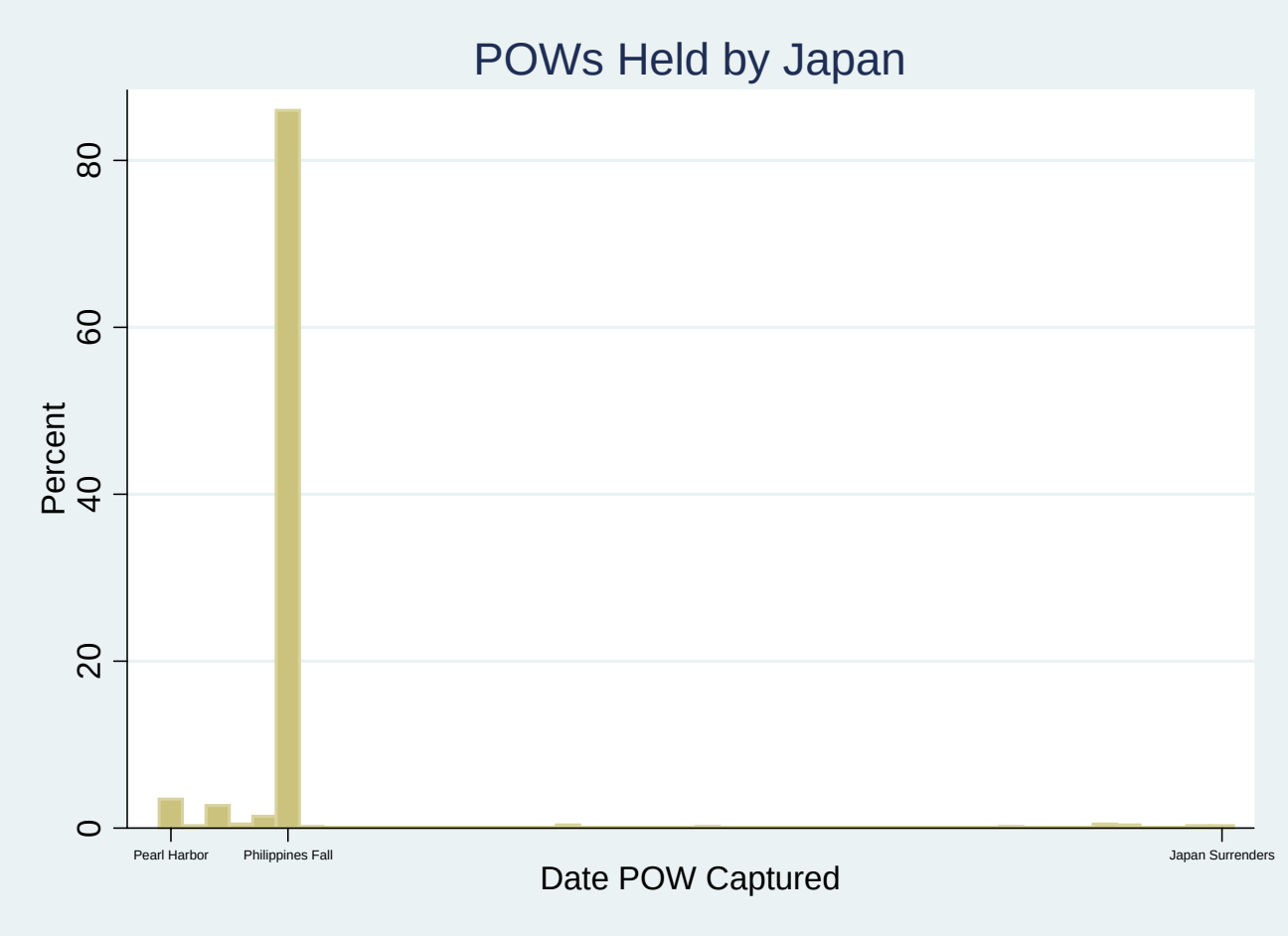

Figure 2. Histogram of when American military personnel were captured by Japan during World War II. There are 29,099 POWs represented in this histogram. Data come from the World War II Prisoners of War Data File (National Archives of the United States).

Table 1

Summary statistics on United States military prisoners of war (POWs) held by Japan and Germany during World War II. For age, height, weight, months of captivity, camp, and cohort characteristics we first report the average, then the (median), and finally the standard deviation. Number of observations varies with the data item. All data items are defined in Table 2.

	All POWs	Germany	Japan
Death Rate	10%	3%	36%
Execution Rate	4%	< 1%	12%
Age in 1945	26	26	27
	(25)	(25)	(27)
	4.50	4.64	3.49
Height (inches at enlistment)	68	68	68
	(68)	(68)	(68)
	2.95	2.94	3.02
Weight (pounds at enlistment)	144	143	144
	(142)	(144)	(142)
	22.46	22.57	22.02
POW has Dependents	30%	33%	16%
Months before War Ends POW was Captured	17	9	39
	(10)	(7)	(40)
	14.26	6.55	6.00
Number of Camps	280	188	92
Distance from Camp to Berlin or Tokyo	869	402	1,809
	(437)	(402)	(1,252)
	1,130	243	1,557
Camp Located Outside of Germany or Japan Proper	29%	15%	67%
POWs per Camp	377	406	318
	(7)	(6)	(15)
	1,257	1,346	1,055
Number of Cohorts	1,938	1,276	662
POWs per Cohort (captured in same month and assigned to same camp)	53	57	44
	(2)	(3)	(2)
	301	250	380
Total POWs	122,765	93,666	29,099

Table 2

Dependent Variables

	Description	Source
Survival Rate	Takes a value of one if the POW survives captivity and zero if he dies in captivity. If it is unknown whether a POW survives captivity, he is excluded from our analyses. We also exclude from our analyses civilians and those not held by either Germany or Japan (detaining powers).	World War II Prisoners of War Data File (National Archives of the United States).
Executed	Takes a value of one if the POW is reported as being executed by the detaining power (Germany or Japan). Some of those executed by Japan died in "Hell Ships."	Same as above.

Independent Variables

	Description	Source
Size of Group	The natural log of the number of POWs in either the cohort (defined below) or the POW camp depending on the regression specification. Rescaled in all cases (divided by 10).	World War II Prisoners of War Data File (National Archives of the United States).
Distance from Camp to Berlin or Tokyo	The natural log of the number of kilometers from the camp to the national capital of the relevant detaining power. If the camp is in either Berlin or Tokyo, we use the natural log of one kilometer. Rescaled (divided by 10).	Same as above.
Length of Captivity	The number of months before the end of the war the POW was captured. We classifying the war as ending in Europe in May 1945; we classify the war as ending in the Pacific in September 1945. Rescaled (divided by 10).	Same as above.
Height of POW	Height of POW in inches when entering the Armed Services. Rescaled (divided by 10).	World War II Army Enlistment Records (National Archives of the United States).
Age of POW	Age of POW in number of years as of 1945. Rescaled (divided by 100).	Same as above.
Education of POW	Number of years of education beyond eighth grade completed by POW upon entering the Armed Services. Rescaled (divided by 10).	Same as above.

POW has Dependents	Takes a value of one if POW has dependents and zero otherwise.	Same as above.
POW is Officer	Takes a value of one if the POW is ranked Lieutenant or higher at the time of capture.	World War II Prisoners of War Data File (National Archives of the United States).
POW Held by Japan	Takes a value of one if the POW is held by Japan and zero otherwise.	Same as above.

Units of Analysis

	Description	Source
Camp	The camp where the POW is initially incarcerated.	World War II Prisoners of War Data File (National Archives of the United States).
Cohort	Those POWs who enter the same camp in the same month.	Same as above.
Unit	The POW's military unit before capture.	Same as above.

Measures of Hierarchy

	Description	Source
Relative Hierarchy	The deviation of the POW's hierarchy from the hierarchy established by the U.S. military at the time. Higher values signify hierarchies that are more akin to what had been established by the military at the time. The index, which is fully defined in the text of the paper, ranges from zero to one.	NA
Absolute Hierarchy	The steepness of the POW's hierarchy. Higher values signify steeper (pyramidal) hierarchies. The index, which is fully defined in the text of the paper, ranges from zero to one.	NA

Table 3

Summary statistics on the ranks of United States military personnel during World War II as proxied by the ranks of American military personnel held prisoner during World War II. For sailors and Marines we report the ranks equivalent to the Army ranks based on pay grade. Survival rate is the overall survival rate for American prisoners held either by Germany or Japan. Data come from the World War II Prisoners of War Data File (National Archives of the United States).

Rank	Percent of Armed Forces	Survival Rate
General	0.01	88%
Colonel	0.38	74%
Major	0.55	66%
Captain	1.47	74%
Lieutenant	14.06	92%
Warrant Officer	0.79	89%
Sergeant	27.34	94%
Corporal	8.81	88%
Private	46.59	89%
All Ranks	100.00	90%

Table 4

Comparison of the *Relative Hierarchy* and the *Absolute Hierarchy* for six hypothetical groups of POWs. *Relative Hierarchy* measures the shape of the hierarchy relative to the population of soldiers. *Absolute Hierarchy* measures the steepness of the hierarchy. Both measures are bounded by zero and one. With both measures, an increase in the index signifies an increase in the hierarchy. Both measures are fully defined in the text of the paper.

Rank	Number of POWs at each Rank					
	A	**B**	**C**	**D**	**E**	**F**
Generals	0	0	1	4	115	400
Colonels	0	0	3	8	115	200
Majors	0	0	5	16	115	140
Captains	1,000	0	14	30	115	80
Lieutenants	0	0	140	60	115	60
Warrant Officers	0	0	7	20	80	50
Sergeants	0	0	273	120	115	40
Corporals	0	0	88	250	115	20
Privates	0	1,000	469	492	115	10
Total Men	1,000	1,000	1,000	1,000	1,000	1,000
Relative Hierarchy	0.02	0.71	1.00	0.95	0.85	0.62
Absolute Hierarchy	0.00	0.00	0.35	0.36	0.30	0.14

Table 5

Summary statistics on *Relative Hierarchy*, which measures the shape of a hierarchy, and *Absolute Hierarchy*, which measures the steepness of a hierarchy, for Americans held prisoner by either Germany or Japan during WWII. The data are reported on a camp or cohort basis (as appropriate). All data items are defined in Table 2.

	All POWs	
	Cohort	Camp
Relative Hierarchy		
Mean	0.605	0.743
Median	0.670	0.796
Standard Deviation	0.263	0.229
Maximum	0.999	0.998
Minimum	0.003	0.134
Absolute Hierarchy		
Mean	0.098	0.182
Median	0.000	0.206
Standard Deviation	0.125	0.134
Maximum	0.460	0.417
Minimum	0	0
	Germany	
Relative Hierarchy		
Mean	0.623	0.744
Median	0.696	0.781
Standard Deviation	0.253	0.212
Maximum	0.999	0.998
Minimum	0.003	0.223
Absolute Hierarchy		
Mean	0.098	0.168
Median	0.000	0.167
Standard Deviation	0.123	0.132
Maximum	0.460	0.408
Minimum	0	0
	Japan	
Relative Hierarchy		
Mean	0.574	0.741
Median	0.696	0.850
Standard Deviation	0.279	0.261
Maximum	0.988	0.988
Minimum	0.008	0.133
Absolute Hierarchy		
Mean	0.010	0.212
Median	0.127	0.255
Standard Deviation	0.000	0.133
Maximum	0.435	0.417
Minimum	0	0

Table 6

Probit regressions on whether American POWs survived captivity during World War II. The coefficients report the change in the probability for an infinitesimal change in the continuous variables and the discrete change in the probability for the dummy variables. The regressions include but do not report dummy variables that equal one when the associated variable has missing data and zero otherwise. All variables are defined in Table 2. There are 104,905 observations. (Robust *p*-values in parentheses are clustered by camp.)

	Relative Hierarchy				**Absolute Hierarchy**			
	Cohort		Camp		Cohort		Camp	
Hierarchy	**-0.15**	**-0.14**	**-0.23**	**-0.18**	**-0.31**	**-0.19**	**-0.34**	**-0.18**
	(0.01)	**(0.00)**	**(0.01)**	**(0.00)**	**(0.01)**	**(0.02)**	**(0.06)**	**(0.08)**
POW Held by Japan	-0.27	-0.13	-0.24	-0.10	-0.22	-0.13	-0.22	-0.13
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)
Size of Camp		0.10		0.09		0.12		0.10
		(0.00)		(0.00)		(0.00)		(0.00)
Men in Cohort		0.01				–0.01		
		(0.73)				(0.76)		
Distance to Berlin or Tokyo		-0.25		-0.23		-0.23		-0.24
		(0.00)		(0.00)		(0.00)		(0.00)
Length of Captivity		0.09		0.02		0.10		0.06
		(0.12)		(0.68)		(0.09)		(0.33)
Height of POW		-0.02		-0.02		-0.02		-0.02
		(0.20)		(0.20)		(0.21)		(0.20)
Age of POW		-0.09		-0.08		-0.09		-0.10
		(0.00)		(0.00)		(0.00)		(0.00)
Education of POW		-0.02		-0.02		-0.02		-0.02
		(0.01)		(0.01)		(0.02)		(0.03)
POW has Dependents		0.02		0.02		0.02		0.02
		(0.04)		(0.05)		(0.05)		(0.05)
POW is Officer		-0.03		-0.02		-0.02		-0.02
		(0.21)		(0.20)		(0.29)		(0.39)
Pseudo R^2	0.30	0.41	0.29	0.41	0.31	0.41	0.30	0.40

Table 7

Probit regressions on whether American POWs held by Germany during World War II survived captivity. The coefficients report the change in the probability for an infinitesimal change in the continuous variables and the discrete change in the probability for the dummy variables. The regressions include but do not report dummy variables that equal one when the associated variable has missing data and zero otherwise. All variables are defined in Table 2. There are 76,231 observations. (Robust *p*-values in parentheses are clustered by camp.)

	Relative Hierarchy				**Absolute Hierarchy**			
	Cohort		Camp		Cohort		Camp	
Hierarchy	**-0.06** **(0.00)**	**-0.04** **(0.00)**	**-0.09** **(0.00)**	**-0.05** **(0.00)**	**-0.11** **(0.00)**	**-0.07** **(0.00)**	**-0.12** **(0.04)**	**-0.07** **(0.01)**
Size of Camp		0.05 (0.00)		0.04 (0.00)		(0.05) (0.00)		0.05 (0.00)
Men in Cohort		0.01 (0.45)				(0.01) (0.69)		
Distance to Berlin		-0.01 (0.67)		-0.01 (0.93)		0.01 (0.61)		0.01 (0.56)
Length of Captivity		0.03 (0.11)		0.03 (0.10)		0.03 (0.14)		0.05 (0.11)
Height of POW		-0.01 (0.20)		-0.01 (0.23)		-0.01 (0.21)		-0.01 (0.22)
Age of POW		-0.03 (0.00)		-0.02 (0.00)		-0.03 (0.00)		-0.03 (0.01)
Education of POW		-0.01 (0.04)		-0.01 (0.05)		-0.01 (0.05)		-0.01 (0.11)
POW has Dependents		0.01 (0.04)		0.01 (0.03)		0.01 (0.05)		0.01 (0.04)
POW is Officer		-0.01 (0.59)		-0.01 (0.51)		0.01 (0.81)		0.01 (0.91)
Pseudo R^2	0.04	0.26	0.07		0.05	0.27	0.06	0.26

Table 8

Probit regressions on whether American POWs held by Japan during World War II survived captivity. The coefficients report the change in the probability for an infinitesimal change in the continuous variables and the discrete change in the probability for the dummy variables. The regressions include but do not report dummy variables that equal one when the associated variable has missing data and zero otherwise. All variables are defined in Table 2. There are 28,678 observations. (Robust *p*-values in parentheses are clustered by camp.)

	Relative Hierarchy				**Absolute Hierarchy**			
	Cohort		Camp		Cohort		Camp	
Hierarchy	**-0.47** **(0.11)**	**-0.86** **(0.00)**	**-0.42** **(0.66)**	**-0.89** **(0.20)**	**-1.25** **(0.22)**	**-0.94** **(0.32)**	**-1.57** **(0.43)**	**-0.55** **(0.69)**
Size of Camp		0.23 (0.24)		0.37 (0.08)		0.29 (0.24)		0.30 (0.10)
Men in Cohort		0.21 (0.17)				0.10 (0.64)		
Distance to Tokyo		-1.45 (0.00)		-1.42 (0.00)		-1.37 (0.00)		-1.36 (0.00)
Length of Captivity		0.07 (0.91)		-0.61 (0.24)		-0.13 (0.87)		-0.69 (0.22)
Height of POW		-0.18 (0.19)		-0.18 (0.19)		-0.18 (0.20)		-0.18 (0.18)
Age of POW		-0.33 (0.04)		-0.34 (0.03)		-0.30 (0.05)		-0.33 (0.02)
Education of POW		-0.07 (0.06)		-0.06 (0.07)		-0.06 (0.07)		-0.06 (0.07)
POW has Dependents		0.20 (0.00)		0.20 (0.00)		0.20 (0.00)		0.20 (0.00)
POW is Officer		-0.19 (0.08)		-0.18 (0.11)		-0.16 (0.12)		-0.16 (0.11)
Pseudo R^2	0.01	0.18	0.00	0.18	0.02	0.18	0.02	0.17

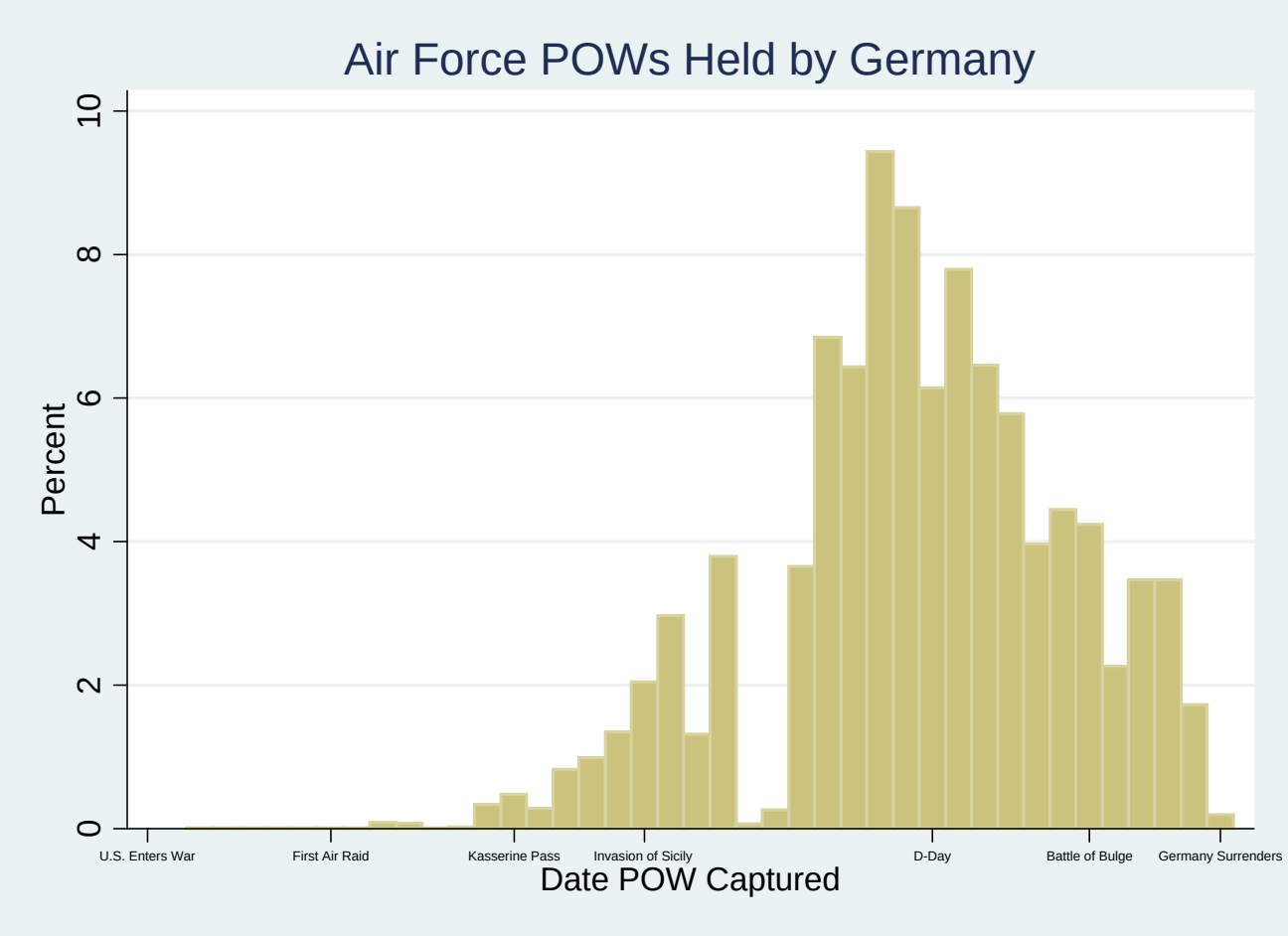

Figure 3. Histogram of when American airmen (U.S. Army Air Force) were captured by Germany during World War II. There are 23,536 POWs represented in this histogram. Data come from the World War II Prisoners of War Data File (National Archives of the United States).

Table 9

Probit regressions on whether American Air Force POWs held by Germany during World War II survived captivity. The coefficients report the change in the probability for an infinitesimal change in the continuous variables and the discrete change in the probability for the dummy variables. The regressions include but do not report dummy variables that equal one when the associated variable has missing data and zero otherwise. All variables are defined in Table 2. There are 23,534 observations. (Robust *p*-values in parentheses are clustered by camp.)

	Relative Hierarchy				**Absolute Hierarchy**			
	Cohort		Camp		Cohort		Camp	
Hierarchy	**-0.03**	**-0.01**	**-0.03**	**-0.01**	**-0.06**	**-0.01**	**-0.06**	**-0.01**
	(0.09)	**(0.04)**	**(0.00)**	**(0.01)**	**(0.03)**	**(0.00)**	**(0.02)**	**(0.00)**
Size of Camp		0.01		0.01		0.01		0.01
		(0.00)		(0.00)		(0.00)		(0.00)
Men in Cohort		0.01				0.01		
		(0.01)				(0.02)		
Distance to Berlin		0.01		0.00		0.01		0.00
		(0.64)		(0.72)		(0.66)		(0.41)
Length of Captivity		-0.01		-0.01		-0.01		-0.01
		(0.06)		(0.06)		(0.03)		(0.08)
Height of POW		-0.01		-0.00		0.01		-0.00
		(0.28)		(0.31)		(0.19)		(0.34)
Age of POW		-0.01		-0.00		-0.01		-0.00
		(0.48)		(0.33)		(0.47)		(0.32)
Education of POW		0.01		0.00		0.01		0.00
		(0.96)		(0.95)		(0.83)		(0.82)
POW has Dependents		-0.01		-0.00		-0.01		-0.00
		(0.69)		(0.76)		(0.72)		(0.79)
POW is Officer		0.01		0.00		0.01		0.00
		(0.47)		(0.21)		(0.15)		(0.09)
Pseudo R^2	0.03	0.45	0.18	0.47	0.06	0.47	0.15	0.48

Table 10

Probit regressions on whether American POWs survived captivity during World War II. These regressions consider the hierarchy among those POWs from the same pre-captured unit either in the same cohort (which is defined as entering the same POW camp in the same month, Revised Cohort) or in the same camp (Revised Camp). The coefficients report the change in the probability for an infinitesimal change in the continuous variables and the discrete change in the probability for the dummy variables. The regressions include but do not report dummy variables that equal one when the associated variable has missing data and zero otherwise. All variables are defined in Table 2. There are 69,919 observations. (Robust *p*-values in parentheses are clustered by camp.)

	Relative Hierarchy				**Absolute Hierarchy**			
	Revised Cohort		Revised Camp		Revised Cohort		Revised Camp	
Hierarchy	**-0.04**	**-0.01**	**-0.04**	**-0.03**	**-0.06**	**-0.01**	**-0.06**	**-0.03**
	(0.00)	**(0.02)**	**(0.00)**	**(0.00)**	**(0.00)**	**(0.68)**	**(0.00)**	**(0.00)**
POW Held by Japan	-0.63	-0.48	-0.63	-0.43	-0.62	-0.52	-0.63	-0.45
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Size of Camp		0.01		-0.01		0.01		–0.01
		(0.71)		(0.95)		(0.75)		(0.80)
Men in Cohort		-0.03				-0.03		
		(0.00)				(0.00)		
Distance to Berlin or Tokyo		-0.11		-0.11		-0.11		-0.11
		(0.00)		(0.00)		(0.00)		(0.01)
Length of Captivity		0.06		0.05		0.07		0.06
		(0.01)		(0.04)		(0.00)		(0.02)
Height of POW		-0.01		-0.01		-0.01		-0.01
		(0.36)		(0.41)		(0.33)		(0.38)
Age of POW		-0.03		-0.03		-0.03		-0.03
		(0.01)		(0.00)		(0.01)		(0.00)
Education of POW		-0.01		-0.01		-0.01		-0.01
		(0.00)		(0.00)		(0.00)		(0.02)
POW has Dependents		0.01		0.01		0.01		0.01
		(0.00)		(0.00)		(0.00)		(0.00)
POW is Officer		0.01		0.01		0.01		0.01
		(0.21)		(0.10)		(0.05)		(0.02)
Pseudo R^2	0.61	0.67	0.61	0.66	0.61	0.67	0.61	0.67

Table 11

Probit regressions on whether the survival of American POWs during World War II was more likely with larger, more hierarchical cohorts and camps. The coefficients report the change in the probability for an infinitesimal change in the continuous variables and the discrete change in the probability for the dummy variables. The regressions include but do not report dummy variables that equal one when the associated variable has missing data and zero otherwise. All variables are defined in Table 2. There are 104,905 observations. (Robust *p*-values in parentheses are clustered by camp.)

	Relative Hierarchy				**Absolute Hierarchy**			
	Cohort		Camp		Cohort		Camp	
Size * Hierarchy	**-0.46**	**-0.30**	**-0.26**	**-0.17**	**-0.54**	**-0.18**	**-0.09**	**-0.01**
	(0.05)	**(0.02)**	**(0.30)**	**(0.24)**	**(0.22)**	**(0.57)**	**(0.83)**	**(0.97)**
Hierarchy	-0.02	-0.03	-0.05	-0.06	-0.07	-0.12	-0.26	-0.17
	(0.68)	(0.17)	(0.70)	(0.41)	(0.57)	(0.20)	(0.28)	(0.29)
Size of Cohort or Camp	0.49	0.32	0.35	0.24	0.23	0.11	0.15	0.10
	(0.02)	(0.00)	(0.10)	(0.05)	(0.06)	(0.21)	(0.14)	(0.13)
POW Held by Japan	-0.18	-0.09	-0.19	-0.08	-0.18	-0.14	-0.20	-0.13
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Distance to Berlin or Tokyo		-0.18		-0.21		-0.23		-0.24
		(0.00)		(0.00)		(0.00)		(0.00)
Length of Captivity		0.04		0.01		0.09		0.06
		(0.35)		(0.86)		(0.13)		(0.36)
Height of POW		-0.02		-0.02		-0.02		-0.02
		(0.18)		(0.19)		(0.18)		(0.20)
Age of POW		-0.06		-0.07		-0.09		-0.10
		(0.00)		(0.00)		(0.00)		(0.00)
Education of POW		-0.01		-0.01		-0.02		-0.02
		(0.00)		(0.01)		(0.02)		(0.03)
POW has Dependents		0.02		0.02		0.02		0.02
		(0.05)		(0.05)		(0.05)		(0.05)
POW is Officer		-0.02		-0.02		-0.02		-0.02
		(0.14)		(0.20)		(0.33)		(0.39)
Pseudo R^2	0.32	0.41	0.31	0.41	0.33	0.40	0.32	0.40

Table 12

Probit regressions on whether the hierarchy of American POWs during World War II favored the survival of officers (Officer * Hierarchy). The coefficients report the change in the probability for an infinitesimal change in the continuous variables and the discrete change in the probability for the dummy variables. The regressions include but do not report dummy variables that equal one when the associated variable has missing data and zero otherwise. All variables are defined in Table 2. There are 104,905 observations. (Robust *p*-values in parentheses are clustered by camp.)

	Relative Hierarchy				**Absolute Hierarchy**			
	Cohort		Camp		Cohort		Camp	
Officer * Hierarchy	**-0.05**	**-0.02**	**-0.06**	**-0.06**	**-0.15**	**-0.17**	**-0.13**	**-0.19**
	(0.17)	**(0.14)**	**(0.20)**	**(0.02)**	**(0.05)**	**(0.00)**	**(0.17)**	**(0.00)**
Hierarchy	-0.12	-0.12	-0.17	-0.11	-0.28	-0.17	-0.30	-0.13
	(0.00)	(0.00)	(0.02)	(0.00)	(0.03)	(0.03)	(0.11)	(0.19)
POW is Officer	-0.07	-0.04	-0.05	-0.03	0.01	0.02	0.01	0.03
	(0.01)	(0.10)	(0.01)	(0.09)	(0.79)	(0.10)	(0.71)	(0.08)
POW Held by Japan	-0.27	-0.16	-0.23	-0.10	-0.23	-0.17	-0.23	-0.14
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Size of Cohort or Camp		0.07		0.09		0.06		0.10
		(0.00)		(0.00)		(0.00)		(0.00)
Distance to Berlin or Tokyo		-0.25		-0.23		-0.24		-0.24
		(0.00)		(0.00)		(0.00)		(0.00)
Length of Captivity		0.09		0.02		0.11		0.07
		(0.08)		(0.65)		(0.06)		(0.29)
Height of POW		-0.03		-0.02		-0.03		-0.02
		(0.16)		(0.19)		(0.16)		(0.19)
Age of POW		-0.09		-0.08		-0.11		-0.10
		(0.00)		(0.00)		(0.00)		(0.00)
Education of POW		-0.02		-0.02		-0.02		-0.01
		(0.01)		(0.01)		(0.03)		(0.06)
POW has Dependents		0.02		0.02		0.02		0.02
		(0.04)		(0.04)		(0.04)		(0.04)
Pseudo R^2	0.30	0.41	0.30	0.41	0.31	0.41	0.31	0.40