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Hierarchies and the Survival of Prisoners of War During World War II

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Using a comprehensive database of American prisoners of war during World War II, we find that survival from captivity generally declines as the hierarchy of a prisoner's group becomes steeper or more closely matches the military's established hierarchy. There is no evidence that survival is enhanced by being held in more hierarchical groups. One interpretation of these findings that is consistent with survivors' accounts is that the military's hierarchy was too inflexible to adapt from the battlefield to captivity and this inflexibility impeded trading among the prisoners.

Key words: hierarchy; markets; centralization; decentralization; organizational structure
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1. Introduction

How does the structure of a hierarchy affect its success? How well does an established hierarchy adapt to change in environment? Is a hierarchy that is optimal in one environment still optimal in a related yet different environment?

We investigate these issues of hierarchical success and adaptability by studying a high-stakes natural experiment—the survival of Americans held as prisoners of war (POWs) during World War II. This setting presents an opportunity to study hierarchical success and adaptability for several reasons. First, military data are well suited for studying hierarchies, both because the rank of each of the over 100,000 soldiers held captive is unambiguous and because the protocol for interaction among soldiers is well established. For many other types of organizations it is often unclear, at least to an outsider, who takes orders from whom. Moreover, POW camps during World War II were organized hierarchically; if a soldier disobeyed the lawful commands of his superiors, even during captivity, the consequences could be severe. Finally, the situation was obviously important for those involved.

Because of the vagaries of war, sometimes during World War II, the established military hierarchy persisted largely intact into captivity; at other times, the established hierarchy was seriously fractured and prisoners found themselves in a less hierarchical environment. We use this variation in hierarchies both across and within POW camps to study the relation between the strength of a hierarchy and the survival of prisoners in that hierarchy.

The military's hierarchy evolved over many years, presumably to win battles. There is research going back to the Scitovsky et al. (1951) landmark study of production during World War II showing that hierarchies offer special advantages in times of war and not just on the battlefield. Bolton and Farrell (1990) and Hart and Moore (2005) formalize the intuition about these benefits. Bolton and Farrell (1990) show that hierarchy allows for quicker decisions, whereas a flat organization can lead to duplication and hence to delays. Bolton and Farrell (1990, p. 805) note, "Centralization—in our model—does not involve delay and consequently is a good system for 'emergencies,' when delay is very costly. This prediction of our model is consistent with the fact that almost all organizations rely on central direction in emergencies. In particular, in warfare ... armies work by command." In the setting we study, quick decisions by senior POWs, for example, could help other prisoners survive, especially when food and medicine were limited as was often the case.

Hart and Moore (2005) show how hierarchy promotes coordination. If more coordination is needed, a steeper hierarchy becomes optimal. In our setting a well-coordinated hierarchy could help maintain discipline among the prisoners and present a unified front when dealing with the detaining power. A hierarchy could also help organize POWs in their day-to-day activities, such as maintaining camp cleanliness and hygiene. This would be especially beneficial in the tropics where many prisoners were held.

These theories and others identify several reasons why a hierarchy will be optimal on the battlefield. Although some of these benefits might continue in a POW camp, an alternative hypothesis is that a hierarchy designed for the battlefield might not adapt well to a different albeit related environment: a POW camp. If this is the case, being held in a hierarchical setting may not increase one's chances for survival. Staw et al. (1981) address what they label "threat rigidity," which arises when unexpected events cause people to fall back on well-learned routines that are no longer appropriate. It is business as usual even though the situation has changed. A POW camp is a change from a battlefield, yet soldiers may nevertheless have continued to follow their preexisting organizational roles. Likewise, Sah and Stiglitz (1985) and Stiglitz (1991) speculate that organizations, especially hierarchical organizations like the military, are often rigid and unable to adapt to new environments. One possibility is that the information from subordinates is more valuable in the POW camp than on the battlefield, and an inflexible hierarchy impeded the transfer of this valuable information. This scenario is consistent with Halbe (2011), who finds that the U.S. military structure stifles criticism from subordinates to superiors.

A wide range of empirical investigations reject the theory that hierarchies helped American prisoners survive during World War II. Many findings even suggest that hierarchies were associated with lower survival rates. These findings hold both for Japan and Germany, even though the unconditional probability of an American dying in Japan was 12 times greater than the probability of dying in Germany. Our findings also hold for different measures of a hierarchy, namely, its steepness and how closely it approximates the shape of the military's established hierarchy; different groupings of prisoners, both within camps and across camps; and for a group of prisoners for whom a reverse causality explanation seems unlikely, airmen shot down over occupied Europe. These findings are practically significant as well. Prisoners in the most hierarchical groups were 20% less likely to survive than those in the least hierarchical groups.

We explore three possible explanations why hierarchy apparently did not enhance the survival of American POWs during World War II and may have even hindered it. First, the military's hierarchy may have focused on the survival of officers at the expense of the survival of soldiers in general. This possibility may have been, in a sense, intended, because officers are likely to be more valuable, or it may have been an unintended consequence of an agency conflict where officers made self-interested decisions that were suboptimal for the military as a whole. The evidence does not support these interpretations. The survival rate of officers was lower than the survival rate of enlisted men, and officers in more hierarchical groups had lower survival rates than officers in less hierarchical groups.

A second possibility for the negative relation between hierarchy and survival reflects an omitted variable that is correlated with hierarchy. Specifically, less hierarchical groups might have had stronger social networks, which, in turn, promoted survival. This explanation is also inconsistent with the evidence. A POW who is held with members of his precapture unit is less likely to survive than if he is held with strangers.

Finally, we consider whether the established hierarchy impeded survival-enhancing trading in the camps. Although we are not able to formally test this possibility, it is consistent with several empirical regularities. Specifically, we find that survival increases with the size of the prisoner's group. Given that the benefits of trade should increase with the size of the market, this finding is consistent with the proposition that larger groups offered greater possibilities for voluntary exchange, and this, in turn, resulted in higher survival rates. When we interact group size with the strength of the group's hierarchy, the resulting term is negative and significant in some specifications and it is never positive. This raises the possibility that the military's hierarchy had the most detrimental impact when it was most complete and when the environment offered the greatest possibility for voluntary exchange, namely, in larger groups.[1]

The possibility of the established hierarchy interfering with potentially valuable trades is also supported by accounts of the prisoners themselves. They note that they often sought to trade among themselves and occasionally with guards and the local population. Some officers sought to suppress these voluntary exchanges, 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. One interpretation of our findings is that the more complete was the military's hierarchy during captivity, the greater was the suppression of trade by the established hierarchy, and the lower was the survival rate among the prisoners.

2. American Prisoners of War During World War II

Approximately 120,000 Americans were held as prisoners of war during World War II. The fate of a prisoner depended very much on whether he was held by Germany or Japan.

2.1. Germany

The United States declared war on Germany on December 11, 1941. Initially, there were few prisoners because there was little military action between the

[1] This finding departs from previous literature, such as Skarbek (2012), which argues that hierarchy is more valuable for larger groups.

two countries. 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.

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. Many of those captured in this battle never fired a shot because their units were surrounded by the rapidly advancing Germans. Among the thousands of prisoners from this battle was perhaps the most famous American POW of the war, at least in retrospect, Kurt Vonnegut Jr. (who is in our database). By the end of the war approximately 90,000 U.S. soldiers were held by Germany.

American POWs were held in 188 camps run by the German High Command (OKW). The largest camp held 8,418 Americans; the smallest camp held a lone 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 prewar German military districts. Prisoners generally were assigned to the camp closest to the point of their capture. For example, those captured in Italy were assigned to camps in Southern Germany.

Although historians have concluded that American POWs were treated relatively well by Germany, it was nevertheless a precarious situation. For instance, even though the Geneva Convention (which was 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,"[2] food rations for Western prisoners were nevertheless reduced by one-third starting in December 1941. The situation became more precarious in September 1944 when Adolf Hitler transferred control of the camps to the Schutzstaffel, or the SS as it was commonly known. 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.

2.2. Japan

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. The Japanese invading forces quickly over-ran the north of the country, and General MacArthur concentrated his forces on the Bataan Peninsula in Manila Bay. The U.S. troops in the Philippines surrendered in March and April of 1942; those captured close to Manila then began the infamous Bataan Death March. Approximately 80% of the American POWs held by Japan during the war were in the Bataan Death March. Most of the other prisoners were captured with the fall of other islands early in the war or later in the war when their planes were shot down, primarily over the Japanese mainland.

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 that demanded absolute devotion of all soldiers and viewed surrender, whether by its own troops or those of its enemies, as an extreme disgrace. 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 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" (MacKenzie 1994, p. 514).[3] 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, 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" (MacKenzie 1994, p. 514).

2.3. The Established Military Hierarchy and POWs

In both Germany and Japan, American POWs 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

[2] Convention of July 27, 1929. Relative to the treatment of prisoners of war, http://avalon.law.yale.edu/20th_century/geneva02.asp#art11 (last accessed May 29, 2012).

[3] After the war, Tojo was found guilty of "ordering, authorizing, and permitting the inhumane treatment of prisoners of war" (International Military Tribunal for the Far East, judgment November 4, 1948, count 54). He was executed in 1948.

U.S. military, with enlisted men and officers being held in the same camps.[4] Although conditions differed between the German and Japanese camps, one similarity was the importance of maintaining the military's established 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." Prisoners who violated the Code were subject to court martial upon their return to U.S. military control. If convicted, the penalties ranged from dishonorable discharge to imprisonment.

3. Data and Summary Statistics

The core data for our investigations come from the World War II Prisoners of War Data File, which is available from the National Archives of the United States. 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.

The records that survive and which we use generally contain the following information: the individual's name, 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), state of residency, race, and whether he survived captivity. We add information from another, much larger National Archives electronic database, the World War II Army Enlistment Records. This database contains information on 9.2 million enlisted personnel who joined the U.S. Army between 1938 and 1946. Typically, these records include 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, encompassing virtually all American POWs during World War II. These records were crucial to the war effort, so considerable resources were devoted to ensure their accuracy. We cross-checked numerous published accounts of individual POWs with our database and found the database to be accurate.

There are, on the other hand, some limitations. The most prominent is that the Enlistment Database is limited to personnel who enlisted in the Army between 1938 and 1945. Accordingly, it does not include individuals who joined the service as officers, sailors and Marines, and those who joined the Army prior to 1938.[5] (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.[6] We are able to match approximately 55% of the POWs with the Enlistment Database. The enlistment data provide 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 as Pontiff and Woodgate (2008) and McLean (2010), we assign missing independent variables as having a value of 0 and create dummy variables that take the value of 1 if the associated variable is missing. This allows us to use all data without distorting the coefficients of the independent variables. In robustness tests, we replicate our key analyses using only those observations where we have complete data.

An additional limitation is that 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. We also 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, but we do know if he was executed. Although we know where a POW generally was first held, we do not know if he was subsequently moved to another camp.[7] Some prisoners were moved, particularly from the Philippines starting in 1943 and in Germany as the advancing Allied armies overran the Reich in the spring of 1945. This movement creates an errors-in-variables problem in measuring hierarchies, the key explanatory variable in our regressions. It introduces noise and will bias our coefficients toward zero, making the null hypothesis of no relation between hierarchy and survival during captivity more difficult to reject. Despite this bias, the estimated coefficients on the hierarchy measures are usually statistically significant, even when comparing specifications with varying exposure to this potential problem.

[4] Only 3% of the POWs in our database were in camps without any officers; less than 1% were in camps with only officers.

[5] It does, however, include individuals who joined as enlisted men and later became officers.

[6] Email from Lee A. Gladwin of the National Archives, April 14, 2008.

[7] Specifically, we know the first camp where a prisoner came to the attention of the International Committee of the Red Cross. The Red Cross then passed this information on to the U.S. Department of War, which combined it with electronic data it already had on the soldier.

Table 1 Summary Statistics

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

Notes. Summary statistics on U.S. military POWs held either by Japan or 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.

Because we are interested in the impact of hierarchies on survival, 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). Table 1 reports summary statistics, first for all prisoners and then broken out by Germany and Japan. (All data items used in the paper are defined in Table 2.) The most striking differences, obviously, are the table's first two statistics. The unconditional probability of dying while being held by Japan was 12 times the probability of dying while being held by Germany. Similarly, the Japanese execution rate was 12 times the German execution rate.

4. Core Empirical Analyses

4.1. Two Measures of Hierarchy

We measure a prisoner's hierarchies in two ways: one is an absolute measure and the other is a relative measure. Both measures compare hierarchies of varying sizes and both fully incorporate all ranks within a group of soldiers. Alternative measures are considered in §5.

4.1.1. Steepness of a Hierarchy. We use the Gini Index to measure how steep a hierarchy is in an absolute sense. There are several advantages to using this measure. First, the Gini Index has been used by social scientists for over a century, so its strengths and weaknesses have been well vetted.[8] A second advantage is that the Gini Index is population and scale independent. Thus, it works equally well on a small group as it does on a large group; it works equally well with a group of officers as it does with a group of enlisted men. Finally, there is a simple intuitive interpretation as the index ranges from 0, complete equality or flatness in ranks, to 1, complete inequality or steepness in ranks.

Steepness of Hierarchy is measured with an ordered Gini coefficient following Damgaard and Weiner (2000). We calculate this index as follows: Each soldier in a group of n men is indexed by *indiv*, which is in nondescending 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 (there were nine ranks in the U.S. military during the war):

$$\textit{Steepness of Hierarchy} = 1 + \frac{1}{n} - \left(\frac{2\sum_{indiv=1}^{n}(n+1-indiv)Rank_{indiv}}{n\sum_{indiv=1}^{n}Rank_{indiv}}\right).$$

4.1.2. Sameness of a Hierarchy. The U.S. military established a hierarchy that presumably reflected its assessment of the optimal hierarchy of troops. *Sameness of Hierarchy*, our second index, measures the squared deviation of a group of POWs relative to the established hierarchy.[9] This measure is in the spirit of the Herfindahl Index and, in contrast to our other measure, is a relative measure. We rescale this measure for two reasons. First, we want an increase in the index to represent a movement toward the established hierarchy. Second, to facilitate comparisons, we

[8] Biologists, for instance, have used it to measure size hierarchies in plant populations (Weiner and Solbrig 1984). One problem is that the Gini Index is influenced by the granularity of its data. Less granularity will typically yield a lower Gini estimate than more granularity. This should not be a problem for our analyses because we have the most refined data possible, that of the level of the individual soldier. Furthermore, the granularity of our data is the same for all groups in our analyses.

[9] Ideally, we would use the percentage of soldiers in each rank from the population of American troops during World War II. In spite of extensive searches, we have been unable to locate this data. Consequently, we use the percentage of soldiers in each rank from the population of American POWs during World War II.

Table 2 Description of Variables

	Dependent variables
Survival rate	Takes a value of 1 if the POW survives captivity and 0 if he dies in captivity. If it is unknown whether a POW survives captivity, he is excluded from our analyses. We also exclude civilians and those not held by either Germany or Japan (detaining powers).
Executed	Takes a value of 1 if the POW is reported as being executed by the detaining power. Some executed by Japan died in "hell ships."
	Independent variables
Men in captured or camp cohort	The natural log of the number of POWs in either the captured cohort (defined below) or the camp cohort depending on the regression specification. Rescaled in both cases (divided by 10).
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).
Length of captivity	The number of months before the end of the war the POW was captured. We classify 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).
Height of POW	Height of POW in inches when entering the Armed Services. Rescaled (divided by 10).
Age of POW	Age of POW in number of years as of 1945. Rescaled (divided by 100).
Education of POW	Number of years of education beyond eighth grade completed by POW upon entering the armed services. Rescaled (divided by 10).
POW has dependents	Takes a value of 1 if POW has dependents and 0 otherwise.
POW is officer	Takes a value of 1 if the POW is ranked lieutenant or higher at the time of capture.
POW held by Japan	Take a value of 1 if the POW is held by Japan and 0 otherwise.
	Units of analysis
Camp cohort	The camp where the POW is initially incarcerated.
Captured cohort	Those POWs who enter the same camp in the same month.
Unit	The POW's military unit before capture.

scale this index to be consistent with the scale of our other index, namely, a range from 0 (all generals, the least common rank) to 1 (a perfect match for all ranks with the existing hierarchy):

$$\textit{Sameness of Hierarchy} = 1-\left(\frac{1}{1.319}\right)\sum_{Rank=1}^{9}(\textit{Group Fraction} - \textit{Population Fraction})^2.$$

We use 1.319 to scale the sum of the squared deviations because that number ensures that the hierarchy measure will equal 0 for the least hierarchical group.

Table 3 reports the *Steepness* and *Sameness* for six hypothetical groups of prisoners. Consider Groups C and A. Group C exactly matches the proportions of the established hierarchy and thus has a *Sameness* value of 1. Group A, in contrast, has only one rank. Therefore, it has a very low *Sameness* value. Consider next Groups A and B. Both consist of only one rank; in other words, there is complete equality in ranks so both have a *Steepness* index of 0. Group A, however, has (all) captains and Group B has (all) privates. Because privates constitute a greater percent of the established hierarchy than do captains (Group C), Group B has a higher *Sameness* value than does Group A. Finally, consider Groups C and D. Group D has higher ranking soldiers and thus a greater *Steepness* value. Group F is an inverted pyramid, and thus has a lower *Steepness* value than Group E, which has equal numbers at most ranks.

4.2. Hierarchical Groups

We measure the *Steepness* and the *Sameness* of two different hierarchies for each prisoner. First, we measure a prisoner's cohort when captured, which we

Table 3 Comparing the Steepness and Sameness Hierarchy Measures

	Group					
	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
Steepness of the Hierarchy	0.00	0.00	0.35	0.36	0.30	0.14
Sameness of the Hierarchy	0.02	0.71	1.00	0.95	0.85	0.62

Notes. Comparison of the *Steepness of the Hierarchy* and the *Sameness of the Hierarchy* for six hypothetical groups of POWs. *Steepness of the Hierarchy* measures the steepness of the hierarchy in an absolute sense. *Sameness of the Hierarchy* measures the shape of a hierarchy relative to the shape of the hierarchy established by the U.S. military. Both measures are bounded by 0 and 1. With both measures, an increase in the index signifies an increase in the hierarchy. Both hierarchy measures are defined in the text of the paper. Group C exactly matches the distribution of ranks found in the U.S. military during World War II (as proxied by the ranks of American military personnel held prisoner during World War II).

define as those prisoners who enter a given POW camp during the same month ("captured cohort"). We do so because survivors' accounts indicate that those who enter a camp at the same time sometimes have a preexisting relationship that continues through captivity. When there is no preexisting 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 hierarchical group is a prisoner's camp ("camp cohort"). Although a POW's closest relationships may often be within his captured cohort, the chain of command runs to the senior POW in the camp.

4.3. Controls

It is likely that several factors, not just hierarchy, affected survival. Notably, survivors' accounts suggest that the conditions of captivity often varied by camp, sometimes dramatically. To address this heterogeneity, when we analyze a prisoner's captured cohort, we use a dummy variable for each POW camp and then compare survival rates among cohorts within the same camp. These camp fixed effects should remove much of the camp-related noise, such as the severity of the camp's commandant or the weather, enabling us to more accurately estimate the relation between a cohort's hierarchy and the survival of its members. We cannot use camp dummy variables when we evaluate camp cohorts, however, because the regression would be overspecified. We do, however, control for the number of men in the camp as well as the distance from the camp to the detaining power's national capital to account for possible agency problems between a camp's commandant and headquarters.

It is also likely that characteristics of the individual prisoners influenced survival. Accordingly, we control for the date of a prisoner's capture, his rank at time of capture, height, age, years of education, and whether he has dependents. We also control for the number of men in the cohort. We include a squared term to capture possible nonlinearities in the relation between hierarchy size and survival. All control variables are defined in Table 2.

4.4. Key Empirical Findings

Table 4 presents the key empirical findings of the paper. The dependent variable in all instances (here and elsewhere in the paper) takes a value of 1 if a prisoner survives captivity and 0 if he does not.[10] Table 4 reports the marginal effects of a probit regression at the means of the independent variables. Because error terms tend to be correlated within a cohort, all regressions use heteroscedastic robust standard errors that are calculated by clustering observations either by captured cohort or camp cohort (whichever is appropriate). We present both simple specifications and specifications with individual and group controls to determine how sensitive the results are to the specification of the regression.

The hierarchy coefficients in all Table 4 specifications are negative and at least marginally significant. At the highest level these findings imply that the probability of survival declines as the POW's hierarchy becomes steeper or as his hierarchy gets closer to the shape of the hierarchy established by the military. These findings are not only statistically significant but practically important as well. For instance, a prisoner from a captured cohort that is in the top quartile in *Steepness of the Hierarchy* is six percentage points less likely to survive than one from the bottom quartile (81% versus 87%).[11] Table 4 also reveals that the captured hierarchy p-values are as small or smaller than the corresponding camp hierarchy p-values despite the fact that the captured coefficients tend to be closer to zero. This suggests that the camp cohort fixed effects remove some of the camp-associated noise.

The control variables with the strongest statistical significance are a POW's age and education, both of which have a negative association with survival, and whether he has dependents, which has the opposite association. One interpretation is that younger POWs had stronger constitution that older POWs. This interpretation is reinforced by unreported results showing that older POWs were less likely to survive in the more demanding conditions of the Japanese camps. Regarding education, some survivors speculate that a tough upbringing, which is likely to be negatively correlated with years of education, helped in the battle for survival (Hastings 2007). Conversely, survival increased when a prisoner had dependents. One interpretation of this finding is that men who were married were healthier and thus more likely to survive captivity. Another interpretation is that prisoners with dependents were more motivated to survive.

4.5. Both Hierarchy Measures Together

Because *Steepness* and *Sameness* are correlated, we place them in separate probits in Table 4. At the camp cohort level the correlation is 0.92; at the captured cohort level the correlation is 0.91. We now assess whether one of the hierarchy measures has a dominant influence in forecasting survival. The results of our investigations are summarized in Table 5.

Panel A reports the coefficients and p-values for the hierarchy measures for specifications that simultaneously include both *Steepness* and *Sameness*.

[10] 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.

[11] These implied probabilities come from second regression of Table 4.

Table 4 POW Survival by Captured and Camp Cohorts

	Steepness of POW's hierarchy				Sameness of POW's hierarchy			
	Captured cohort		Camp cohort		Captured cohort		Camp cohort	
Hierarchy	**−0.06**	**−0.11**	**−0.33**	**−0.18**	**−0.03**	**−0.07**	**−0.23**	**−0.18**
	(0.00)	**(0.00)**	**(0.06)**	**(0.10)**	**(0.01)**	**(0.00)**	**(0.01)**	**(0.00)**
POW held by Japan			−0.22	−0.13			−0.24	−0.10
			(0.00)	(0.00)			(0.00)	(0.00)
Men in hierarchy		0.09		0.11		0.10		0.15
		(0.02)		(0.62)		(0.01)		(0.41)
Men in hierarchy squared		−0.00		−0.00		−0.00		−0.00
		(0.18)		(0.96)		(0.16)		(0.76)
Distance to Berlin or Tokyo				−0.24				−0.23
				(0.00)				(0.00)
Length of captivity		0.01		0.06		0.01		0.02
		(0.82)		(0.33)		(0.79)		(0.66)
Height of POW		−0.03		−0.02		−0.03		−0.02
		(0.11)		(0.20)		(0.11)		(0.19)
Age of POW		−0.08		−0.10		−0.08		−0.08
		(0.00)		(0.00)		(0.00)		(0.00)
Education of POW		−0.02		−0.02		−0.02		−0.02
		(0.00)		(0.04)		(0.00)		(0.01)
POW has dependents		0.02		0.02		0.02		0.02
		(0.07)		(0.04)		(0.06)		(0.04)
POW is officer		−0.04		−0.02		−0.04		−0.02
		(0.05)		(0.39)		(0.04)		(0.20)
Pseudo R^2	0.54	0.55	0.30	0.40	0.53	0.54	0.30	0.41

Notes. 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. Slope coefficients and p-values of the hierarchy variables are in bold. The regressions include but do not report dummy variables that equal 1 when the associated variable has missing data and 0 otherwise. The cohort regressions also include but do not report dummy variables for each POW camp. All variables are defined in Table 2. There are 100,464 observations. (Robust p-values in parentheses are clustered by either captured cohort or camp cohort.)

The four specifications mirror the specifications in Table 4: captured and camp cohorts with both simple specifications and specifications with the full set of explanatory variables. Although Table 4 finds that *Steepness* and *Sameness* when used separately consistently produce negative coefficients that are typically statistically significant, the panel A results of Table 5 are more fragile. Consistent with a multicollinearity problem, only one of the two coefficients is significant in three of the four specifications; in one specification neither coefficient is significant. In the three specifications that produce significant coefficients, *Steepness* is significant once and *Sameness* twice.

Table 5 Both Hierarchy Measures Together

	Captured cohort		Camp cohort	
	Simple	Complex	Simple	Complex
	Panel A			
Measures themselves				
Steepness of Hierarchy	−0.09	−0.04	−0.32	0.09
	(0.01)	(0.14)	(0.35)	(0.69)
Sameness of Hierarchy	0.02	−0.05	−0.01	−0.24
	(0.27)	(0.01)	(0.95)	(0.05)
	Panel B			
ROC incremental values				
Steepness of Hierarchy	(0.13)	(0.04)	(0.00)	(0.00)
Sameness of Hierarchy	(0.00)	(0.50)	(0.00)	(0.00)

Notes. Panel A: Summary of probit regressions when both hierarchy measures are included in the same specification simultaneously. The columns correspond to the appropriate columns in Table 4. (Robust p-values in parentheses are clustered by either captured cohort or camp cohort.) Panel B: (p-values) from a test of differences in the area under two ROC curves. The null hypothesis is that a model that includes both steepness and sameness has no incremental benefit over a model with only one of these variables (Hanley and McNeil 1983).

Panel B addresses this multicollinearity with a probit-appropriate F-test. This test determines whether each hierarchy measure adds incremental information to a specification that includes the other measure. We implement this with a test of differences in area under two receiver operating characteristic (ROC) curves (Hanley and McNeil 1983). Using the same specifications as in Table 4, we first estimate a probit with one hierarchy measure and then with both measures simultaneously. The test statistic is calculated under the null hypothesis that the specification with both measures does not have incremental ability to predict survival above the first specification. Panel C shows that when the measures are calculated at the camp level both have incremental information regardless of whether a simple or complex estimation is used. The captured results are less conclusive. For the simple specification, *Sameness* rejects the null of no incremental information, and *Steepness* does not. For the complex specification, *Steepness* rejects the null of no incremental information, and *Sameness* does not.

The takeaway from Table 5 is that the hierarchy results in Table 4 do not appear to be driven by only one of the hierarchy measures. The ROC tests in panel B suggest that at the camp level both measures matter. At the captured level, however, the ROC tests suggest that one of the hierarchy measures does not contain incremental information on survival, although the identity of the redundant measure depends on the specification.

5. Alternative Explanations, Robustness Tests, and Possible Endogeneity

5.1. Germany and Japan Separately

The regressions in Table 4 pool data from Germany from Japan. As discussed earlier, these were two very different regimes for prisoners, with Japan being far harsher. We use camp dummy variables or a Japan dummy in Table 4, but these may not fully capture the differences between the two regimes. Consequently, we replicate our Table 4 analyses separately for Germany and Japan (reported in previous versions of the paper). The hierarchy coefficients remain universally negative. They are significant in all eight of the German specifications and in the four Japanese specifications involving the captured cohorts.

5.2. Social Networks as Alternative Explanations

Costa and Kahn (2007) 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 precapture unit ("friends").

To determine if our findings are driven not by a POW's hierarchy but instead by his social network, we first remove the hierarchy measures from the four multiple regressions in Table 4 and add the log of the number of men from the same precapture unit in the captured or camp cohort (friends). (We know the precapture unit for about half of the prisoners.) Next, we add the hierarchy measures back in and keep the friend measure. In all eight of these (unreported) regressions, the coefficient for the number of friends is negative and significant (the largest *p*-value is 0.02), and the hierarchy coefficients remain negative and at least as significant as they are in Table 4.

In a second set of tests, we revise our two hierarchy measures to reflect only POWs from the same precapture unit who are in the same captured cohort or camp cohort. We then reestimate the Table 4 regressions using these new hierarchy measures, again adding the log of the number of friends in the hierarchy to the multiple regressions. The friends-based hierarchy measures are insignificant in all instances (*p*-values around 0.50).

We suspect that one reason why our findings conflict with Costa and Kahn's (2007) are fundamental differences between Civil War and World War II combat units. Civil War regiments were typically formed on a state basis. Men, therefore, often knew each other before enlisting. The U.S. military had largely abandoned the practice of state or territorial units by World War II. As a consequence, soldiers in World War II were less likely to have had associations that predated their military days than were their Civil War counterparts. Another factor is that a Civil War company, on average, had only about 100 men. World War II combat units were typically much larger. Anthropologists have found that once a group gets beyond 150 members, it begins to lose cohesion (Dunbar 1993). If we assume that social networks are not quickly established, Civil War combat units were likely stronger social units compared with combat units during World War II. To the extent these groups persisted into captivity, they would have helped in the battle for survival during the Civil War but not during World War II.

5.3. Additional Robustness Checks

As additional robustness checks, we rerun all of our Table 4 regressions with the following changes:

5.3.1. Alternative Calculations of the Hierarchy Measures. Because of the paucity of empirical investigations of the full ranks of an organization, there is no accepted measure for either the steepness or sameness of a hierarchy. Thus, we calculate alternative versions of both of our hierarchy measures. For the *Alternative Steepness of a Hierarchy*, we use the pay grade of the ranks during World War II. For the *Alternative Sameness of a Hierarchy*, we use the ratio of each rank in a cohort divided by the ratio of the same rank as established by the military (Group C, Table 3):

Alternative Sameness Hierarchy

$$= 1 - \left(\frac{1}{10{,}000}\right) \sum_{Rank=1}^{9} \left(\frac{\textit{Group Fraction}}{\textit{Population Fraction}} - 1\right)^2.$$

Like the original measure, the *Alternative Sameness Hierarchy* attains a maximum value of 1 if each rank is represented with the same proportion as the entire armed forces. Compared with the original measure, the alternative measure places more weight on hierarchical imbalances that are associated with higher-ranking officers.

We also recalculate our original *Sameness* measure using absolute differences in ranks instead of squared differences in ranks between the cohorts and the military's existing hierarchy. We do so because squared differences will generate larger outliers, and we want to determine if this is driving any of the Table 4 results.

5.3.2. Different Hierarchy Measures. We next define three different measures of hierarchy. The first is the number of different ranks in a group of prisoners. This corresponds to the number of levels or layers of an organization. The second is the sum of the ranks of prisoners in a group, with a private being assigned a value of 1, a corporal a value of 2, and so forth, up to a general who is assigned a value of 9. This measure, in contrast to the simple number of ranks in a group, gives more weight to higher-ranked prisoners. Because these two measures are mechanically related to cohort size (larger groups are more likely to have more different ranks than smaller groups), we limit our analyses with these measures to the (revised) multiple regressions of Table 4, where we can control for cohort size. The third hierarchy measure is administrative intensity. Adapting Pondy's (1969) definition to our situation, we define administrative intensity as the percent of the members of a POW group who are ranked above private. (Forty-six percent of the POWs are privates.)

5.3.3. Different Subsets of Database. We conduct our Table 4 analyses using four different subsets of our database. First, we rerun our regressions only for observations where we have complete data. This affects only the multiple regressions. Next, because some cohorts had few prisoners, we want to investigate if our basic result is being driven by these small hierarchies. Accordingly, we limit our analyses to cohorts with at least 50 or (alternatively) 100 men. Lastly, we exclude executions because a strong hierarchy could have an ambiguous impact on the frequency of executions.

5.3.4. Summary of Robustness Tests. 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. The coefficients on the hierarchy measures in all robustness tests remain negative and many have p-values of less than 0.01.

5.4. Test for Endogeneity: Air Force POWs in Germany

As with any observational study, unrecognized endogeneity or omitted correlated variables could invalidate our basic interpretation that hierarchy did not aid the survival of POWs during World War II. Any endogeneity or omitted variable explanation, however, needs to take account of a consistent pattern between hierarchy and survival found with two very different regimes. Germany is a western nation with a temperate climate; Japan is an eastern nation, and many of its prisoners were held in the tropics. Germany treated its western POWs relatively well; Japan's treatment was harsh, often in the extreme. Germany typically assigned POWs to the closest camp. Japan sometimes moved prisoners across the seas for forced labor. In spite of all of these differences, in both regimes we find a negative relation between hierarchy and survival. There is also a negative relation between hierarchy and survival for both captured cohorts and camp cohorts. The same relation persists when we run parsimonious regressions, when we run more complicated specifications, and when we measure hierarchy in 10 different ways.

During the course of this research, we considered many endogeneity-based explanations for our basic findings but ruled most out for being based on far-fetched logic or involving assumptions that run counter to historical accounts. The only plausible explanation we have been able to think of is that units with weaker hierarchies might have been more likely to surrender early in battle and thus had fewer injuries than those units with stronger hierarchies that fight longer and thus suffer more combat injuries before surrendering. Under this alternative explanation, the higher death rate during captivity would reflect the harder fighting and resulting injuries due to a stronger hierarchy before captivity, not the effects of a prisoner's hierarchy during captivity. (Recall that we do not know if a prisoner was injured when captured.)

Although this is the only plausible endogeneity explanation we can think of, we are nevertheless skeptical of it because it ignores how most soldiers were captured during World War II. Most soldiers surrendered not after a hard fight but after their units were surrounded, often without firing a shot. This occurred in large scale at the Battle of the Bulge and with the fall of the Philippines, for instance. Thus, it is not clear that the strength of a precapture hierarchy would have had much to do with the probability of capture or with the extent of any injuries of those entering captivity.

Nevertheless, to consider the possibility of unmeasured endogeneity driving our basic result, we focus on one group of American POWs during World War II for which their units' hierarchies were largely unrelated to their capture and assignment to cohorts and camps—airmen captured by Germany. Which planes in a formation happened to be attacked by fighter planes, hit by antiaircraft shells, or experienced mechanical failures was largely random. As one airman wrote, "the flak gunners simply seemed to have our number."[12] There is likely to be little relation

[12] Reminisces of Second Lieutenant Carl W. Remy (POW from September 28, 1944, to May 1, 1945) in Spiller (1998, p. 109).

between the hierarchy of an airplane or air squadron and the capture or injury of its members. Moreover, some planes were hit (or experienced mechanical failure) over their targets, while others were hit far from the targets. Once a plane was hit, some would crash immediately, while others would keep flying, sometimes for hundreds of miles. Because of the regional nature of the German POW system, airmen were held where they happened to crash, not where their planes were hit or where their targets were located. Finally, for the entire war, downed airmen were held exclusively in Luftwaffe-run camps with other captured airmen.

We replicate our Table 4 analyses using only U.S. Army Air Force personnel held by Germany (reported in earlier versions of the paper). We find no evidence that either the *Steepness* or *Sameness* of a hierarchy was associated with higher survival rates. Only one of the eight specifications has a hierarchy coefficient that is positive (the simple regression involving the *Sameness* for a captured cohort), and that has a p-value of 0.56. Of the remaining seven hierarchy coefficients, one is marginally significant (the complex specification involving the *Steepness* of a captured cohort, p-value 0.07) and four are highly significant (all of the camp specifications). These findings would seem to rule out many endogeneity explanations, including the explanation that the precapture hierarchy of a unit was positively related to injuries upon capture, leading to higher cohort mortality.

6. Interpretation of the Evidence on Hierarchies and Survival

6.1. What Constitutes Success with POWs?

We have assumed to this point that success during captivity is the survival of soldiers. Perhaps this is not the objective of the military's hierarchy. One version of this hypothesis is that the military focuses solely on winning battles; helping soldiers survive captivity is irrelevant. This hypothesis, however, conflicts with long-stated objectives of the U.S. military and is contradicted by the resources the military has historically devoted to prisoners. For instance, upon its return to the Philippines, the U.S. military devised a daring plan to rescue soldiers held at the notorious Cabanatuan POW camp. One hundred twenty-one officers and men of the Army's elite Rangers trekked 30 miles behind Japanese lines before surprising the captors and freeing the American prisoners. Upon their return, the prisoners were "treated like royalty" by other soldiers (Sides 2001, p. 326).

Another version is that success during incarceration might not have been the survival of soldiers but sabotage of the enemy's military operations or at least forcing the enemy to devote more resources to holding prisoners. This seems far-fetched. The vast majority of prisoners were held far behind the front line by older soldiers or even civilians. Yet there were only a handful of successful escapes during the war. As for sabotage, this seems to be a figment of Hollywood's imagination. For instance, in the movie *The Bridge Over the River Kwai* a Japanese bridge is destroyed by the commanding prisoner, Colonel Nicholson (Alec Guinness). In reality, there were two bridges built by Allied prisoners and both were used for two years. They were then damaged by Allied bombing, not by prisoner sabotage as in the movie.

A more plausible explanation for the negative relation between hierarchy and survival of soldiers in general could be that the objective of the military's hierarchy during captivity is not the survival of soldiers overall but the survival of officers. 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 postwar West German army. Alternatively, preservation of the officer corps could simply reflect agency problems: officers using their authority to expropriate resources intended for lower-ranked men.

To test the theory that the military's objective was to aid the survival of officers over enlisted men, we interact the hierarchy measures with an officer dummy variable. In Table 6 we see that this interactive term in all instances is negative and in several specifications it is significant. There likewise is no evidence in any of the (unreported) robustness tests that an officer's survival was enhanced by either the *Steepness* or the *Sameness* of his hierarchy.[13]

6.2. Hierarchies and Markets

Economists, going back at least to Coase (1937) and Hayek (1945), have recognized that markets are an alternative to hierarchies for allocating resources. It is difficult to imagine markets playing any meaningful role on a battlefield, but there is considerable evidence that markets were important in many POW camps during World War II.

There is no better illustration of this than Radford's (1945) classic paper "The Economic Organisation of a P.O.W. Camp." Radford, an economist, was a British soldier in Italy who was captured in 1943. Eventually, he was interned in a POW camp in Southern Germany. Radford (1945, pp. 189–190) writes, "It would be wrong to underestimate the importance

[13] 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 noncommissioned officers as well as officers. We also conduct all of our tests for Germany and Japan separately.

Table 6 Officer Survival and Hierarchies

	Steepness of POW's hierarchy				Sameness of POW's hierarchy			
	Captured cohort		Camp cohort		Captured cohort		Camp cohort	
Officer × Hierarchy	**−0.02**	**−0.04**	**−0.13**	**−0.18**	**−0.05**	**−0.04**	**−0.06**	**−0.08**
	(0.59)	**(0.20)**	**(0.14)**	**(0.00)**	**(0.07)**	**(0.05)**	**(0.32)**	**(0.02)**
Hierarchy	−0.06	−0.08	−0.28	−0.11	−0.01	−0.04	−0.22	−0.14
	(0.00)	(0.00)	(0.12)	(0.24)	(0.45)	(0.00)	(0.03)	(0.01)
POW is officer	−0.02	−0.02	0.01	0.03	0.01	0.01	0.02	0.03
	(0.10)	(0.32)	(0.66)	(0.05)	(0.37)	(0.51)	(0.67)	(0.08)
POW held by Japan			−0.23	−0.14			−0.23	−0.10
			(0.00)	(0.00)			(0.00)	(0.00)
Men in hierarchy		0.09		0.09		0.11		0.13
		(0.02)		(0.64)		(0.00)		(0.45)
Men in hierarchy squared		−0.00		0.00		−0.00		−0.00
		(0.18)		(0.97)		(0.11)		(0.84)
Distance to Berlin or Tokyo				−0.23				−0.21
				(0.00)				(0.00)
Length of captivity		0.01		0.07		0.01		0.03
		(0.77)		(0.24)		(0.80)		(0.57)
Height of POW		−0.03		−0.02		−0.03		−0.02
		(0.11)		(0.18)		(0.10)		(0.18)
Age of POW		−0.08		−0.10		−0.08		−0.08
		(0.00)		(0.00)		(0.00)		(0.00)
Education of POW		−0.02		−0.01		−0.02		−0.01
		(0.00)		(0.07)		(0.00)		(0.01)
POW has dependents		0.02		0.02		0.02		0.02
		(0.06)		(0.03)		(0.06)		(0.04)
Pseudo R^2	0.55	0.56	0.32	0.41	0.55	0.56	0.31	0.42

Notes. 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. Slope coefficients and p-values on the *Officer × Hierarchy* variables are in bold. The regressions include but do not report dummy variables that equal 1 when the associated variable has missing data and 0 otherwise. The cohort regressions also include but do not report dummy variables for each POW camp. All variables are defined in Table 2. There are 102,334 observations. (Robust p-values in parentheses are clustered by either captured cohort or camp cohort.)

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."

Lester Tenney, who was held at a camp on the Japanese mainland, explained to us how important trading was for survival. Nausea often prevented POWs from being able to consume their daily rice rations, and the climate and sanitary conditions of the camp made physical storage of the cooked rice impossible. Trading allowed sick POWs to exchange their current rations for future rations. Such exchange was so important that prisoners often risked their lives by trading even though the Japanese authorities had decreed that there would be no trading. 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."[14] Lester Tenney told us: "I was willing to gamble my life to trade for food." He lost the gamble as the Japanese found out about his trading. He was sentenced to be beheaded. He survived only because of a witty confession to the camp commander.[15] Others were not as fortunate.

The military's hierarchy could have adapted to this new environment and the potential value of market transactions by facilitating voluntary exchange among the prisoners by defining and assigning property rights and enforcing voluntary agreements. Reports of the prisoners suggest this did not happen. Instead prisoners report that the established hierarchy often interfered with trades. The few references Radford makes of the military's hierarchy are of efforts by senior officers to prohibit specific exchanges. For instance, he (Radford 1945, p. 198) writes, "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

[14] Everett Marion Perry and Associates. U.S.S. Canopus, AS-9. Last accessed May 29, 2012, http://www.evperry.com/canopus.html.

[15] Interview with Lester I. Tenney, January 23, 2009. Tenney is Emeritus Professor of Finance at Arizona State University. We highly recommend his extraordinary memoirs, Tenney (2000).

by the Senior British Officer, was now in a position to enforce price controls both inside and outside its walls." Some Allied officers even saw it their duty to enforce the Japanese prohibition on trading. For example, 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've got a lot to learn.' "[16]

The conflict between the military's hierarchy and trading is the central theme in Clavell's (1962) best seller *King Rat*. Although nominally a historic fiction about a Japanese POW camp, the book reflects Clavell's own imprisonment during World War II in the notorious Changi POW camp on the eastern end of Singapore Island. *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 between markets and hierarchies, Grey is attempting to maintain military discipline by stopping the King from trading. Clavell attributed his own survival to the King's successful circumvention of the military's prohibition on trading.

Although other camp survivors echo Cavell's thoughts on the conflict between the military's hierarchy and trading, we lack data to test formally this hypothesis. Several of our empirical findings, however, are at least consistent with this explanation. When we rerun the multiple regressions in Table 4 and delete the squared term of the log of the number of men in the hierarchy, in all four cases the term for the log of the number of men in the hierarchy is positive and highly significant (reported in earlier versions of the paper). Following Adam Smith's legendary insight that the division of labor is limited by the extent of the market, this finding is consistent with the proposition that larger cohorts offered greater possibilities for voluntary exchange and this, in turn, resulted in higher survival rates. (Although Smith was talking about production, his insight applies equally to exchange.)

If the military's hierarchy impeded prisoners' trading, it should have had the most detrimental impact when the hierarchy was most complete and when the environment offered the greatest possibility for voluntary exchange. One way to test this is to interact our hierarchy measures with the size of the hierarchy. When we do so (an unreported revision of Table 4), we find mixed results. On one hand, the interactive term is always negative. On the other hand, the term is (highly) significant only with the regressions involving the *Sameness* of a prisoner's captured cohort. A better test for inflexible hierarchies impeding markets would be to interact our hierarchy measures with the per capita Red Cross food shipments at a particular camp. If this interactive term were negative, we would have stronger evidence of a conflict between the military's hierarchy and voluntary exchange. We have attempted to secure these data both from the International Committee of the Red Cross in Geneva and the American Red Cross in Washington, D.C., but to no avail.

A final piece of evidence supportive of the conflict between hierarchies and markets is a comparison with the Vietnam War. During the Vietnam War, American prisoners were held in near isolation and thus had few, if any, opportunities to trade.[17] The accounts of these POWs seldom mention trading but instead extol the value of maintaining the military's hierarchy. The accounts of the World War II POWs, in a potentially telling contrast, seldom mention the value of the military's hierarchy but instead extol the value of trading.

7. Summary

Hierarchies are central in our way of life, whether it is in the army, in the university, or in a firm. Given this prominence, it is understandable that researchers are making increasing efforts to understand hierarchies. Much of this research is theoretical, but some of it is empirical.[18] Ours is one of the few papers to compare hierarchies of widely different group sizes and to consider all levels of a hierarchy. To conduct these investigations, we propose two measures of hierarchies that can be used to investigate hierarchies in other settings.

We investigate the success and adaptability of hierarchies by studying a high-stakes natural experiment, American soldiers held captive during World War II. We find that the steeper was a prisoner's hierarchy or the closer was the shape of his hierarchy to the shape of the established military hierarchy, the lower was his survival rate. These findings are robust to how we define a prisoner's cohort, to a wide variety of individual prisoner and camp controls, and to alternative measures of hierarchy. Furthermore, these results hold both for prisoners held by the Germans and for

[16] Reminisces of J. J. Carter in Knox (1981, p. 415).

[17] Stockdale and Stockdale (1984) or McCain and Salter (1999). Senator John McCain was held in solitary confinement for two years. This was virtually unheard of among American POWs during World War II.

[18] Rajan and Wulf (2006) note the imbalance between the number of theoretical and empirical papers on hierarchies. Other notable empirical papers on hierarchies are Scott et al. (1996), Karpoff (2001), Guadalupe and Wulf (2010), and Csaszar (2012).

prisoners held by the Japanese, even though the latter was a far harsher situation.

One interpretation of these findings is that a hierarchy developed for one environment, winning battles, did not adapt well to a related but different environment, surviving captivity. Although a command and control might be optimal for the battlefield, it is less appropriate for a POW camp. The accounts of the POWs themselves and some of our findings raise the possibility that the military's hierarchy impeded trading among the prisoners. Perhaps in other settings hierarchies are more flexible and valuable. But among those Americans held captive during World War II, this does not appear to be the case.

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