U.S. ARMY PROCUREMENT OF DRAFT AND PACK ANIMALS IN THE CIVIL WAR ERA

Larry Sawers
American University

The old adage attributed to Napoleon that an army marches on its belly reminds us of the importance of supplying an army in the field. Logistical supremacy cannot win a battle by itself, but adequate supply is necessary to the ultimate success of any military campaign. The North's naval blockade of the South and its overwhelming dominance of rail transport proved decisive in the outcome of the Civil War. Soldiers must be fed, clothed, and provided weapons, and these supplies must be carried from dock or depot to camp. During the Civil War, mules and horses transported most of the supplies that provisioned the combatants. The economics of the army's procurement of draft and pack animals is thus a crucial, though little studied, aspect of the Union's victory.

Kyle Kauffman's 1996 article in this journal, "The U.S. Army as a Rational Economic Agent: The Choice of Draft Animals during the Civil War," returns to a theme that he has developed in several publications: the role of agency in the choice between the mule and the draft horse [Kauffman 1992; 1993a; 1993b; 1996a; 1996b; 2000; Kauffman and Liebowitz, forthcoming; Galassi and Kauffman, undated]. He argues that the army chose the abuse-resistant mule instead of the horse—despite the mule's higher price—where soldiers using the animals were not closely monitored by officers and thus were more likely to abuse the animals in their charge. He finds a statistically significant and positive correlation between the ratio of enlisted men to all soldiers (enlisted men plus officers) and the ratio of mules to all draft equines (mules plus horses) in 486 U.S. army installations between 1863 and 1866, and argues that this correlation corroborates his hypothesis that monitoring costs determined the choice of military draft animal.

Kauffman describes two differences between horses and mules that are widely noted in the literature on equines. While the horse can be driven to the point of exhaustion or even death, the mule will stubbornly resist its handler's demands when it becomes fatigued or overheated. Additionally, the horse can make itself sick by eating and drinking too much, but the more sensible mule generally will not. For both these reasons, inattentive or incompetent animal handlers can injure or kill a horse more easily than a mule. Kauffman concludes that a rational army procurement strategy would have selected mules rather than horses in situations where the animal handlers could not be carefully supervised. Conversely, units in which soldiers were better monitored (that is, units with a higher ratio of officers to soldiers) would have preferred horses since they were everywhere about 10 percent cheaper than mules

Larry Sawers: Department of Economics, American University, Washington, D. C. 20016-8029.
E-mail: lsawers@american.edu

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during the period in question [Kauffman 1996, 334]. There are several troublesome issues raised by Kauffman's agency hypothesis.

SOME PROBLEMS WITH THE AGENCY HYPOTHESIS

An examination of the army's procurement practices in the 1860s suggests that the army gave little attention to price, and that a 10 percent price difference between mules and horses was unlikely to have played an important role in the choice between the two animals. Fred Shannon's description of the effort to outfit the union army bears quoting: "Through haste, carelessness, or criminal collusion, the state and federal officers accepted almost every offer and *paid almost any price* for the commodities, regardless of character, quality, or quantity. . . . In the purchase of horses and mules . . . the most unblushing frauds were perpetrated" [1928, Vol. I, 55, 64, italics added]. Moreover, the army did not pay anything for many of the animals that it acquired, so did not have to pay the price premium for mules. From the beginning of the war, field commanders confiscated mules and horses (and other supplies) without compensation from those who could not prove their loyalty to the Northern cause [Simon, 1969, Vol. I, 311; Vol. II, 388, 401; Shannon 1928, Vol. I, 239–43]. Some of this foraging was against orders, but officers rarely disciplined those who took what was needed.

A second problem with the agency hypothesis is that it recognizes only part of the agency costs associated with equines. Although mules might survive rough treatment that horses could not, mules can become extremely difficult to handle once mistreated. The mule quickly learns to behave badly with inept, uncertain, or unkind treatment. Mules are legendary for their ability and eagerness to exact revenge with bites and potentially lethal kicks [Bradley, 1998, 315, 320–21, 337]. Soldiers can injure or kill horses, but mules can injure or kill soldiers. The mule has certain advantages if its handlers are indifferent or unskilled (it is a sturdier animal), but certain disadvantages as well (it more easily learns uncooperative behavior). The principal-agent hypothesis speaks to the advantages but not the disadvantages of using a mule that might face mistreatment, and thus overstates the importance of agency.

Even if one assumed that the military bureaucracy,[1] widely regarded as archetypically inefficient, thoughtfully considered the relative merits of the mule versus the horse and decided which animal should be assigned to which kinds of units, it is not clear how quartermasters could have complied with the official procurement strategy, even if they knew of and wished to conform to that policy. Quartermasters would have been required to adjust the proportion of mules to the staffing ratio in each command, even though both of these ratios varied sharply from month to month, as battle casualties, disease, recruitment, and desertion changed the number of officers, enlisted men, mules, and horses in very different ways.

Lastly, to test the agency hypothesis, one must be able to measure the intensity of agency problems. Kauffman assumes that the "severity of the agency problem varied across each fort, outpost, division and brigade, depending on the relative number of enlisted men to officers" [1993b, 337]. In other words, enlisted men in units where each officer had to monitor many men, were poorly supervised.[2] This presumes that

the chief task of officers was to monitor enlisted men (or monitor junior officers who in turn monitored enlisted men). In fact, many military officers held staff positions; supervising enlisted men did not figure prominently among their duties. Officers included administrators, doctors, recruitment officials, logistics specialists, accountants, political attachés, intelligence analysts, and attorneys. Given the wide range of military activities performed at different installations and by officers attached to those installations, it is by no means clear that enlisted men in units with a high proportion of officers were more closely supervised. Compare, for example, the relaxed atmosphere of a small recruiting post in Rhode Island staffed mostly or entirely by officers to the taut discipline that a handful of officers would have imposed on a sprawling infantry encampment in Mississippi preparing for the next day's battle. The ratio of enlisted men to total soldiers may only reflect differences in the functions performed by the installation or by the officers attached to it and tell us nothing about how carefully officers supervised enlisted men.

If the agency hypothesis does not work, what then would be a rational procurement strategy for the army?

TRANSPORTATION COSTS AND EQUINE PROCUREMENT

During the war, quartermasters were unlikely to have been overly picky about the choice of draft animals for their units. The survival of their comrades in arms—and, indeed, the nation as a whole—was at stake. Just after the war, the area in which most of the army was stationed was in chaos. The transportation infrastructure lay in ruins, guerrilla bands threatened supply convoys, and the institutions needed to undergird the economy, including equine markets, had collapsed. The number of draft animals in the lower South during the period in question had just dropped by at least one-third [Lamb, 1963, 33–34],[3] but draft animals were among the army's most critical requirement. Given the urgent need for draft animals and their extraordinary scarcity, the rational procurement officer might have requisitioned anything that walked. Calculations about whether the mule was really worth an extra 10 percent for one brigade but not for another would have been irrelevant.

If the army procured animals that were already close to where they were needed, then army units operating in regions where mules were prevalent would have had higher mule/equine ratios than units operating where mules were scare. This point forces our attention to the geographical distribution of mules and horses as the war began. Most of the country's mules (83 percent) in 1860 were in the lower South, where they were used as draft animals, or in the border states, where they were bred [Lamb 1963, 33]. The use of mules also varied widely across the South, from 10 percent of all draft equines in Virginia to 40 percent in Louisiana. In the lower South as a whole, 33 percent of draft equines were mules, in the West, 11 percent, and in the North, only 3 percent.

Biological differences between mules and horses explain the geographical distribution of equines. The mule was widely used on Southern farms by the 1860s and as a draft and pack animal in the West, but was rare in the North. The reasons for the mule's popularity in the South had to do with regional variations in mule prices

relative to horse prices, the greater heat tolerance of the mule, and the crops that were grown in the region [Sawers, forthcoming].

Since it is more difficult to breed mules than horses, specialists tended to dominate mule breeding whereas farmers often bred their own horses. Thus, mule breeding was far more concentrated geographically than horse breeding. Second, the seasonal pattern of rainfall and acid soils of the South produced generally poor pastures. In the 1860s mule breeding was found mostly in three border states with good pasture land—Missouri, Tennessee, and Kentucky [Bradley, 1998, 92]. Since farmers paid the delivered price of the mule, the higher the transportation cost from these three states, the higher was the price of the mule relative to the price of the horse. Mules were cheaper in areas near or down river from the principal mule-breeding states and more expensive on the eastern seaboard. Although the hot Southern climate discouraged the breeding of mules, it encouraged their use because of the mule's ability to withstand hot and humid conditions that prevailed in much of the region.

The crops that dominated Southern agriculture in the 1860s were cotton, tobacco, and sugar. The first two crops are grown in rows, a cultivation pattern especially appropriate to mules because of their agility and responsiveness to voice commands. Sugar was grown in the most hot and humid parts of the South, hence the nearly exclusive use of mules in sugar cultivation. In addition, most of the sugar was grown on large plantations; as explained below, operations using large numbers of animals would have preferred mules over horses. In contrast, Northern agriculture was dominated by the cultivation of small grains (not grown in rows) or corn (grown in widely spaced rows in the nineteenth century), so the agility and responsiveness of the mule was less important. Moreover, large farms with many animals were extremely rare in the North. Given the distinctive biological characteristics of the two animals, species-specific animal markets and human capital developed, further molding the choice of draft animal.

In the West, mules were an especially appropriate choice as draft and pack animals. Their steady temperament and responsiveness to voice commands made them good draft and pack animals in general. Moreover, their sure-footed agility made them superior to horses in mountainous terrain. Their heat tolerance made them superior to horses crossing the deserts of the Southwest.

Before the war began, mules were therefore very unevenly distributed across the United States. After the war began, the army incurred the cost of transporting the animal from where it could be obtained to the point of service, whether civilian agents or the army itself transported the animal, and whether or not the army paid anything for the animal. Even in peacetime, transport costs could be half the retail price of the mule. In 1920, for example, mules in South Carolina were nearly twice as expensive as in Missouri, the most important breeding state [Bradley, 1998, 200]. During and just after the war, transport costs would have been far higher than during peacetime. If the procurement decision was time constrained, as is common in wartime, transport costs could have been infinite. If these propositions are correct, economizing on transport costs would have played a prominent role in the army's procurement of draft animals.

THE MULE AND THE SIZE OF THE INSTALLATION

If quartermasters did try to match the mix of mules and horses to the characteristics of the military command, what characteristics of the unit would have been salient? I have argued that the enlisted men/soldier ratio would tell us little about the unit that was relevant to draft animal procurement.[4] Moreover, the differences between mules and horses suggest that quartermasters might have paid attention to the number of animals assigned to the military command when they were choosing between mules and horses, favoring mules where large groups of animals were needed. There are at least three reasons why large groups of mules in a military setting are easier and cheaper to handle than large groups of horses.

Large groups of horses are awkward for handlers because of the horse's tendency to overeat or over drink, which can lead to sickness and even death. Preventing horses from eating and drinking each other's food and water requires separate stalls or widely spaced tethering. Preventing horses from consuming too much of their own food and water requires the frequent distribution of small quantities of provisions. In contrast, mules are more sensible at the trough and can be kept together in large corrals, feeding and drinking from a common source and stopping when they are satisfied. Food and water can be provided for more than one day at a time without any need to monitor how much the animals are eating and drinking.

A second reason why large groups of mules are easier to manage than large groups of horses is because horses (stallions, mares, and even geldings) fight among themselves for dominance [Bradley 1998, 74, 318]. Mules, on the other hand, have little interest in establishing a pecking order, and large groups can be corralled without the animals fighting over which is to be the dominant animal.

A third reason why large groups of mules in a military setting are more economical is their greater resistance to disease and injury. Draft horses were about six times more likely to become ill than mules in the Mexican War and again in World War I [Lamb, 1963, 28; Bradley, 1998, 313], and presumably a similar ratio prevailed during the Civil War. In the data set analyzed below, less than 1 percent of mules in U.S. military installations from 1863 to 1866 were out of service, compared to nearly 14 percent of horses. The two most common sources of draft animal mortality in military campaigns were skin disease and stampede, both of which are a greater problem in large groups of animals than in small groups. The mule's widely noted resistance to disease and their disinclination to stampede made them especially appropriate for military draft work where large numbers of animals were used.

In sum, large groups of mules are easier to handle than large groups of horses, especially in a military setting, for reasons related to the mule's prudent eating habits, disinclination to fight over dominance, and lower mortality and morbidity in military campaigns. Note that this argument works independently of any agency issues, that is, it is easier to manage large groups of mules no matter how well or poorly one is able to monitor the animal handlers. To properly understand the choice of equines by the army, one needs to address the difficulties in managing animals and to abandon an exclusive focus on the difficulties in managing animal handlers.[5]

A STATISTICAL TEST

The foregoing discussion suggests that commands in parts of the country where mules were prevalent would have had a higher mule/equine ratio than otherwise. Moreover, mules would have been especially favored in Western commands. Third, army units with large numbers of draft animals would have been more likely to use mules over horses. I tested these hypotheses using the same source of data that Kauffman employed, the "Report on the Means of Transportation, Number of Officers, Men, Animals, &c." These reports were sent monthly by every army corps or outpost in the country to the Quartermaster General's office in Washington. I drew a 10 percent sample of the extant reports.[6] From this sample, there were 85 usable reports.[7]

Using this data, I estimated an ordinary least squares (OLS) multivariate regression. The dependent variable was the ratio of mules to all draft animals in each installation (*MULE/EQUINE RATIO*). The independent variables were the proportion of draft animals that were mules in the state in which the command was located (*MULE PREVALENCE*), a dummy variable that equalled one if the command was located in the West and zero if not, and a dummy variable (*LARGE COMMAND*) that took the value one if the command had more than 50 draft animals and zero if there were 50 or fewer draft animals.[8] I also included the variable that Kauffman used to test the agency hypothesis, the ratio of enlisted men to all soldiers (*SOLDIER RATIO*). The t statistic is in parenthesis underneath the regression coefficient:

(1) *MULE/EQUINE RATIO* =

.977	– .678 *SOLDIER RATIO*	+ .206 *LARGE COMMAND*	+ .661 *MULE PREVALENCE*	+ .162 *WEST*
(.757)	(–.843)	(2.40)	(2.50)	(1.95)

The R^2 is .202 and the F statistic is significant at the 99.9 percent level. Mule prevalence and the size of the command are significant at better than the 98 percent level and the location in the West dummy is significant at the 94.5 percent level. All three coefficients have the predicted sign. The proportion of enlisted men to all soldiers is insignificant and with the wrong sign, offering no support to the agency hypothesis.[9]

As measured by the standardized regression coefficient (β coefficient) and the partial correlation coefficient, the most important independent variable was the prevalence of mules in the state in which the military command was located. Other things equal, commands located in the state with the highest mule prevalence would have had a mule/equine ratio 24 percentage points higher than commands in the state with the lowest mule prevalence.[10] Other things equal, western commands had mule/equine ratios that were 16 percentage points higher than other commands, and commands with more than 50 draft equines had mule/equine ratios that were 21 percentage points higher than smaller commands. The regression results provide strong support for my hypothesis that the army's preference for mules instead of horses was mostly a matter of location and size of the installation.

CONCLUSION

The agency hypothesis flows naturally from the presumption that, from the army's point of view, the only salient advantage of the mule over the draft horse is the former's resistance to abuse.[11] In fact, mules differ from horses in a variety of ways that have potential implications for military procurement. Abused mules are more intractable than abused horses. Mules are more steady, less skittish, easier to keep healthy in large groups (because of their more disciplined feeding habits, their disinterest in dominance, and their resistance to disease and stampeding), more heat tolerant, and more difficult to breed (hence the geographical specialization in mule breeding). The relative price of mules compared to horses varied systematically with transportation cost from mule breeding regions. Their sure-footed agility and responsiveness made them especially appropriate in the cultivation of certain crops and as pack animals in mountainous terrain. For all of these reasons, the use of mules in civilian transport and agriculture in the 1860s varied substantially by geographic location. In this article, it was hypothesized that a rational procurement strategy would have taken these factors into consideration.

In a sample of U.S. military commands between 1863 and 1866, the proportion of mules among all draft animals varied positively with the prevalence of mules within the state where the command was located. This is consistent with the hypothesis that army procurement officers tended to choose the animal that was readily available. It was transport costs rather than agency costs that played the most important role in shaping procurement decisions. The data also show that Western commands, other things equal, had a higher ratio of mules to equines than other commands. Mules would have been especially appropriate in the West given the terrain and climate of the region. Lastly, the analysis shows that, to the extent that army procurement paid any attention to the installation for which they acquired draft animals, it was the number of draft animals, not the proportion of officers, that was important. This is to be expected since large groups of mules are easier to manage than large groups of horses.

NOTES

1. His quoting the Quartermaster General [Kauffman, 1996, 335–36] suggests that Kauffman believed the strategy to have been set at the highest levels.
2. The direction of causation may have run in the opposite direction. Units with discipline problems may have been assigned a disproportionately large number of officers. In that case, a high proportion of enlisted men would indicate low agency problems, the opposite of what Kauffman assumes.
3. It is most likely that the one-third intercensal decline in draft animals during the 1860s is an average of an even larger drop during the first half of the decade and an increase after the war was over.
4. Kauffman and I draw our data from the "Report on the Means of Transportation," which does not give the number of draft horses, only the number of horses other than cavalry, artillery, and privately owned horses. Most of these horses were probably draft horses, but some could have been mounts for officers who did not own their own horses. Installations with many officers needed more horses for those officers to ride. Accordingly, Kauffman's regressions may show only that officers, some of whom did not own their own mounts, rode horses.
5. Kauffman's data show that smaller military commands, especially very small ones (fewer than 100 enlisted men) had (1) high proportions of officers among all soldiers, (2) high proportions of horses among all draft equines, and (3) smaller absolute numbers of draft animals than did larger com-

mands [Table 2, 339 and Figure 2, 340]. He finds a highly significant statistical correlation between the first two variables, but I argue that he should have looked for a correlation between the second and third variables. Given the high degree of multicollinearity, one cannot be sure whether it is the size of the installation or the staffing ratio that 'explains' the mule/equine ratio, and thus Kauffman's claim that his statistical analysis corroborates the agency hypothesis is problematic.

6. I excluded from the sample reports with no enlisted men, no officers, or no draft animals, reports where the location of the installation was not recorded or was illegible, and more than one report per year from any one installation. Note that the universe from which the sample was drawn was all reports, not all installations. Some of the reports contained information for a single installation, but other commands reported on several units (twenty or more). Some of these could have been battalions located in the same encampment, but others were clearly widely dispersed outposts. One report from the St. Louis command, for example, included data for New Mexico, Minnesota, and Kansas.
7. There are about 1500–2000 reports located in the National Archives and Records Administration in Washington. (Since counting the fragile reports leads to their physical degradation, I only estimate the number of reports.) Kauffman states that only 486 reports survive; I have no explanation for why I was able to locate many more reports than Kauffman could find. Kauffman asserts that his sample is unbiased [1993b, 337] without offering any evidence or argument to justify the claim. Until we know how Kauffman selected the 486 reports, we do not know whether they represent an unbiased sample of extant reports. Of course, neither of us know whether the extant reports are an unbiased sample of all reports since we do not know why most of the reports did not survive.
8. In my sample, there were no commands with between 40 and 100 draft equines, so within this range the statistical results are insensitive the cut off.
9. I also replicated Kauffman's statistical analysis with my sample with a bivariate OLS regression in which *MULE/EQUINE RATIO* was regressed on the *SOLDIER RATIO*.

$$\underset{}{MULE/EQUINE\ RATIO} = \underset{(.823)}{.852} - \underset{(-.250)}{.216\ SOLDIER\ RATIO}$$

The R^2 is .001; the regression coefficient is insignificant and does not have the sign predicted by Kauffman. Because he no longer has a copy of his data, the two data sets cannot be compared to explain the very different results.

The reports to the Quartermaster General also enumerate animals that were out of service (presumably lame, diseased, or wounded), allowing us to test Kauffman's hypothesis directly. If poorly supervised troops were more likely to abuse the army's animals, the ratio of enlisted men to total soldiers should correlate positively with the proportions of animals that were out of service. Instead, the correlations are negative and significant at the 99.9 percent level. The table below presents the statistics for OLS regressions using the proportion of mules, horses, and total animals (including cavalry, artillery, and privately owned horses) that were out of service as the dependent variable and the ratio of enlisted men to soldiers as the independent variable. These regressions offer no statistical support for Kauffman's hypothesis.

Percent Out-of-Service Animals to All Animals Regressed on the *SOLDIER RATIO*

Dependent variable	**Regression Coefficient**	***t* statistic**	**R^2**
Ratio of out-of-service mules to all mules	−2.68	−6.09	.334
Ratio of out-of-service horses to all draft horses	−3.04	−5.09	.254
Ratio of out-of-service equines to all equines	−1.69	−4.33	.176

10. Mule prevalence here is measured by state. Nevertheless, it was many days' march across most Southern states where most of the army was stationed, and mule prevalence varied widely in different parts of every state. A measure of mule prevalence in the environs of each command would have been preferable to the state-wide measure, and county-level data on mule prevalence is available. Unfortunately, the precise location of many commands could not be determined.
11. Kauffman made this assumption explicit when he said, "As in this [acclimation to the sounds of war] and virtually every other respect, horses and mules are near perfect substitutes when it comes to draft work [342, footnote 13].

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