An Empirical Analysis of New Orleans Slave Auctions: 1840-1860

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Abstract

Auctions were legally required in New Orleans estate sales during the 1800s. Since records of slave transactions were carefully documented, we are afforded the opportunity to test whether the number of bidders increased or decreased during this period using well-developed empirical methods. Auction theory tells us that the winning bid in a private-value auction will increase if an additional bidder is added. Therefore, if the number of bidders increased between 1840 and 1860, this would suggest that westward expansion was influential in the increase in average price of slaves during the same period. If the number of bidders decreased, the only remaining argument would be that slaves were simply becoming more valuable assets. We find that the number of bidders decreased over the period, so we can argue that slaves were becoming more valuable and that the increase in price was not merely a frontier effect that could not be sustained. Our results fortify the conclusion that slavery was not going to die due to economic obsolescence, and that the Civil War was a necessity to settle the future of slavery in the United States.

1. The Profitability of Slavery in General

For many years, it was believed that slavery was unprofitable in its later years, and thus the Civil War could have easily been avoided without undue economic hardship for the southern states. This paradigm was dubbed "the Phillips school" by Fogel and Engerman (1974) after U.B. Phillips, the most influential historian of the ante bellum south. Several of these early scholars, such as Charles Ramsdell (1929) and Eugene Genovese (1965) argued that slavery would not have continued to exist without the territorial expansion of slavery. In particular, the rapid deterioration of the soil in the Southeastern U.S. was making expansion into states with more fertile soil necessary for the U.S. to continue to lead the world in cotton production. Indeed, Genovese argues that, even on the frontier, land could not be reclaimed once it had been utilized for cotton, and crop rotation was rendered impossible. The natural conclusion is that the interregional trade of slaves was propping up slavery in the 'Old South' (this term will generally refer to Maryland, Virginia, the Carolinas, Georgia, and Alabama. Meanwhile, Tennessee, Arkansas, Louisiana, and Texas will be termed the 'New South.').

Conrad and Meyer (1958) did much to counter the Phillips school. Conrad and Meyer made the case that slave labor was quite profitable in the New South. However, considering the lower level of production in states such as South Carolina and Alabama, the rates of return seen in the Old South do not seem to reach the level of railroad or municipal bonds until possible profits from the slave trade are factored into the analysis. Conrad and Meyer are unambiguous on this point, offering "Slavery in the immediate ante bellum years was, therefore, an economically viable institution in virtually all areas of the South *as long as slaves could be expeditiously and economically transferred from one sector to another* (emphasis added)."

In *Time on the Cross* (1974), Fogel and Engerman reviewed Conrad and Meyer's work and concluded that Conrad and Meyer's rates of return were too low because the authors underestimated slave productivity. Fogel and Engerman pointed out that Conrad and Meyer utilized rates of productivity growth that were not current. Utilizing their estimates instead of Conrad and Meyer's productivity estimates, Fogel and Engerman concluded that the average rate of return on a slave was approximately ten percent and was consistent across geographic regions.

Fogel and Engerman's primary basis for positing that slavery was universally profitable in southern America was the work of Evans (1962). Evans utilizes the rates of hire for slaves as the gold standard for the revenue of slave holders. Indeed, the practice of hiring slaves out for other activities was quite common. In fact, the proportion of slaves under hire in Richmond during 1860 was over fifty percent (Fogel and Engerman 1974). Evans asserts that rates of return ranged between 9.5 and 18.5 percent between 1830 and 1860. These rates were noticeably higher than the returns that could be expected from bonds and other similar instruments during this period. However, it is unclear whether these results would have continued to be valid after the construction of the railroads was virtually completed, since railroad construction undoubtedly explained much of the excess demand for slave labor.

Evans goes on to consider the broader question of slavery's ultimate viability. Evans posits that, if slavery were actually moribund, the price of slaves themselves should have declined. Since this was clearly not the case, Evans claims that slavery was on a firm grounding for the foreseeable future. In the end, this argument, with the addition of the likelihood that worldwide demand for cotton would have remained strong (if the war

would not have happened) in Great Britain during the mid-to-late 1800s, seems compelling that slavery would have thrived in the New South at least until the end of the century. The future of slavery in the Old South is a much more interesting question.

2. Returns to Slave Labor in the Old South and Westward Expansion

Ramsdell (1929) propagated the 'natural limits' thesis, which essentially holds that climate and soil effectively set a geographical limit to the extension of slavery. In fact, Ramsdell posited that this natural limit had been reached by 1860. As noted earlier, Genovese (1965) and Conrad and Meyer (1958) subscribe to the related view that slavery in the Old South could not survive (at least profitably) without westward expansion and profits from the slave trade. The continued degradation of the soil in the more established slave states as well as the perverse lowering of the price of cotton due to interregional migration/trading make this argument intuitively appealing. The powerful sentiment of southerners concerning the westward expansion of slavery further fortifies this conclusion. The argument could be made that concern over the complete banning of slavery due to loss of political power (fewer slave states relative to free states) was the true worry of southerners. However, this hypothesis is undermined by the fact that secession would have been an absolute certainty in that case. The complete outlawing of slavery was not politically tenable (the Dred Scott decision in 1857 made the banning of slavery impossible without a constitutional amendment), and southerners were completely aware of it.

The most obvious route to take in analyzing the effect of westward expansion on slave prices, and thus on profitability in the Old South, would be to examine the historical data on westward expansion. The best available estimates are that approximately

835,000 slaves were moved from the Old South to New South states between 1790 and 1860 (Goldin (1972) and Calderhead (1972)). Fogel and Engerman (1974) claim that the low percentage of interregional sales indicates that intervention in slave reproduction was not occurring in the Old South. This inference neglects the possibility that prospective migrants procured slaves before they actually moved. Procurement before relocation would be eminently sensible because of the presumably large transaction costs associated with returning to acquire slaves. It is difficult to imagine that migrants would sit idle at their new home and then suddenly realize slaves would be needed. Indeed, Pritchett (1998) and Tadman (1989) estimate that the percentage of migrating slaves originating out of the slave trade was fifty and sixty percent, respectively.

Another way to approach this problem is to construct an equilibrium model and attempt to draw conclusions concerning the effect of westward expansion on the price of slaves. Obviously, westward expansion would tend to inflate slave prices due to increased demand, but the resulting decrease in the price of cotton would tend to decrease the value of the labor producing that cotton. Passell and Wright (1972) and Kotlikoff and Pinera (1977) conclude that the suppression of cotton prices involved with the selling of slaves to those in the west overwhelmed the increase in demand for slaves, so westward expansion had a net negative effect on the prices of slaves. As Schmitz and Schaefer (1981) note, the negative results of both papers depend crucially on the price elasticities of both cotton and land. Schmitz and Schaefer contend that Passell and Wright and Kotlikoff and Pinera used poor estimates of these price elasticities, causing their results to be severely flawed. Schmitz and Schaeffer then utilize the arguably more reliable elasticity estimates of Wright (1971). They were then able to conclude that expansion

had a slightly positive effect on the prices of slaves. Clearly, the explicit dependence on a proper specification of these elasticities continues to be an issue.

In this paper, we drop any reliance on price elasticities. The vital assumption will be that bidders' individual values assigned to slaves available for auction follow a certain distribution, in this case a lognormal distribution with a specified standard deviation. It could certainly be the case that this assumption is every bit as onerous as assumptions concerning elasticities, so we will find it necessary to test the sensitivity of the results to violations of this assumption in later work. Regardless, we obtain a result that is wholly independent of any others currently in the literature.

Our approach will be to utilize the techniques of Laffont, Ossard, and Vuong (1995) to estimate the number of bidders in an auction. Therefore, we will find it possible to separate the effects of an increase in demand (represented by an increase in the number of bidders), and the mean intrinsic value bidders assign to the slaves offered for auction in New Orleans between 1840 and 1860. Therefore, we plan to separate the effects of westward expansion from the buyers' perceptions of the value of slave labor. A large increase in the number of bidders would point to westward expansion as the primary catalyst for price growth, while a decrease indicates slaves were becoming more valuable. The implications for the imminent demise of slavery in the Old South are clear: an increase in the intrinsic value of slave labor was necessary for the perpetuation of intervention in slave reproduction as the basis of profit because the 'natural limits' theory would eventually carry the day due to an always limited amount of arable land. The structure of this paper is as follows. In section 3 we describe how the data was collected and summarize the data to compare it with results from previous studies. In section 4 we

provide a brief introduction to auction theory. In section 5 we develop the econometric model and present the results. Section 6 concludes.

3. Description of the Data, Data Collection, and Comparison with Straight Sales of Slaves

Slave auction data was collected from the New Orleans Notarial Archive[1]. The observations were obtained through a manual search of individual notarial acts concerning the sale of slaves. Each notary collected his/her acts in a ledger which were not sorted by transaction type. Therefore, all the acts in a notarial ledger were skimmed to determine whether they concerned the auction of a slave. Some notarial ledgers were written in Creole French and some were written in English. When it was determined that a notarial act concerned the auction of slave(s), the relevant information was collected from the act. Data was not collected if it was not explicitly stated that the sale was facilitated by use of an auction. Since a notarial act was a legal document, the data collected in this manner is likely to be quite accurate. The acts were categorized by notary and then by year within each notary.

For several reasons, the collected data cannot totally be considered a random sample of slave sales between 1840 and 1860. First of all, our sampling was designed to gather data from specified individual years so some years have been missed. Secondly, a subset of notaries known to specialize in estate sales was selected for searches. Therefore, other biases that could result from these notaries' clienteles could be present.

The current analysis examines data from slave auctions occurring between the years 1840 and 1860. Selecting such a relatively short window of time allows for control of

[1] The New Orleans Notarial Archives is a repository of signed acts compiled by the notaries of New Orleans, Louisiana between the years of 1731 and 1970. More information can be obtained at http://www.notarialarchives.org.

such variables as political climate and number of slaves on sale in the market. Since information concerning many economic variables is not available for this time period, the effects of many potentially confounding variables cannot be adequately captured.

The dataset contains information concerning the year of the auction, age, sex, and skills of the slave, notary recording the act, the population of New Orleans, the price of cotton, and the productivity of slaves in general during the years in question. The only variables not available from the notarial archives are the population of New Orleans, the price of cotton, and the productivity of slaves. The population of New Orleans for the years 1840, 1850, and 1860 was collected from the U.S. Census for those years. In the intervening years, an exponential growth rate was assumed. The price of cotton and the productivity of slaves were taken from Conrad and Meyer (1958). Data is available for over half of the years between 1840 and 1860.

It will be useful to compare summary statistics from our data to those presented in Kotlikoff (1978) and Fogel and Engerman (1974)[2] to get an indication whether our data are comparable to that used in those studies. We might first want to compare yearly means for slave prices. Figure 1[3] below summarizes these means[4].

[2] Kotlikoff uses the data from Fogel & Engerman (1977). For convenience, we will label this data as F&E.
[3] Data from Phillips (1929) estimated from Chart 1 in Kotlikoff (1977).
[4] A more complete summary of the data is included in the data appendix.

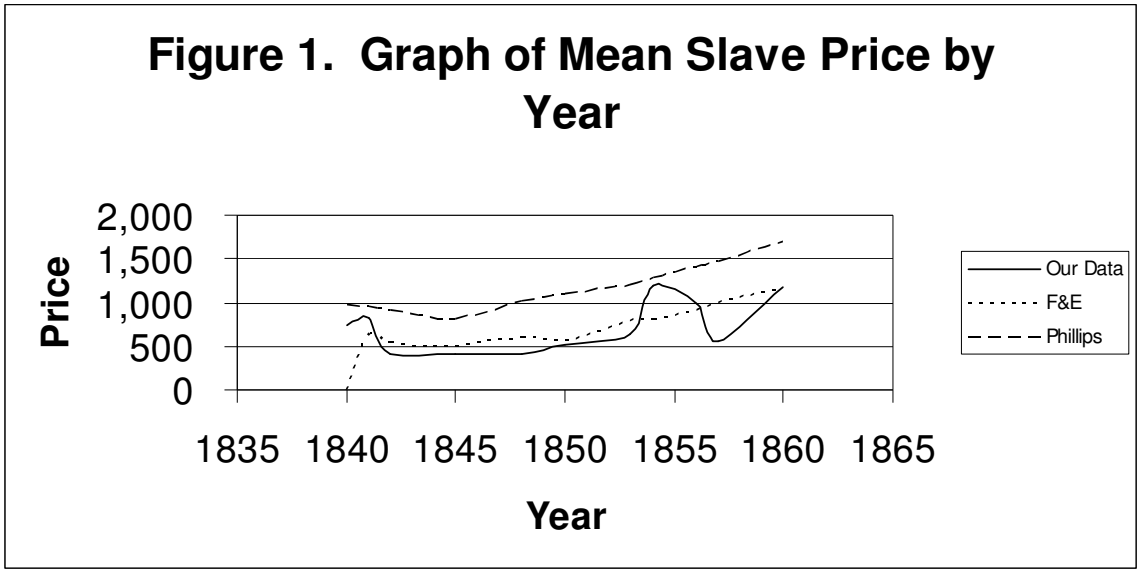

Figure 1 compares the temporal patterns of slave prices of our data with Fogel and Engerman (1974) and Phillips (1929). The downturn in prices seen in 1857 in this data is not seen in Fogel and Engerman, but their data does indicate a downturn in prices around 1855. The upturn in prices in 1841 is also not seen in Fogel and Engerman's data, but it is a very minor up tick in this data considering the sample size. These summary statistics are also consistent with those given by Phillips (1929). Not only do prices seem to follow a similar time pattern, but the overall mean price levels appear to be consistent.

We also want to investigate whether there is a gender premium involved, since much is made of this in the literature due to the hypothesis of intervention in slave reproduction. We find that there is a 36% premium for buying a male versus a female in this dataset. This is alarming because the literature suggests a 10-15% premium for males relative to females. There is a 15% premium in Fogel and Engerman's data. If anything, this provides more strength for our private values assumption because, if reproductive intervention were a major concern for these particular slaves, we would not see such a large gender premium. It seems clear that these slaves were being bought for

use as field hands and not for resale. This significant discrepancy should be kept in mind when we analyze our results later on in the paper.

We can also investigate how sales price varies with age. Significant differences could arise in the price/age profile for a number of reasons, for example differing compositions of house slaves as opposed to field hands in auction sales versus regular sales.

In Figure 2, we present the results of a polynomial regression using age to explain price. Our data has a more pronounced slope, but the general relationship is almost identical to that found by fitting the same model to Fogel and Engerman's data[5].

[5] A third-order polynomial was utilized. All of the parameter estimates were statistically significant ($p < 0.10$) at this level.

Next we estimate an exploratory reduced-form model of winning bids to compare to Kotlikoff's (1978) results for the sale of slaves for the years 1804 to 1862. Kotlikoff's dependent variable is the logarithm of the relative price, so this analysis will be consistent:

$$\ln b_n^w = \ln b_n^{(2)} = \ln v_n^{(2)} = x_n'\beta + \varepsilon$$

where $b_n^{(2)}$ is the observed price, $x_n^{'}$ is the vector of explanatory variables, and ε represents the error term. For now, we will assume that the errors on the bids that are observed are normally distributed. We will no longer assume this when we move beyond exploratory data analysis. Table 1 summarizes the results of this model.

Table 1. Regression Analysis Results

Explanatory Variable	Coefficient	t-Stat
Intercept*	-6.096	-2.76
Ln(Age)*	7.224	5.32
Ln(Age)^2	-1.180	-5.62
Gender*	0.2735	4.82
Skills	0.0730	0.829
Ln(Cotton price)*	0.7033	4.84

* - statistically significant at the 1% level

Although Kotlikoff splits the decades into separate regressions, we can comment on some similarities and differences in our results. Unlike Kotlikoff, we find that skills are not statistically significant. However, we agree with Kotlikoff on the signs and statistical significance of the age parameter estimates. In addition, both models find that gender is statistically significant.

In summary, although our data exhibits more variation than the data seen in earlier studies, it appears the data is, for the most part, consistent with other studies. The most important difference between our new data and others is that the gender premium is much higher than in other studies. As noted, this result actually helps solidify our private values assumption because such a large gender premium suggests the females were not being bought for intervention in slave reproduction. This is intuitively appealing because these slaves were to be working some of the most fertile crop land in the world, so short-term efficiency was important.

4. Brief Background on Auction Theory

Before auction data can be analyzed, several issues need to be addressed. The first concerns the format of the auction; the equilibrium strategy chosen by bidders will depend in a fundamental manner on how the auction is conducted. From the discussion in Phillips (1929), it is clear that slave auctions were conducted using a typical second-price ascending auction. That is, higher prices were barked by the auctioneer until only one bidder remained.

The second issue is whether bidders assigned a common or private value to a slave being auctioned. That is, we must decide whether bidders evaluated worth based entirely on their own valuation (pure private value auction), completely based on the valuation of others, including perhaps an expert (pure common value auction), or by some combination of the two (affiliated value auction). Fogel and Engerman (1974) and Fogel (1989) indicate that slaves were almost always purchased for private use by pointing out that the great majority of slave sales were estate sales. That is, plantation owners typically did not sell slaves unless they were bankrupt. As mentioned previously, slave

sales were mandated in New Orleans when ownership of slaves was not specified in a will. Therefore, the fact that a strong secondary market existed is mitigated by the fact that secondary sales were seldom conducted under ordinary circumstances, otherwise the slaves were to be utilized by the buyer until one of their deaths. A supporting reason for a private values framework is that the slaves sold in the auctions we are investigating were to be working some of the most fertile fields in the country. It would appear counterintuitive to resell if the owner was planning to use the slave in the most productive manner possible. We will assume that slave auctions were private-value auctions[6].

With these two key issues in mind (in addition, we will assume that bidders' private values are drawn independently from the same distribution), we can turn our attention to developing the theoretical model. Vickrey (1962) established that a weakly dominant strategy in a second-price ascending auction is to bid one's true value, or

$$b_{l,i} = v_{l,i}$$

where l represents the l-th auction and i represents the i-th bidder.

Therefore, the payoffs for individual bidders are

$$\pi_i = v_i - \max_{j \neq i} b_j$$

if the bidder wins the auction ($b_i > \max_{j \neq i} b_j$). Clearly, the payoff is zero if the highest bid bidder does not win the auction. Finally, the expected payment for bidder i is

$$\begin{aligned} m(v) &= \Pr(Win)\, xE[2nd \text{ highest bid} \mid v \text{ is the highest bid}] \\ &= \Pr(Win)\, xE[2nd \text{ highest bid} \mid v \text{ is the highest value}] \end{aligned}$$

[6] In fact, we are not able to identify the parameters in our model if slaves were a pure common value good (Athey and Haile 2000).

Myerson (1981) and Riley and Samuelson (1981) established that, if values are independently and identically distributed and all bidders are risk neutral, then all standard auctions yield the same expected revenue to the seller. This implies that we may use results applying to first-price auctions when these assumptions are met. Therefore, we may utilize the general methodology of Laffont, Ossard, and Vuong (1995) to analyze the New Orleans slave auctions. As Laffont, Ossard, and Vuong mention, we will be able to obtain structural estimates of the parameters under the private-values framework.

5. Econometric Methods and Results

The method of simulated non-linear least squares (SNLLS) of Laffont, Ossard, and Vuong (1995), based on the work of McFadden (1995) and Pakes and Pollard (1989), seems to be most appropriate for the analysis of independent and private-value auctions with an assumed distribution of private values. Ordinarily, maximum likelihood methods would be a compelling choice, but, the support of the distribution of winning bids depends on the parameter values themselves. This renders maximum likelihood methods inappropriate for estimation. Non-parametric and semiparametric models are also strong choices, but we do not possess a sufficient number of observations to make such techniques practical. Finally, Bayesian techniques such as those utilized in Bajari and Hortascu (2002) require the assumption of a prior distribution, so we do not feel that such a methodology would be more informative since we have scant prior knowledge concerning slave prices. More importantly, the number of actual bidders is not available for our study, and Laffont, Ossard, and Vuong's techniques allow for estimation of the number of bidders. Since these other estimation techniques are inappropriate, and

Laffont, Ossard, and Vuong's estimator is consistent and asymptotically normal under our assumptions, the SNLLS estimator is a compelling choice.

In the method of SNLLS, the distance between the observed winning bid and simulated winning bids is minimized. That is, the most intuitively appealing objective function is

$$Q_{s,l}(\theta) = \frac{1}{L}\sum_{l=1}^{L}(b_l^w - \overline{X}_l(\theta))^2$$

where L = number of auctions

s = number of simulations per auction

b_l^w = winning bid for i - th auction

$\overline{X}_l(\theta)$ = simulated winning bid for l - th auction

As shown in Laffont, Ossard, and Vuong, the estimator of θ that would result from such a minimization would be inconsistent. We introduce a bias correction term

$$\Delta_{S,L} \equiv \frac{1}{L}\sum_{l=1}^{L}\frac{1}{S(S-1)}\sum_{s=1}^{S}(X_{sl}(\theta) - \overline{X}_l(\theta))^2$$

so that

$$Q_{s,l}^{*}(\theta) = \frac{1}{L}\sum_{l=1}^{L}[(b_l^w - \overline{X}_l(\theta))^2 - \frac{1}{S(S-1)}\sum_{s=1}^{S}(X_{sl}(\theta) - \overline{X}_l(\theta))^2]$$

is our objective function, and our estimator will be the $\hat{\theta}$ resulting from minimizing this function. We can then use the results from Pakes and Pollard (1989) to establish that the given estimator will be consistent and asymptotically normal. We will utilize the fact that

$$Eb_l^w = E[\max(v_{l,(I-1)}, p_l^o)]$$

where p_l^o = reservation price (assumed zero here because these were estate sales)

to stimulate the first moment of b_l^w. As in Laffont, Ossard, and Vuong, estimation of the number of bidders will proceed utilizing a grid search methodology. The simulated bids will then by generated using the model

$$E \ln b_n^w = E \ln b_l^{(2)} = E \ln v_n^{(2)} = x_n^{'} \beta + \ln \rho_n^{(2)}$$

The distributional assumption comes into play here in that the error term $\rho_n^{(2)}$ is an order statistic of the simulated lognormal error terms. Estimates of the parameters β are then determined utilizing standard minimization routines. The covariance matrix was generated using the asymptotic approximation

$$\hat{\Sigma}_{S,L} = \hat{A}_{S,L}^{-1} \hat{B}_{S,L} \hat{A}_{S,L}^{-1}$$

with

$$\hat{A}_{S,L} = \frac{1}{L} \sum_{l=1}^{L} [\overline{Y}_l(\hat{\theta}) \overline{Y}_l(\hat{\theta})' - \frac{1}{S(S-1)} \sum_{s=1}^{S} (Y_{sl}(\hat{\theta}) - \overline{Y}_l(\hat{\theta}))(Y_{sl}\hat{\theta}) - \overline{Y}_l(\hat{\theta}))']$$

$$\hat{B}_{S,L} = \frac{1}{L} \sum_{l=1}^{L} d_{S,l}(\hat{\theta}) d_{S,l}(\hat{\theta})'$$

$$d_{S,l}(\hat{\theta}) = (b_l^w - \overline{X}_l(\hat{\theta})) \overline{Y}_l(\hat{\theta}) + \frac{1}{S(S-1)} \sum_{s=1}^{S} (X_{sl}(\hat{\theta}) - \overline{X}_l(\hat{\theta})) Y_{sl}(\hat{\theta}).$$

This estimator was proven consistent by Laffont, Ossard, and Vuong.

The right-hand side variables included the age of the slave, age squared, gender, a dummy to indicate whether the slave was skilled, the price of cotton, and the productivity of slaves using results from Conrad and Meyer (1958). The parameter estimates and their associated p-value range are listed in Table 2. It should be noted that the overall standard deviation was chosen to be consistent with the data presented in Phillips (1929).

Table 2. Results for Model 1

Variable	Coefficient Estimate	P-value range
Constant	6.6391	$p < 0.05$
Gender	0.4016	$p < 0.05$
Ln(Age)	-0.7657	$p < 0.05$
$[\text{Ln(Age)}]^2$	0.0908	$p < 0.05$
Skill dummy	0.3471	$p > 0.10$
Ln(Price of cotton)	0.6931	$p > 0.10$
Ln(Productivity)	0.9814	$p < 0.05$

The signs on the parameter estimates agree with our intuition. Since the relationship between price and age is clearly more complicated (see graph by age) than a simple linear relationship, the squared term was added and found statistically significant. In addition, some of our results confirm the points noted in our descriptive statistics. The gender premium in our data was much larger than in previous studies, and so we are not surprised that the dichotomous variable gender is statistically significant in our structural modeling results. It is not possible to conclude much from relative sales price by gender because females were almost as productive as males when not pregnant or raising children, and, if intervention in slave reproduction was the goal of the purchase, we would expect a premium price despite the loss of productivity. It is therefore impossible to separate these effects without being able to track each slave after purchase. In addition, we seem to have more statistical outliers for the females in this population, as a

very disproportionate share of the females had a sales price of below $ 500. Since the private value assigned to a slave seems (with strong intuitive appeal) to have been low at very advanced ages, the negative coefficient for ln(age) is in line with what common sense would tell us. It is not surprising that the estimates for the price of cotton and slave productivity are positive. As indicated in Conrad and Meyer (1958), the price of cotton was certainly not monotonic during this period of time, so this variable was included to explain the possible effects of speculation on price. It is interesting to note, however, that the price of cotton is not statistically significant in explaining price. The results for estimating the number of bidders by year are listed in Table 3. In some cases, multiple years were aggregated in order to increase that cell's sample size[7].

Table 3. Estimating the Number of Bidders – Model 1

Year(s)	Estimated Number of Bidders
1840	2
1841-1842	16
1845-1848	7
1850	4
1853-1854	10
1856-1858	5
1860	4

[7] For auctions within a single year, this assumption is not as strong as it seems, since auctions were often conducted on the same day. Across years this grouping becomes more problematic. In order to minimize the effects of this grouping, we chose natural clusters of years so that there was always a gap of at least one year between groupings.

These results certainly seem counterintuitive. One would expect the number of bidders to increase, if for nothing else, because the population of New Orleans increased by a large amount during this period. We see that, if anything, the number of bidders decreased between 1840 and 1860. Before attempting to explain this result, we will verify that the result is not sensitive to slightly different specifications of the model. Removing the skill dummy from the analysis, we get the results presented in Tables 4 and 5.

Table 4. Results for Model 2

Variable	Coefficient Estimate	P-value range
Constant	6.5814	$p < 0.05$
Gender	0.3903	$p < 0.05$
Ln(Age)	-0.6189	$p < 0.05$
$[\text{Ln(Age)}]^2$	0.0713	$p < 0.05$
Ln(Price of cotton)	0.6341	$0.10 < p < 0.15$
Ln(Productivity)	0.9516	$p < 0.05$

We see that the results are largely unaffected by this change. The price of cotton is now borderline significant (at the 0.10 level). Both age terms retain both their signs and statistical significance. Table 5 seems to confirm this model's robustness to this minor change. The number of bidders has remained constant for each grouping. Our overall conclusions still hold.

Table 5. Estimating the Number of Bidders – Model 2

Year(s)	Estimated Number of Bidders
1840	2
1841-1842	16
1845-1848	7
1850	4
1853-1854	10
1856-1858	5
1860	4

In order to control for possible spurious results due to multiple slaves being sold at the same time (typically, a mother and child), we include an indicator variable for this.

Table 6. Results for Model 3

Variable	Coefficient Estimate	P-value range
Constant	6.8642	$p < 0.05$
Gender	0.3098	$p < 0.05$
Ln(Age)	-0.7912	$p < 0.05$
$[\text{Ln(Age)}]^2$	0.0898	$p < 0.05$
Multiple	0.3430	$p > 0.10$
Ln(Price of cotton)	0.6685	$p < 0.05$
Ln(Productivity)	0.9460	$p < 0.05$

The number of bidders is not affected. We see that neither the parameter estimates nor the estimates of the number of bidders are affected much by alternative specifications of the model.

6. Conclusions

Utilizing techniques from the empirical analysis of auctions, we have estimated a structural model to explain the behavior of slave prices between 1840 and 1860. We have determined that the number of bidders decreased over this period, suggesting that westward expansion may not have been the driving force behind the increase in slave prices over this same period. The most logical conclusion to draw from this result is that the 'natural limits' hypothesis is valid, and that Ramsdell (1929) was correct in asserting that this limit had been reached before 1860. The increase in the average sales price for a slave suggests that slavery was very much alive and well in the New South, and the strong demand for cotton throughout the world would have kept the practice of slavery very much alive there until (most likely) the turn of the century. Meanwhile, the implications for slavery in the Old South are much less auspicious. Since it appears that the interregional slave trade was not the panacea some had hoped it would be, slavery would not have continued to be profitable in the Old South after railroad construction was completed. Since most of the railroads in the Old South were completed before 1880, it is quite possible that slavery would have greatly decreased at this point. It appears as if the railroads were more influential in propping up slavery in the Old South than the delivery of slaves to the New South.

Appendix: Data Collection and Descriptive Statistics

The data was collected onsite at the New Orleans Notarial Archive in New Orleans, Louisiana. Notarial acts are contained in ledgers for individual notaries. Generally, notaries filled one ledger per year but occasionally notaries would fill more than one volume per year. Estate sales could very easily necessitate more than one act, as land and housing sales would appear under a separate act. The sale of slave(s) was always a separate act so the identification of such an act was straight-forward. It was then determined whether the slave was sold through auction. The sale was included only if the notarial act *specifically* mentioned that the sale was conducted using an auction.

We now include summary statistics and compare the results to those of Fogel and Engerman when possible:

Table A.1. Mean slave prices in New Orleans auctions for selected years

Year	Our Data	Fogel & Engerman	Our Sample Size
1840	$ 735	605	23
1841	828	626	5
1842	421.25	540	16
1845	412.5	490	8
1848	422	605	14
1850	520	547	27
1853	643.33	780	3
1854	1194	814	13
1856	983	900	21
1857	553	998	3
1860	1169	1157	35

Table A.2. Mean Price by Gender

Gender	Our Data	Fogel & Engerman	Our Sample Size
Male	$ 876	739	101
Female	646	645	67

Table A.3. Mean Price by Age

Age Range	Our Data	Fogel and Engerman
10 - 14	730	545
15 – 19	858	731
20 – 24	1034	837
25 – 29	791	794
30 – 34	844	737
35 – 39	565	588
40 – 44	310	476
45 – 49	457	411
50+	238	294

Table A.4. Correlation Matrix for Selected Variables

	YEAR	PRODUCTIVITY	COTTON PRICE	POPULATION
Year	1	-	-	-
Productivity	0.834	1	-	-
Cotton Price	0.612	0.515	1	-

Population	0.970	0.913	0.587	1

The gender premium for the data used in this paper was 35%. That is, the average winning bid on an average male slave was 35% than that observed for the average female. The literature suggests a 10-15% gender premium. In explaining the discrepancy, we note that our sample of females was skewed toward the higher ages (as shown in Figure A.1.) and the sample of males contained two influential outliers with very high winning bids (as shown in Figure A.2.). However, even if the outliers are removed from the male sample and the females that were older than any male in the study (older than 51 years old) are excluded, a 25% gender premium remains. Since our mean price for females is almost identical to Fogel & Engerman's results for females, a natural conclusion is that our sample contains males that were more likely to be prime field hands than other New Orleans slaves sold during this time period.

Figure A.1. Boxplot of Age by Gender

Figure A.2. Boxplot of Price by Gender

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