# Demographic Causes and Consequences of the Interregional Slave Trade: The Slave Breeding Hypothesis[*]

by

Jonathan B. Pritchett

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I estimate the demographic causes and consequences of the interregional U.S. slave trade using a unique micro-data set that enables me to identify the census records of slave sellers. Using published census data, I show that the child-woman ratio was higher in the exporting areas of the U.S. South, a result commonly attributed to slave breeding. By comparing the dates of sale and census enumeration, I show that slave sales caused higher child-woman ratios rather than the reverse. For plausible assumptions, I show that the interregional slave trade fully accounts for the higher child-woman ratio observed in the exporting areas.

[*] Department of Economics, Tulane University, New Orleans, LA 70118. E-mail address: jprit@tulane.edu. Thanks to Tim Guinnane, Naomi Lamoreaux, Trevon Logan, Richard Sutch, and seminar participants at Yale University for helpful comments and suggestions on an early draft of this paper.

"I am from a slave-breeding state—where slaves are reared for the market as horses, sheep, and swine are." – Frederick Douglass (1846)

Slave breeding is a difficult subject in American history. It remains a popular concept in the historical imagination about slavery yet we know relatively little about it. Researchers debate its definition and disagree about its evidence. Despite the controversy, slave breeding has important implications regarding the interpretation of our demographic history. Southern apologists cite high rate of natural increase for America's enslaved population as evidence that North American slaves were treated better than slaves found elsewhere whereas abolitionists, such as Theodore Weld (1839), argue that high fertility rates were due to slave breeding. Because slaveholders profit from the reproduction of their slaves, evidence of slave breeding informs the debate about financial incentives and the treatment of slaves. To increase fertility, slaveholders practiced different methods -- some methods were benign whereas others were reprehensible. Researchers continue to debate which of these practices were examples of slave breeding.

Slave breeding may have also encouraged the development of the interregional slave trade. For Virginia's colonial planters, the use of slave labor allegedly led to soil exhaustion and a decline in agricultural profit. After the prohibition of the international slave trade and the purchase of Louisiana, rising slave prices "made slavery in Virginia again profitable, as a means of breeding slaves for exportation and sale to the South" (Simpson 1863, p. 3). According to John E. Cairnes (1862, p. 75), "Slavery had robbed Virginia of the best riches of her soil, but she still had a noble climate – a climate which would fit her admirably for being the breeding place of the South. A division of labor between the old and the new states took place. In the former

the soil was extensively exhausted, but the climate was salubrious; in the later the climate was unfavourable to human life spent in severe toil, but the soil was teeming with riches." Accordingly, the interregional slave trade promoted slave breeding, regional specialization, and the interregional transfer of labor.

In this paper, I show the demographic effects of the interregional slave trade using household data. Using aggregate census data, I confirm that the child-woman ratio was higher in the exporting areas than in the South as a whole (a result often attributed to slave breeding) and that these ratios equalized after the war. I use sales records deposited in the New Orleans Notarial Archives to identify slave sellers in the exporting areas of the South and I estimate the effect of sales on the demographic composition of slaveholdings, as reported in the manuscript census schedules. Because I observe the probable sale dates, I can establish causation by comparing the dates of sale and census enumeration and I show that slave sales caused higher child-woman ratios rather than the reverse. Finally, I show that using a plausible set of assumptions, selective migration (and the interregional slave trade) can fully account for the higher child-woman ratios of the exporting areas and that these higher ratios need not imply higher fertility rates or, for that matter, slave breeding.

Slave Breeding

Despite extensive research, there are few (if any) documented cases of slaveholders breeding slaves for sale.[1] "It has been said by various anti-slavery spokesmen that many

[1] An incomplete literature review includes Weld (1839), Cairnes (1862), Simpson (1863), Collins (1904), Phillips (1918), Gray (1933), Bancroft (1931), Myrdal (1944), Stampp (1956), Conrad and Meyer (1958), Dumond (1961), Fogel and Engerman (1974, 1992), Engerman (1976), Gutman and Sutch (1976), Sutch (1975, 1988), Lowenthal and Clarke (1977), Steckel (1982), Fogel (1989), Tadman (1989), Walker (1993), and Sublette and Sublette (2016).

slaveowners systematically bred slaves for the market. They have adduced no shred of supporting evidence however" (Phillips 1918, p. 361). Kenneth Stampp (1956, p. 245) agrees that "evidence of systematic slave breeding is scarce indeed, not only because it is unlikely that many engaged in it but also because written records of such activities would seldom be kept. But if the term is not used with unreasonable literalness, if it means more than owner-coerced matings, numerous shreds of evidence exist which indicate that slaves were reared with an eye to their marketability – that the domestic slave trade was not 'purely casual.'"

Evaluating evidence of slave breeding can be controversial. According to Stampp, some breeders did not record their practices and consequently, current researchers may not be able to observe evidence of it. Even if they can observe the evidence, some researchers may not recognize it as such. Robert Fogel and Stanley Engerman (1974, p. 78) adopt a narrow definition of slave breeding that requires slaveholders to (1) interfere in the sexual habits of slaves to maximize female fertility and (2) raise slaves for sale. Richard Sutch (1975, p. 411-2) prefers a broader definition that includes any slaveholder practice that increases the fertility of the slave population. Sutch's definition includes practices that might benefit both mother and child, such as "the provision of both pre- and postnatal medical care." Fogel and Engerman disagree that such practices are examples of slave breeding, preferring to classify them as pro-natalist practices. Fogel and Engerman choose a narrow definition of slave breeding, find meager evidence to support it and conclude that slave breeding was a "myth." In contrast, Sutch chooses a broader definition of slave breeding and finds substantial evidence of it. Because these researchers disagree on the definition of slave breeding, they also disagree as to what constitutes evidence of it.

If slave breeding is poorly defined and potentially unobservable, then researchers seeking to establish its importance need indirect or circumstantial evidence of it. Sutch (1975), for example, suggests that slave breeders owned holdings with unusually low sex ratios and unusually high fertility rates.[2] Some researchers find that the financial returns from slave breeding were uncorrelated with slave fertility rates. Because the present value of a slave's lifetime earnings exceeds his rearing costs (Yasuba 1971), most historians agree that an increase in slave fertility was potentially profitable for slaveholders. Even the most ardent skeptics of slave breeding acknowledge that slaveholders promoted slave fertility by rewarding family formation. They disagree about more extreme forms of slaveholder interference such as owner-coerced matings. Finally, Fogel and Engerman (1992, p. 471) calculate that the financial returns from slave breeding were small and that any financial gain could be outweighed by resistance from the slaves themselves. "Just a slow walk out to the field each morning would be enough to wipe out the master's gain."

For this project, I search for circumstantial evidence of slave breeding by exploiting the link between slave breeding and slave sales. I avoid the controversy regarding the definition of slave breeding by using a proxy variable for it. Regardless of how it is defined, I can analyze the holdings of slave breeders if slave breeders are correlated with slave sellers. Using New Orleans notarial records, I identify the holdings of slave sellers from the 1830 decennial census. By comparing the holdings of sellers with those of other slaveholders, I can analyze the demographic characteristics associated with slave breeding.

[2] For his fertility rate, Sutch (1975, p. 192) uses the ratio of children to adults rather than the ratio of children to adult women. For a critique of this measure, see Fogel and Engerman (1992).

Demographic Effects of Slave Sales

Between 1790 and 1860, approximately one-million slaves migrated to the southwestern United States.[3] This forced migration took two basic forms: the migration of planters (and their slaves) and the interregional slave trade. Migrating planters were non-selective and took all of their slaves regardless of their ages or gender. In contrast, traders purchased slaves singly and for these slaves, family separations were inevitable. Evidence from the New Orleans slave market indicates that the vast majority of imported women were sold without a child or a spouse.[4] Although planter migrations destroyed some marriages and families, the interregional slave trade was clearly more disruptive for the family lives of slaves.

The interregional slave trade may have also affected the demographic composition of the remaining slave population. Unlike planters who migrated with all of their slaves, traders preferred to purchase teenagers and young adults and they avoided the purchase of young children (Pritchett and Chamberlain 1993). Because traders preferred to purchase women rather than children, the child-woman ratio would have increased in those areas that sold to traders.[5] Table 1 shows that from 1820 to 1860 the child woman ratios were 6 to 11 percent higher in the exporting areas than in the South as a whole. After the Civil War, fertility rates were virtually

[3] Because relatively few slaves travelled eastwards (Graves, Sexton, and Vedder 1983), net migration estimates should closely approximate the westward migration of slaves. From 1790 to 1860, Claudia Goldin (Fogel and Engerman 1974b, p. 44) estimates an interregional net migration of 835,000 slaves whereas Michael Tadman (1989, p. 12) estimates a net migration of approximately 1,110,000 slaves. Apparently, Tadman's estimate is greater than Goldin's because he adjusts for the net migration of young children. To be sure, Tadman does not directly estimate the net migration of children, aged less than 10 years, because they had not yet been born as of the previous census. Instead, Tadman derived his estimate from the product of the net-migration of adult women and a presumed child-woman ratio.

[4] For imported women aged 15 to 49 years, 90 percent were sold without a child and 98 percent were sold without a husband.

[5] I define the states of Virginia, North Carolina, and Maryland as exporting areas because they accounted for 78 percent of the imported slaves sold in New Orleans in 1830.

the same across the South. Environmental factors such as a harsh climate or extreme labor conditions in the Southwest may have contributed to the regional difference in antebellum fertility rates. The regional difference disappears after the war, which suggests that slavery (and not simply the environment) was an underlying cause of it.

Higher child-woman ratios may indicate higher fertility rates if not deliberate slave breeding. "Whether systematically bred or not, the natural increase of the slave force was an important, probably the most important, product of the more exhausted soil of the Old South" (Conrad and Meyer 1958, p. 113). Using published census data, Sutch (1975, p. 185) finds "the selling states exhibited a significantly higher rate of slave births than did the states with more fertile soil in the southwest." According to Fogel and Engerman (1974, p. 82), the higher child-woman ratio is a statistical artifact. "A fertility rate, it should be remembered, is a ratio. The denominator consists not only of married women but also of single women. Hence the fertility rate will be higher in the Old South if the share of single women without children in the interregional migration was higher than in the population that remained behind." For Fogel and Engerman, the selective migration of slaves accounts for the higher child-woman ratios in the exporting areas of the South. Because planters took all of their slaves with them, including both women and children, their migration would have little effect on child-woman ratios for the remaining slaves. Rather than planter migrations, the interregional slave trade increased the child-woman ratios in these areas.[6]

The interregional slave trade is a manifestation of the forces of supply and demand.

[6] Steckel (1992: p. 388) and Tadman (1989, p. 124) also attribute the regional difference in the child-woman ratio to the selective migration of slaves. In another publication, Fogel and Engerman (1979, p. 571) attribute the regional difference to higher Southwestern mortality rates rather than the selective migration of unmarried women.

According to the slave-breeding hypothesis, plantations located in the exporting areas were particularly well suited for raising slaves. Planters who bred slaves increased in their labor supply, increased their labor-land ratio, and decreased the marginal productivity of their labor. These planters would have sold slaves to adjust their labor-land ratio and to supplement their agricultural income. Under these circumstances, the breeding of slaves causes the slave trade. According to the selective migration theory, the demand for labor in the Southwest creates a regional price differential and an arbitrage opportunity for slave traders. Because traders prefer to purchase women rather than children, the child-woman ratio would increase among the remaining slaves. Under these circumstances, the demand for labor in the Southwest (and the interregional slave trade) causes the higher child-woman ratio in the exporting areas.

Both theories predict slave sales and higher child-woman ratios for the exporting areas. Using aggregate census data, their predictions are observationally equivalent. In my paper, I use micro-level data to identify probable sale dates and establish causation by comparing the dates of sale and census enumeration. For those planters who sold before the enumeration date, slave sales cause higher child-woman ratios, as predicted by the selective migration theory. For those planters who sold after the enumeration date, higher child-woman ratios cause slave sales, as predicted by the slave-breeding hypothesis. To summarize the empirical results, the sale of a childless woman increased the child-woman ratio among the slaves left behind. In addition, the demographic composition of the slaveholding had relatively little effect on the owner's decision to sell. Overall, these findings suggest that slave sales rather than slave breeding causes higher child-woman ratios for the exporting areas.

Description of Data

During the antebellum period, New Orleans was the largest city in the southern United States and the site of its largest slave market. Under Civil Law, Louisiana treated slave sales like real estate transactions and all sales had to be notarized. Each notarial invoice includes information on the price, name, age, and sex of the slave, as well as the names and residences of the buyers and sellers. The New Orleans Notarial Archive was established in 1867 as the depository for the notarial records and because of the size of the slave market and the quality of the records, it is the best source of information on slave sales in the United States.[7] These notarial records are the primary data source for this study.

For an imported slave sold in 1830, the notarial records include additional information. The Louisiana legislature passed a law in 1829 that required an out-of-state slave be accompanied by a so-called certificate of good moral character endorsed in the county of origin. This law was repealed in 1831. Most important for this study, the certificate of good character lists the name of the previous owner and the date and place of certification. The availability of this information allows me to identify the records of slave sellers as reported in the 1830 decennial census. Because I identify the records of slave sellers, I can estimate the demographic causes and consequences of the interregional slave trade.

The initial sample includes the extant records of 6,174 slaves sold in New Orleans during 1830. After excluding the records of local slaves (who were sold without certificates), the sample includes the records for 2,289 imported slaves. The certificates did not list the names of

[7] A description on the New Orleans Notarial Archives can be found at the following website: http://www.orleanscivilclerk.com/history.htm

24 sellers and the owners rented or employed 15 slaves rather than sold them; excluding these records decreases the sample size to 2,250 observations. As illustrated in Figure 1, the imported slaves in the sample originated from 11 southern states and 192 different counties. Although they originated from across the South, traders purchased approximately 78 percent of the slaves from the states of Virginia, North Carolina and Maryland (Freudenberger and Pritchett 1991, p. 460).

The large number of sellers per trader indicates the professional character of the trade. The sample includes the records of 185 traders who purchased slaves from 1,698 different slaveholders in the exporting areas, or approximately nine sellers per trader. The traders and slaveholders were likely unrelated (as indicated by their different surnames) and most slaveholders (83 percent) sold only one slave. An example of a professional slave trader is James Barnes Diggs, who purchased 115 slaves from 100 different slaveholders. Diggs purchased slaves from many holdings, bundle them in lots, and shipped them to New Orleans for sale.

Interregional traders shipped more males than females to New Orleans. For imported slaves aged 15 years or more, the sex ratio equaled 1.94, or nearly two males for every female. In addition, they shipped relatively few children to this market (see figure 2). Although children, aged 0 to 9 years, comprised 35 percent of the U.S. slave population in 1830, they accounted for less than 4 percent of the imported slaves sold in New Orleans. Very few families were sold together. Most slaves were purchased singly and most were teenagers or young adults. Less than 10 percent of the adult females were sold with a child and the child-woman ratio was only 0.11. As seen in Table 1, the contemporary child-woman ratio in the exporting areas was 1.243 or approximately 11 times greater than the ratio for imported slaves. The paucity of children sold

in New Orleans provides prima facie evidence of the slave trade's effect on child-woman ratios.

In this paper, I estimate the demographic effects of the interregional slave trade using data created by an 1830 Louisiana law. Because data are not available, I cannot compare my results with those derived for other markets and for other years. I can, however, examine slaveholder incentives to breed or sell slaves. As seen in figure 3, slave prices were generally higher in other years (with some notable exceptions) and consequently, financial incentives to breed or sell slaves may have also been higher. Conversely, fertility rates declined after 1830 and if slaveholders achieved higher fertility rates by breeding slaves, then the likelihood of discovering breeding should have also declined. In addition, because the intent of the Louisiana law was to prohibit the importation of criminal slaves, using certificates to identify slave sellers in the exporting areas should not bias the results. In particular, the required certification would not preclude breeders from selling slaves to interregional traders (unless these slaves were especially prone to committing crimes).

Linked Records

The records of imported slaves sold in New Orleans are matched to the 1830 manuscript census using the names of the previous owners and the counties of certification as listed on the certificates of good character.[8] The linking of these records provides information on the holdings of 533 sellers of 731 slaves. The observable characteristics of the linked sample are similar to those for the entire sample of imported slaves. Children account for approximately 4.1 percent of the slaves in the matched sample and the sex ratio for the matched sample is

[8] The 1830 decennial census provides valuable demographic information but relatively little information about anything else. Record linkage was done by the author's hand using published indices (Jackson 1976). The control group includes census records from counties that sold at least one slave to a New Orleans trader.

approximately 2. These statistics suggest that the linking process did not systematically remove observations from the working sample.[9]

The linked sample represents approximately 29 percent of the sellers and approximately 28 percent of the imported slaves sold in New Orleans. For a variety of reasons, I could not link the records of some sellers. Some names were illegible or abbreviated whereas others were modified by the census marshals or the clerks of court. Because the 1830 census only reports the names of household heads, only sellers who were household heads could be match to census records. I also exclude observations for sellers with multiple holdings in the county of certification (who were few in number), and to minimize the number of false positives, I exclude uncertain matches. Despite these limitations, the overall match rate is comparable to those found in other historical studies using this methodology.

The death of a previous owner might explain the failure to link some sellers to the decennial census. Citing the work of William Calderhead (1972), Fogel and Engerman (1974, p. 55) write that "approximately one half of all sales were the consequence of the breakup of the estates of decreased planters whose heirs were unable or unwilling to continue the family business." The certificates of good character provide some information regarding the sources of imported slaves sold in New Orleans. Under the heading that lists the owner's name, the certificates indicate that traders acquired 31 slaves from the administrators, executors, or trustees of estates. Traders also acquired slaves from sheriffs and the agents of sellers. Interregional traders previously owned some imported slaves and they sold other slaves on consignment. Overall, traders acquired 109 slaves, or approximately 5 percent of the imported slaves, from

[9] The certification dates for the linked records are similar to those for non-linked records (see figure 4).

these sources. For the vast majority of cases, the certificates provide no additional information other than the name and residence of the previous owner. Apparently, traders purchased most of their slaves from the holdings of ongoing farms and plantations.[10]

The dates of certification and census enumeration play important roles in this study. As set by Congress, the official date of census enumeration was June 1, 1830. Although marshals might visit households after June 1, they were instructed to enumerate all family members "whether present or not, and not to include any person whose usual abode was not in the family they are enumerating on the said 1st day of June. They will, of course, include such persons as may have deceased after that day, and will not include in it infants born after that day" (Wright and Hunt 1900, p. 140). Marshals should record the number of slaves for each sex in age bins of 0 to 9 years, 10 to 23, 24 to 35, 36 to 54, 55 to 99, and 100 years and upward. If a slave was sold after June 1 but prior to the marshal's visit, he should be enumerated with the household.

I use the date of certification to approximate the date of sale and separation of the slave from the holding. Certifications were highly seasonal and for most slaves, the certification date led the New Orleans sale date by approximately three months.[11] As seen in figure 4, most slaves were certified during the fall and early winter and relatively few were certified circa June 1, the date of census enumeration. For those slaves certified before June 1, the census records provide demographic information about the holding after their departure. I use these records to estimate

[10] If traders purchased slaves from the estates of dead owners then the census match rate should be higher for those slaves sold after (rather than before) the enumeration date. In fact, the match rates are nearly identical, suggesting that the failure to link is not caused by the previous owner's death.

[11] Freudenberger and Pritchett (1991, p. 467) link certificates deposited in New Orleans to sales records deposited in Maryland and find that the recorded sale dates closely approximate the dates of certification. For evidence of seasonal slave sales in New Orleans, see Calomiris and Pritchett (2016, p. 8), Freudenberger and Pritchett (1991, pp. 463-467), and Kotlikoff (1979, pp. 503-504).

the effect of slave sales on household composition.[12] For those slaves certified after June 1, the census records provide information about the holding prior to their sale and departure. I use these demographic data to analyze the slaveholder's decision to sell slaves.

The sample includes the census records of all slaveholdings in the exporting areas. In rows (1) and (2) of Table 2, I compare descriptive statistics for the holdings of slave sellers and a control group representing the slave population of the exporting area. Descriptive statistics for subsets of the linked sample are presented in rows (3) and (4). A comparison of these rows indicates that slave sellers had higher child-woman ratios than other slaveholders in the exporting areas, a result that is generally consistent with both the slave breeding hypothesis and the selective migration theory. In the following, I use regression analysis to compare these two alternative theories.

Demographic Causes of the Interregional Slave Trade

Although slave breeding is unobservable (Stampp 1956; Sutch 1975, p. 175), slave selling can be observed by current researchers. If slaveholders bred slaves for sale, then I can use sales data to proxy slave breeding.[13] To be sure, not all sellers bred slaves for the market and not all breeders sold slaves. The choice of an appropriate proxy variable requires it to be

[12] Tadman (1989, p. 295) suggests that some traders may have purchased and left slaves with their former owners until shortly before the time of departure for the lower South. Because marshals may have been erroneously enumerated these slaves with their previous owners, I exclude those observations for slaves certified within two weeks of June 1. To promote accurate estimates, I also exclude the observations of slaves certified more than one year prior to the date of census enumeration. These exclusions reduce the sample size from 731 to 714 observations.

[13] Most researchers define slave breeding as raising slaves for sale. See, for example, Gray (1933, p. 662), Fogel and Engerman (1974, p. 78), Tadman (1989, p. 121), Collins (1904, p. 68) and Phillips (1918, p. 361). Not everyone agrees, however. Whether "slaves were raised for sale for use by their owner does not seem to be relevant to the issue of breeding. Owners could be interested in fostering a high birth rate because they (or their children) would have had use for the labor. No sale need be intended" (Gutman and Sutch 1976, p. 155). According to Weston (1857, pp. 147-148), planters rarely made conscious decisions to breed slaves for sale. However, "the entire business of raising slaves is carried on with reference to the price of slaves, and solely in consequence of the price of slaves; and this price depends, as they well know, solely upon the domestic slave trade."

correlated with the unobserved variable and uncorrelated with the error term. By comparing the holdings of sellers with those of other slaveholders, I analyze the demographic characteristics associated with slave breeding.

The sample consists of all census records from counties that sold slaves to New Orleans in 1830. For slaveholders who sold after the date of census enumeration, I can analyze their decision to sell using the demographic composition of their holdings.[14] For regression (1) in Table 3, the dependent variable is a dichotomous covariate indicating selling status and the independent variables include the child-woman ratio, the sex ratio, the size of the holdings, and county fixed effects.[15] If sellers were also breeders, then I should find higher fertility rates for their slaves. As seen in the regression, the estimated coefficient for the child-woman ratio is negative (which is the wrong sign) and not statistically significant. Consequently, the females owned by slave sellers were not unusually fertile. Either slave sellers were not slave breeders or implausibly, the women owned by breeders did not have higher fertility rates.

To maximize profit from slave sales, Sutch (1975, p. 191) suggests that breeders manipulated the sex ratios of their holdings. A slave breeder "would not need to have one man for each woman. He could have each man impregnate many women." Consequently, slaveholdings with low sex ratios and high fertility rates could be interpreted as evidence of slave breeding. As seen in regression (1) of Table 3, the estimated coefficient for the sex-ratio covariate is positive (which is the wrong sign) and statistically significant. In other words, if

[14] Because I include county fixed effects in the regressions, I exclude from the sample observations from those counties that did not sell slaves after the enumeration date.
[15] I adjust the standard errors for heteroscedasticity. Logit regression results are presented in Table A1 of the Appendix.

sellers were breeders, then these regression results suggest that breeders kept unusually large numbers of males, an implausible result.

Holding size affected both the probability of sale and the probability that an individual slave was sold. As seen in regression (1) in Table 3, the estimated coefficient for holdings with less than 16 slaves is negative (and not statistically significant), indicating that small owners were less likely to sell than large owners with more than 50 slaves (the omitted category in the regression). To estimate the probability that an individual slave was sold, I estimate regression (2), where the dependent variable is the proportion of slaves sold from a holding (for slave sellers, equal to the quotient of slave sales and the holding size). I find that the estimated coefficient for holdings with less than 16 slaves is positive and statistically significant (at the 10 percent level), indicating an increased probability of sale for smaller holdings.

Rather than maximizing the child-woman ratio, Sutch (1975) proposes that breeders sought to maximize the child-adult ratio, thus increasing the number of children for a given investment in adult slaves. In the next regression, I substitute the child-adult ratio for the child-woman ratio as the independent measure of household fertility. As seen in regression (3) of Table 3, the estimated regression coefficient for the child-adult ratio is negative and not statistically significant. In other words, slave sellers did not own large numbers of children for a given number of adults. In addition, the regression results indicate that slave sellers owned unusually large numbers of adult males. If sellers were breeders, then the regression results suggest that breeders did not maximize the number of children for a given investment in adult slaves and that they owned relatively more adult males than adult females, both implausible results.

To summarize, the regression results indicate that slave sellers had relatively more males than females and that their female slaves were not unusually fertile. Although large slaveholders were more likely to sell than other owners, individuals from small holding were more likely to be sold. In the next section, I explore the demographic consequences of these slave sales.

Demographic Consequences of the Interregional Slave Trade

Did slave sales affect child-woman ratios? To answer this question, I use a production function framework that accounts for the men and women taken from their homes. Fogel and Engerman (1992, p. 458) propose that the number of children can be expressed as a function of the number of men and women residing on a farm. For slave sellers, the number of children might also depend on the number of men and women who were recently sold. In the following equation, I modify Fogel and Engerman's function to include not only the men and women residing on the farm, but also those who were recently sold:

$$C^R = f(W^R, M^R, W^S, M^S), \tag{1}$$

where C, W, and M indicate the number of children, women, and men respectively and the superscripts R and S indicate remaining slaves and sold slaves. Assuming the function is homogeneous of degree one, I divide both sides of equation (1) by the number of remaining women to yield the child-woman ratio:

$$\frac{C^R}{W^R} = f\left(1, \frac{M^R}{W^R}, \frac{W^S}{W^R}, \frac{M^S}{W^R}\right). \tag{2}$$

I estimate a linear approximation of equation (2) using regression analysis:

$$\frac{C^R}{W^R} = \alpha + \beta_1 \frac{M^R}{W^R} + \beta_2 \frac{W^S}{W^R} + \beta_3 \frac{M^S}{W^R} + \varepsilon. \tag{3}$$

For those slaveholders who sold prior to the enumeration date, I estimate the effect of the

sale on the holding's child-woman ratio. Regression results are presented in Table 4, where the dependent variable is the child-woman ratio of the remaining slaves. The sample includes records of all slaveholdings from counties that sold slaves to New Orleans traders before June 1. In addition to the sex ratio of the remaining slaves, I include covariates for the sale of women and men as indicated by New Orleans sales records. As seen in regression (1), the estimated coefficient for the sex ratio is both large and statistically significant. Consistent with Fogel and Engerman (1992, p. 459), holdings with higher sex ratios had higher fertility rates. I also find that holdings that sold childless women had higher child-woman ratios than other holdings, a result that is both statistically and numerically significant. If, for example, a farm sold half of its women, then the child-woman ratio of the remaining women is predicted to rise by 0.5, or approximately 44 percent.

Relatively few mothers were sold with their children. For those few who were, the sale had the opposite effect on the child-woman ratio. As indicated by the negative sign of the regression coefficient, the sale of mothers with children lowered the child-woman ratio of the remaining slaves (a result that is statistically significant at the 10 percent level). Finally, the sale of men did not have a statistically significant effect on the remaining child-woman ratio. In conclusion, it was the sale of childless women (and not the sale of slaves in general) that increased the child-woman ratios found on these farms.

The size of the holding also affected the fertility rate. Using county-level data, Steckel (1985, pp. 220-232) finds the child-woman ratio is negatively correlated with the median plantation size. Other things equal, the reduced availability of potential marriage partners should have lowered the fertility rates on smaller farms. Steckel argues, however, that small

slaveholders had little choice but to allow cross-plantation marriages, thus resulting in higher fertility rates on these farms. Consistent with his predictions, the regression results indicate that holdings with more than fifty slaves had significantly lower child-woman ratios than holdings with 16 to 50 slaves. Surprisingly, smaller holdings, with 15 slaves or less, also had lower child-woman ratios, which suggests a need for additional research on the fertility of slaves residing on smaller farms.

Some slaveholders may have sold to traders from other markets than New Orleans. Because I misclassify these holdings as non-sellers, the results presented in regression (1) of Table 4 may be affected by measurement error. In regression (2), I re-estimate the model and omit the control observations. Restricting the sample to observed slave sellers has little effect on the empirical results; the sign and magnitudes of the regression coefficients are qualitatively the same. Once again, I find that the sale of a childless woman increases the child-woman ratio of the remaining slaves and that the sale of a mother with children has the opposite effect. These results suggest that measurement error, and more specifically an undercount of slave sales, is not a significant source of bias.

As a potential falsification test, I designate separate covariates for those holdings that sold before and after the date of census enumeration. As seen in Table A2 of the Appendix, sales that occurred after the data of census enumeration had no effect on the observed child-woman ratio. Consistent with the regression results presented in Table 4, the sale of a childless woman increased the child-woman ratio when the sale occurred prior to date of census enumeration. If the woman was sold after the enumeration date, the sale did not affect the child-woman ratio. Selective sales, and not slave breeding, increased the child-woman ratios of these holdings.

Slave Sales and Fertility Rates

Could slave sales account for the higher child-woman ratios observed in the exporting areas of the South? Do higher child-woman ratios necessarily imply higher fertility rates? The answers to these questions depend on a few assumptions and the relative size of the interregional slave trade. In this section, I estimate the fertility rate of the exporting area adjusting for the emigration of slaves. Assuming an enclosed slave population for the South, I use decennial census data to estimate survival rates for different cohorts of slaves. For a given area, the projected number of surviving slaves equals the product of the base-year population and the cohort survival rate.[16] The projected number of children equals the sum of the emigrating children and the remaining children:

$$C = C^E + C^R, \tag{4}$$

where the superscripts E and R indicate emigrating and remaining slaves. If I divide equation (4) by the number of women, the child-woman ratio can be expressed as follows:

$$\frac{C}{W} = \frac{C^E}{W^E}\frac{W^E}{W} + \frac{C^R}{W^R}\frac{W^R}{W}. \tag{5}$$

The projected child-woman ratio is a weighted average of the child-woman ratios for emigrating and remaining women, where the weights are the net migration rates for adult women. Net migration rates and the child-woman ratio for the remaining women can be estimated using decennial census data. To estimate values for equation (5), I need estimates for the emigrants' child-woman ratio. Because slaves emigrated via the interregional slave trade or

[16] See Tadman (1989, pp. 238-41) regarding the closed population assumption. I cannot estimate survival rates for children aged less than 10 years because they had not yet been born as of the previous census. Instead, I estimate the number of child migrants using the child-woman ratios for female migrants.

planter migrations, the number of emigrating children equals the sum of traded children and the children migrating with planters.

$$C^E = C^S + C^P, \tag{6}$$

where the superscripts S and P indicate slaves sold to traders and slaves migrating with planters respectively. Substituting for the number of emigrating children, I rewrite equation (5) as follows:

$$\frac{C}{W} = \left(\frac{C^S}{W^S}\gamma + \frac{C^P}{W^P}(1-\gamma)\right)\frac{W^E}{W} + \frac{C^R}{W^R}\frac{W^R}{W}, \tag{7}$$

where γ indicates the share of emigrating women sold to interregional traders.

Table 5 shows estimates for the parameters used in equation (7). If I assume that migrating planters took all of their slaves with them, then the child-woman ratio for planter migrations equals the projected child-woman ratio for the exporting area $\left({}^{C_P}/_{W_P} = {}^{C}/_{W}\right)$. Table 1 presents the child-woman ratio for the remaining slaves. I calculate the child-woman ratio for slaves sold to traders from the certificates of good character, and I estimate the net emigration rate for adult women, aged 10 to 54 years, using census data from 1820 and 1830. Because I lack accurate estimates for γ (the share of sales in the emigration of slaves), I calculate equation (5) using different values for it.[17] Sensitivity analysis indicates that increased values for γ will decrease both the child-woman ratio of emigrants and the projected fertility rate of the exporting area. For the extreme case where the slave trade accounts for the entire emigration of

[17] Fogel and Engerman (1974, p. 48) estimate γ equals 16 percent, Tadman (1989, p. 247) estimates γ equals 60 to 70 percent, and Pritchett (2001, p. 471) estimates γ equals "approximately one-half." Steckel and Nicolas Ziebarth (2013, p. 808) estimate that traders accounted for 53.1 percent of the westward coastwise shipment of slaves whereas Pritchett and Freudenberger (2016, p. 159) put that figure at 72 percent of the slaves shipped coastwise.

slaves ($\gamma$=1), then the projected fertility rate equals 1.121, which is lower than the fertility rate for the entire South. In other words, using this extreme assumption, the exporting areas have a comparative *disadvantage* in the breeding of slaves. Conversely, if no slaves were sold to traders ($\gamma$=0), then the projected ratio equals 1.243, which equals the observed child-woman ratio for the remaining population. Finally, if the interregional slave trade accounted for 69 percent of the emigration, then the projected fertility rate of the exporting area would equal the fertility rate for the entire South.

The projected child-woman ratio is sensitive to variation in other parameters listed in Table 5. Planters, for example, might have migrated with fewer children or traders might have shipped more of them, which would decrease the projected fertility rate in the exporting areas. Higher survival rates in the exporting areas would increase the estimated net migration rate and decrease the projected fertility rate. In summary, over a wide range of parameter estimates, the interregional slave trade can fully account for the child-woman ratios observed in the exporting areas.[18] Higher child-woman ratios need not imply higher fertility rates or, for that matter, slave breeding in the exporting areas of the South.

## Discussion and Conclusion

For Fogel and Engerman (1974, p. 82), selling a woman without a child is synonymous to selling an unmarried woman. However, the sale of a childless woman may also indicate the separation of a mother from her child. Did traders buy slaves without regard to their marital status? As seen in figure 2, interregional traders purchased very few children. They may have

[18] Sutch (1975) presented demographic evidence for 1860. As a final robustness check, I evaluated equation (5) using census data from 1860 (see Table A3 in the appendix). If $\gamma$ equals 0.367, the projected fertility rate for the exporting areas would have equaled the fertility rate for the South in 1860.

purchased mothers and left their less-marketable children behind in the holdings of their former owners.

Although the Louisiana Civil Code (1806, section 9) expressly prohibited the separate sale of children under the age of 10 years from their mothers, this law provided scant protection for the slaves living in other states. Anecdotal evidence suggests that some traders separated mothers from children.[19] Ethan Allen Andrews recorded the following conversation he had with a trader, whom he identified as N.

> In selling his slaves, N. assures me that he never separates families, but that in purchasing them he is often compelled to do so, for that "his business is to purchase, and he must take such as are in the market!" "Do you often buy the wife without the husband?" "Yes, very often; and frequently, too, they sell me the mother while they keep the children. I have often known them take away the infant from the mother's breast, and keep it while they sold her." (Andrews 1836: p. 147)

Retaining children who were separated from their mothers would have raised the apparent fertility rate for the women left behind. Indeed, the child-woman ratios observed in exporting areas may be the result of such separations.

I conclude by summarizing what I have and have not accomplished in this paper. To be

[19] For other citations of mothers separated from children, see Bancroft (1931: 197-221), Andrews (1836: p. 50, 105, 165), Weld (1969: pp. 46-48, 166) and Rawick (1972: pp. 44-45).

sure, I do not deny the existence of slave breeding. "Any historical dispute that remains over the question no longer concerns the existence of slave breeding, but rather the matter of degree" (Sutch 1988, p. 84). Without a consensus definition of slave breeding, its existence cannot be proved or disproved. In addition, fertility rates in the exporting areas may have exceeded those found elsewhere in the South. I would need comprehensive birth registrations to show they were equal.

In this paper, I examine the consequences of slave sales on the demographic composition of households in the exporting areas of the South. Using aggregate census data, I confirm that the child-woman ratios were higher in the exporting regions than in the South as a whole (a result often attributed to slave breeding) and that these ratios equalized after the war. I use sales records deposited in the New Orleans Notarial Archives to identify the census records of slave sellers in the exporting areas of the South. Because I observe probable sale dates, I can establish causation by restricting the sample to those slaveholders who sold immediately prior to the census enumeration date. Regression results indicate that the sale of a childless woman increased the child-woman ratio for the slaves left behind. Finally, I show that using a plausible set of assumptions, selective migration (and the interregional slave trade) can fully account for the higher child-woman ratios of the exporting areas and that these higher ratios need not imply higher fertility rates or, for that matter, slave breeding.

I also analyze the demographic characteristics of the holdings of slave breeders. I avoid the controversy regarding the definition of slave breeding by using a proxy variable for it. I chose slave sellers as my proxy variable because previous research suggests that slaveholders bred slaves for sale. In addition, slave breeding would have increased the labor supply and

reduce output per worker over time unless the surplus slaves were sold off to new owners in the Southwest bringing new acreage under cultivation. Regression results indicate that slave sellers owned females with normal fertility rates and relatively large numbers of adult males, results that are inconsistent with the slave breeding hypothesis.

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Table 1
Child-woman ratios, 1820 - 1870

| Census year | | Child-Woman definition | Exporting areas | Entire South | Exporting / South Ratio |
|---|---|---|---|---|---|
| (1) | 1820 | $\frac{enslaved\ children, 0-13\ years}{enslaved\ women, 14-44\ years}$ | 2.088 | 1.882 | 1.109 |
| (2) | 1830 | $\frac{enslaved\ children, 0-9\ years}{enslaved\ women, 10-54\ years}$ | 1.243 | 1.156 | 1.075 |
| (3) | 1840 | $\frac{enslaved\ children, 0-4\ years}{enslaved\ women, 10-44\ years}$ | 1.178 | 1.097 | 1.074 |
| (4) | 1850 | $\frac{enslaved\ children, 0-4\ years}{enslaved\ women, 15-49\ years}$ | 0.768 | 0.718 | 1.070 |
| (5) | 1860 | $\frac{enslaved\ children, 0-4\ years}{enslaved\ women, 15-49\ years}$ | 0.745 | 0.702 | 1.061 |
| (6) | 1870 | $\frac{free\ black\ children, 0-4\ years}{free\ black\ women, 15-49\ years}$ | 0.647 | 0.660 | 0.981 |

Source: U.S. Bureau of the Census, various years.
Note: Exporting areas are defined as the states of Maryland, North Carolina, and Virginia.

Table 2
Descriptive statistics of slaveholdings linked to New Orleans slave sales

| Type of Holding | Child-Woman ratio | Child-Adult ratio | Sex ratio | Slaves per holding | Slaves sold | Number of holdings |
|---|---|---|---|---|---|---|
| (1) All Slaveholdings (161 exporting counties) | 1.15 | 0.57 | 1.02 | 8.10 | n.a. | 114083 |
| (2) All Linked Holdings | 1.22 | 0.54 | 1.26 | 17.68 | 703 | 511 |
| (3) Linked Holdings Slaves Certified after Enumeration | 1.23 | 0.53 | 1.33 | 16.01 | 144 | 102 |
| (4) Linked Holdings Slaves Certified before Enumeration | 1.22 | 0.54 | 1.24 | 18.13 | 563 | 413 |

Source: Controls: 1830 decennial census -- IPUMS. Linked records: 1830 decennial census and New Orleans Notarial Archives.
Note: n.a. indicates data are not available. Exporting counties supplied slaves to New Orleans, as indicated by Certificates of Good Character. The child-woman ratio equals the quotient of the number of slaves, aged 0 to 9 years, and the number of women, aged 10 to 54 years. The child-adult ratio equals the quotient of the number of slaves, aged 0 to 9 years, and the number of adults, aged 10 to 54 years.

Table 3
Demographic causes of slave sales
Linear Probability Model

| Covariate | Regression (1) Dependent Variable: Will Sell Slaves | Regression (2) Dependent Variable: Proportion Sold | Regression (3) Dependent Variable: Will Sell Slaves | Mean |
|---|---|---|---|---|
| Will Sell Slaves (1=yes, 0=no) | | | | 0.003 (0.051) |
| Slaves to be sold / slaves in holding | | | | 0.0004 (0.0129) |
| Intercept | 0.00615* (0.00357) | 0.00010 (0.00031) | 0.00622* (0.00357) | 1 |
| Children, 0-9 years / Women, 10-54 years | -0.00001 (0.00018) | -0.00004 (0.00004) | | 1.124 (1.155) |
| Children, 0-9 years / Adults, 10-54 years | | | -0.00013 (0.00019) | 0.655 (0.786) |
| Men, 10-54 years / Women, 10-54 years | 0.00077** (0.00035) | 0.00010** (0.00005) | 0.00075** (0.00034) | 0.911 (1.266) |
| Holding Size: 1 to 15 slaves (1=yes, 0=no) | -0.00431 (0.00299) | 0.00019* (0.00010) | -0.00431 (0.00299) | 0.836 (0.370) |
| Holding Size: 16 to 50 slaves (1=yes, 0=no) | -0.00082 (0.00319) | 0.00009 (0.00011) | -0.00082 (0.00319) | 0.142 (0.349) |
| Controls (Non-sellers) | Yes | Yes | Yes | |
| County Fixed Effects | Yes | Yes | Yes | |
| Observations | 30556 | 30556 | 30556 | 30556 |
| F value | 1.85*** | 1.11 | 1.85*** | |
| $R^2$ | 0.0029 | .0017 | 0.0029 | |

Source: New Orleans Notarial Archives and 1830 Decennial Census Schedules.
Note: The unit of observation is the slaveholding prior to the date of certification. The dependent variable equals one if the slaveholder will sell a slave, and zero otherwise. The omitted category is holdings with more than fifty slaves. The sample includes holdings with women as of June 1, 1830. Robust standard errors reported in parentheses.
*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Table 4
Demographic consequences of slave sales on the child-woman ratios of slave sellers
OLS regressions

| Covariate | Regression (1) | Regression (2) | Mean |
|---|---|---|---|
| Children, 0-9 years / Women, 10-54 years | | | 1.139 (1.151) |
| Intercept | 1.014*** (0.024) | 0.971*** (0.128) | 1.000 (0.000) |
| Men remaining, 10-54 years / Women remaining, 10-54 years | 0.174*** (0.013) | 0.185*** (0.056) | 0.902 (1.222) |
| Women sold, 10-54 years / Women remaining, 10-54 years | 0.511*** (0.189) | 0.543*** (0.170) | 0.001 (0.026) |
| Mothers sold, 10-54 years / Women remaining, 10-54 years | -1.682* (0.903) | -1.634* (0.964) | 0.000 (0.003) |
| Men sold, 10-54 years / Women remaining, 10-54 years | -0.049 (0.149) | 0.031 (0.187) | 0.001 (0.028) |
| Holding Size: 1 to 15 slaves (1=yes, 0=no) | -0.052*** (0.019) | -0.079 (0.141) | 0.839 (0.368) |
| Holding Size: 16 to 50 slaves (1=yes, 0=no) | 0.194*** (0.022) | 0.149 (0.124) | 0.144 (0.352) |
| Controls (Non-sellers) | Yes | No | Yes |
| County Fixed Effects | Yes | No | |
| Observations | 92909 | 372 | 92909 |
| F value | 49*** | 8.1*** | |
| $R^2$ | 0.075 | 0.118 | |

Source: New Orleans Notarial Archives and 1830 Decennial Census Schedules.
Note: The dependent variable is the child-woman ratio as recorded in the 1830 decennial census. Sample includes holdings with women as of June 1, 1830. Robust standard errors reported in parentheses.
*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Table 5
Estimates of the Slave Trade's Effect on the Child-Woman Ratio
Exporting areas in 1830

| Parameter | Description | Estimate | Source |
|---|---|---|---|
| $C/W$ | Southern child-woman ratio, Children aged 0 to 9 years / Women aged 10 to 54 years | 1.156 | Table 1, row (2) |
| $C^S/W^S$ | Child-woman ratio, slaves sold to traders | 0.110 | Certificates of good character, New Orleans notarial archives |
| $C^P/W^P$ | Child-woman ratio, slaves migrating with planters | 1.156 | By assumption |
| $C^R/W^R$ | Child-woman ratio, slaves remaining in exporting areas | 1.243 | Table 1, row (2) |
| $W^E/W$ | Net emigration rate, women aged 10 to 54 years | 0.108 | Projected population equals the product of 1820 cohort and the survival rate. Emigrants equal difference of projected population remaining population, as reported in 1830 decennial census |
| $W^R/W$ | Proportion remaining in exporting areas, women aged 10 to 54 years | 0.892 | Projected population equals the product of 1820 cohort and the survival rate. Remaining population reported in 1830 decennial census |
| $\gamma$ | Relative size of slave trade, women aged 10 to 54 years | 0.687 | By calculation (see text) |

Note: Exporting areas are defined as the states of Maryland, North Carolina, and Virginia.

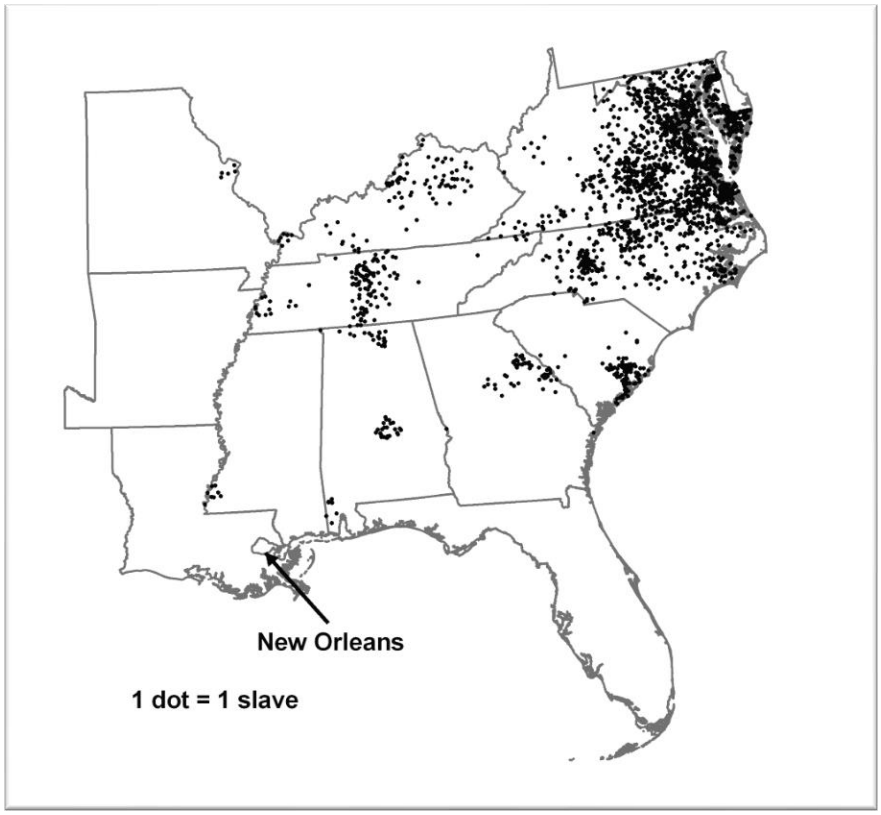


Figure 1 -- Origins of imported slaves sold in New Orleans, 1830
Source: New Orleans Notarial Archives and Mason (2017).

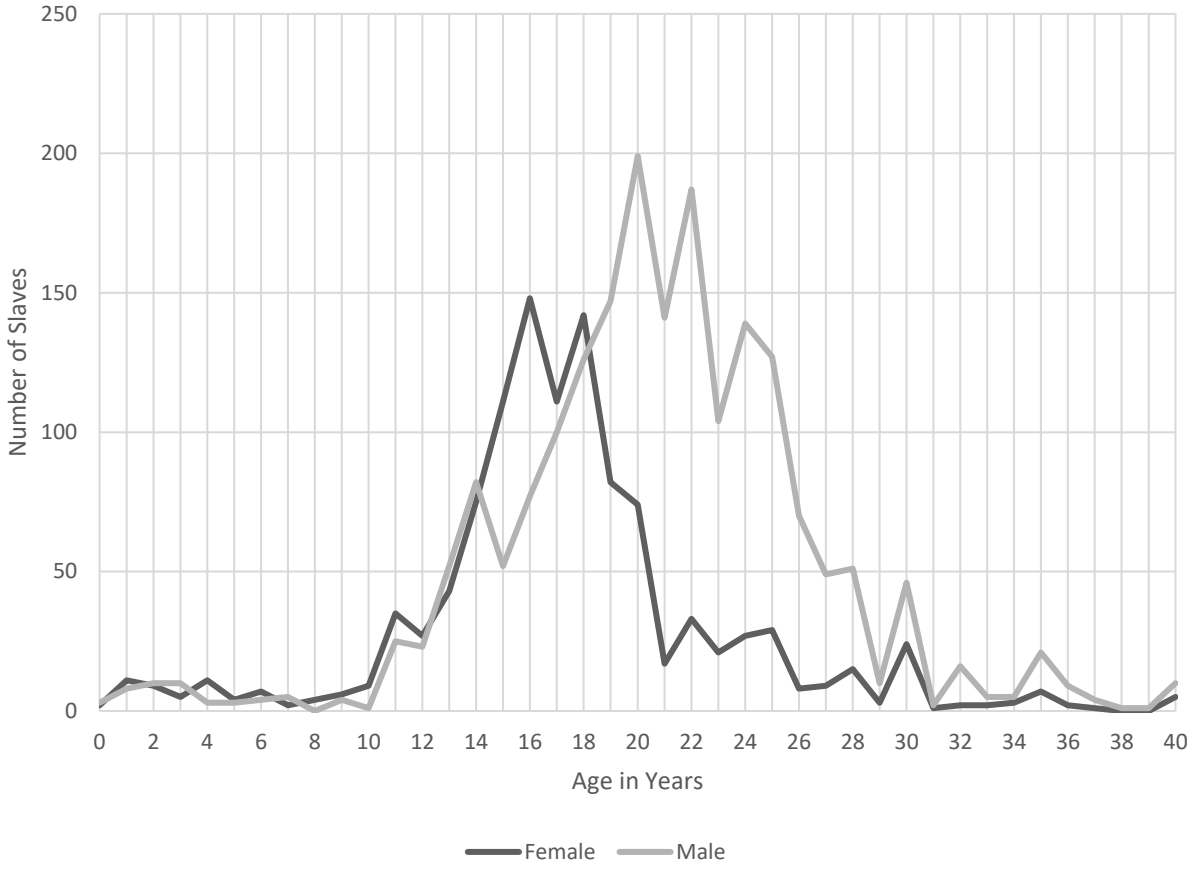


Figure 2 -- Age distribution of imported slaves sold in New Orleans, 1830
Source: New Orleans Notarial Archives

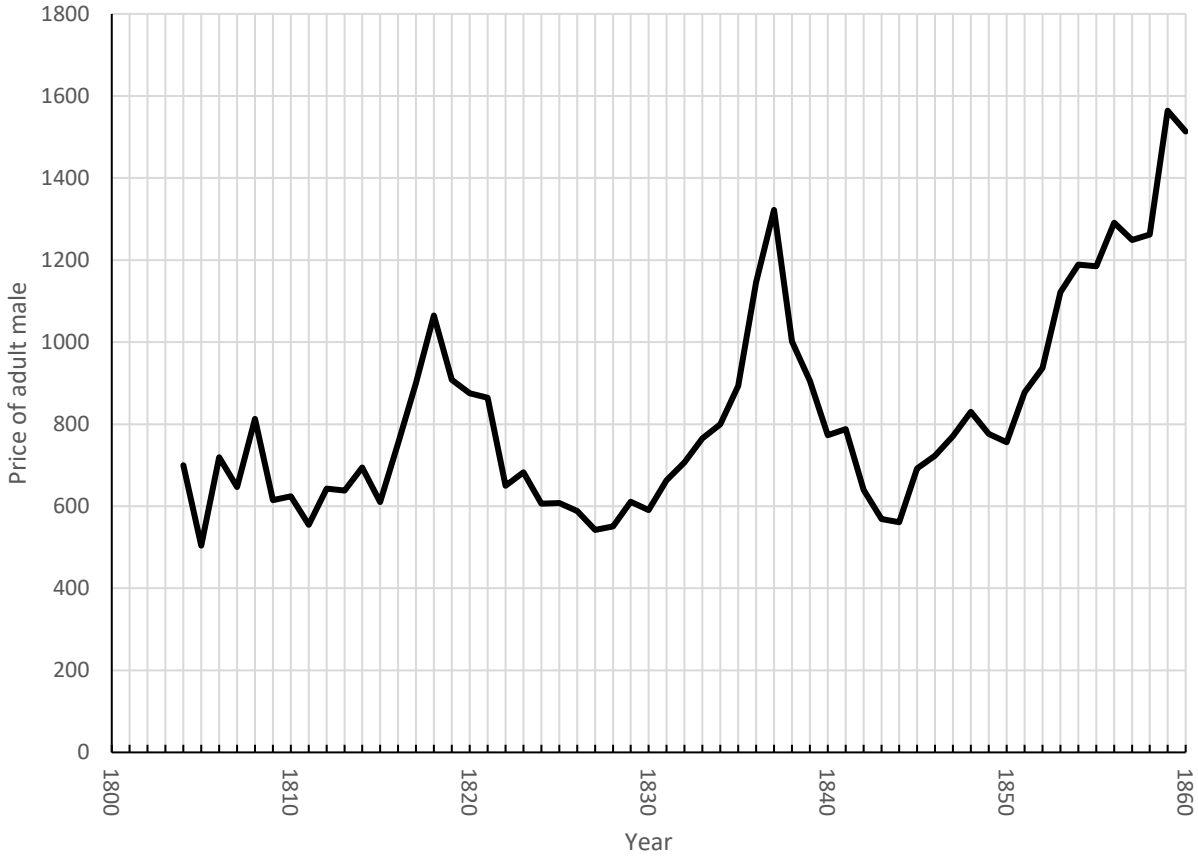


Figure 3 – New Orleans slave prices for males, ages 18 to 30, without skills, fully guaranteed as without physical or other infirmity.
Source: Ransom and Sutch 1988, pp. 155-56.

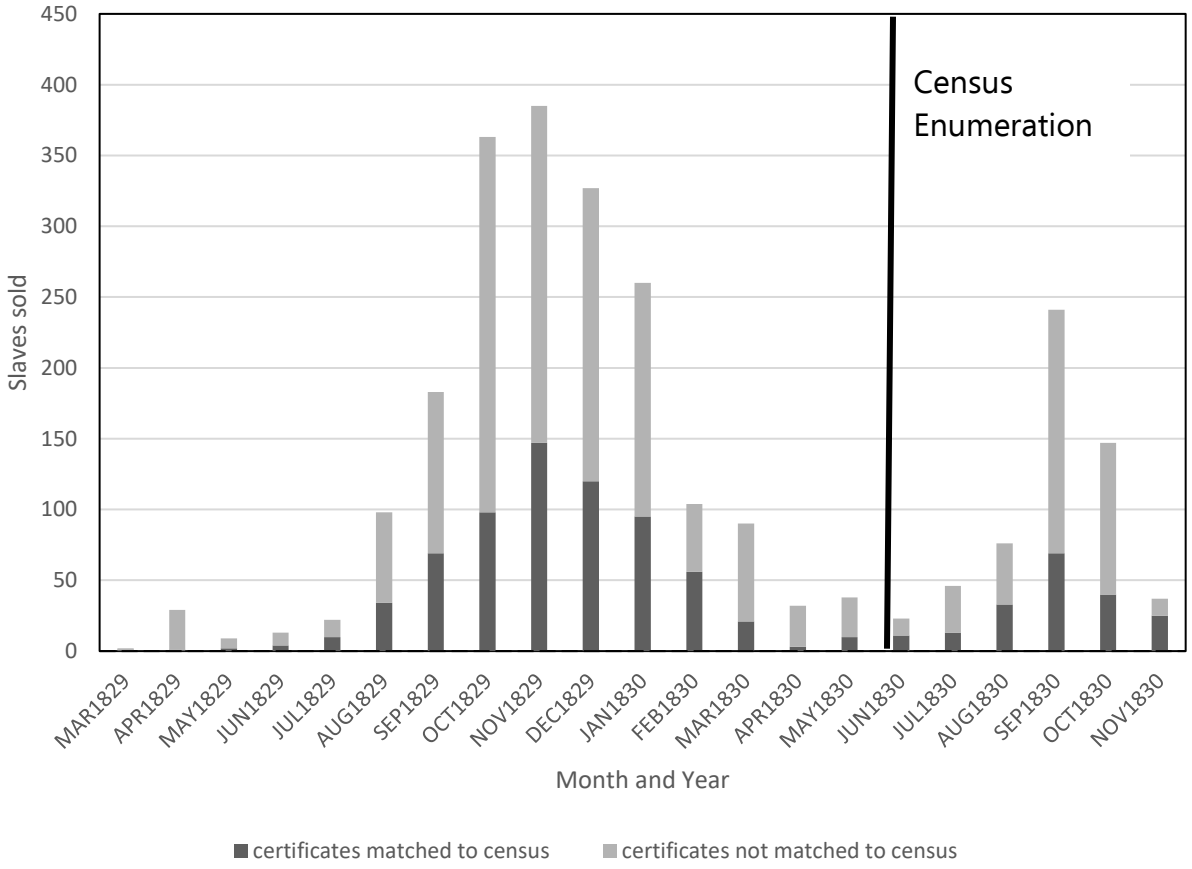


Figure 4 -- Month of Certification in Exporting Areas
Source: New Orleans Notarial Archives

Table A1
Demographic causes of slave sales – Logit regressions

| Covariate | Regression (1) | Odds Ratio | Regression (2) | Odds Ratio | Means |
|---|---|---|---|---|---|
| Will Sell Slaves (1=yes, 0=no) | | | | | 0.0025 (0.0501) |
| Intercept | -5.343 (0.544) | 0.005 | -4.723 (0.893) | 0.009 | 1 |
| Children, 0-9 years / women, 10-54 years | 0.036 (0.087) | 1.036 | 0.015 (0.093) | 1.015 | 1.124 (1.156) |
| Men, 10-54 years / Women, 10-54 years | 0.054** (0.024) | 1.055 | 0.054** (0.027) | 1.056 | 0.911 (1.266) |
| Holding Size: 1 to 15 slaves | -1.017* (0.548) | 0.362 | -1.436** (0.566) | 0.238 | 0.836 (0.370) |
| Holding Size: 16 to 50 slaves | 0.062 (0.562) | 1.064 | -0.275 (0.570) | 0.759 | 0.142 (0.349) |
| Controls (Non-sellers) | Yes | | Yes | | |
| County Fixed Effects | No | | Yes | | |
| Observations | 30553 | | 30553 | | 30553 |
| McFadden's $R^2$ | 0.021 | | 0.062 | | |

Source: New Orleans Notarial Archives and 1830 Decennial Census Schedules.
Note: The unit of observation is the slaveholding prior to the date of certification. For regressions (1) and (2), the dependent variable equals one if slaveholder will sell a slave, and zero otherwise. For regression (3) and (4), the dependent variable equals the number of slaves to the sold divided by the number of slaves in holding. Sample includes holdings with women as of June 1, 1830. Robust standard errors reported in parentheses.
*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Table A2
Demographic consequences of slave sales on the child-woman ratio of slave sellers
OLS regressions -- Falsification test

| Covariate | Regression (1) | Regression (2) | Mean |
|---|---|---|---|
| Children / women | | | 1.139 |
| | | | (1.150) |
| Intercept | 0.972 | 1.015 | 1.000 |
| | (0.020) | (0.024) | (0.000) |
| Men, 10-54 | 0.178*** | 0.174*** | 0.902 |
| / women, 10-54 | (0.014) | (0.013) | (1.222) |
| Women sold before census | 0.528*** | 0.517*** | 0.001 |
| / women, 10-54 | (0.189) | (0.190) | (0.026) |
| Mothers sold before | -1.768* | -1.690* | 0.000 |
| census / women | (0.929) | (0.904) | (0.003) |
| Men sold before census | -0.014 | -0.044 | 0.001 |
| / women, 10-54 | (0.146) | (0.150) | (0.029) |
| Women sold after census | -0.068 | -0.103 | 0.000 |
| / women, 10-54 | (0.431) | (0.408) | (0.011) |
| Mothers sold after census | -0.046 | 0.056 | 0.000 |
| / women, 10-54 | (0.566) | (0.527) | (0.004) |
| Men sold after census | 0.412* | 0.367* | 0.000 |
| / women, 10-54 | (0.210) | (0.199) | (0.014) |
| Holding size: | -0.036* | -0.053*** | 0.838 |
| 1 to 15 slaves | (0.019) | (0.019) | (0.368) |
| Holding size: | 0.253*** | 0.193*** | 0.145 |
| 16 to 50 slaves | (0.023) | (0.022) | (0.352) |
| Controls (Non-sellers) | Yes | Yes | |
| County Fixed Effects | No | Yes | |
| Observations | 92993 | 92993 | 92993 |
| F value | 533.83*** | 48.09*** | |
| $R^2$ | 0.049 | 0.075 | |

Source: New Orleans Notarial Archives and 1830 Decennial Census Schedules.
Note: The dependent variable is the child-woman ratio. Robust standard errors reported in parentheses.
*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Table A3
Estimates of the Slave Trade's Effect on the Child-Woman Ratio
Exporting areas in 1860

| Parameter | Description | Estimate | Source |
|---|---|---|---|
| $C/W$ | Southern child-woman ratio, Children aged 0 to 4 years / Women aged 15 to 49 years | 0.702 | Table 1, row (5) |
| $C^S/W^S$ | Child-woman ratio, slaves sold to traders | 0.082 | Certificates of good character, New Orleans notarial archives |
| $C^P/W^P$ | Child-woman ratio, slaves migrating with planters | 0.702 | By assumption |
| $C^R/W^R$ | Child-woman ratio, slaves remaining in exporting areas | 0.745 | Table 1, row (5) |
| $W^E/W$ | Net emigration rate, women aged 15 to 49 years | 0.159 | Projected population equals the product of 1850 cohort and the survival rate. Emigrants equal difference of projected population remaining population, as reported in 1860 decennial census |
| $W^R/W$ | Proportion remaining in exporting areas, women aged 10 to 54 years | 0.841 | Projected population equals the product of 1850 cohort and the survival rate. Remaining population reported in 1860 decennial census |
| $\gamma$ | Relative size of slave trade, women aged 15 to 49 years | 0.367 | By calculation (see text) |

Note: Exporting areas are defined as the states of Maryland, North Carolina, and Virginia.