Quantitative Estimates of the
United States Interregional Slave Trade,
1820-1860*

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“It is impossible to say definitely what percentage of the movement of slaves to the
lower South was comprised in the domestic slave trade. . . .” L. C. Gray (1933, p.
658).

Abstract
The selective buying habits of traders provide a method for estimating the share of
sales in the interregional movement of slaves within the southern United States.
Estimates are derived by comparing information about the slaves chosen by traders
with information about all migrants. To derived their estimate, Fogel and
Engerman (1974) used information about the sex of the migrants; Tadman (1989)
used information about their ages. In this paper, I show how their estimating
equations are algebraically equivalent. Using regression analysis and additional
data originally published by Tadman, I estimate that the slave trade accounted for
approximately one-half of the interregional movement of slaves.

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Between 1790 and 1860, approximately 835,000 slaves moved from the exporting areas to the importing areas of the United States South.\(^1\) These slaves either moved with their owners as whole plantations or were bought by interregional traders and shipped to the lower South. Until recent years, historians had no way of estimating the share of sales in the interregional movement of slaves. Consequently, most of the early quantitative estimates of the interregional slave trade were vague or deliberately imprecise.\(^2\)

The frequency of interregional slave sales affects our perceptions of slavery. Most slaves selected by traders for distant markets were purchased and sold separately. Such sales would have severed family ties. Migrating planters were basically non-selective, transporting all of their slaves regardless of their ages or sex. Although planter migrations destroyed some families and marriages, these moves were less disruptive than selective sales to interregional traders (Gutman, 1975, pp. 104-107).

The selective buying habits of traders provide a method for estimating the share of sales in

\(^1\)Fogel and Engerman (1974a, p. 47). Gutman and Sutch (1976, p. 99) estimate “more than a million slaves entered the interstate migration between 1790 and 1860.” For other estimates of the net migration of slaves (or blacks) within the United States, see Collins (1904, pp. 61-67), Bancroft (1931, pp. 382-406; and sources therein), Lang (1975, pp. 57-72), Sutch (1975, pp. 178-180), McClelland and Zeckhauser (1982, pp. 159-164), and Tadman (1989, pp. 237-247).

\(^2\)According to Weld (1841, p. 13), “perhaps four-fifths or more” of the slaves were transported through the interregional slave trade. For the period 1820 to 1850, Collins (1904, p. 62) estimated that less than two-fifths of the migrants were carried south through the trade. According to Phillips (1909, p. 223), “The conjecture of about 25,000 per year which has often been made for the interstate slave trade is probably as just an approximation as can be had. . . .” Bancroft (1931, p. 398) “supposes that” the slave trade accounted for 70 percent of the slave exports. Stampp (1956, p. 239) suggests that the slave trade accounted for “perhaps a majority” of the slave exports.
the forced migration of slaves. Fogel and Engerman (1974a, p. 48) found that most traders preferred to purchase males for distant markets. By comparing the sex ratios of the slaves sold to traders with those of all migrants, they calculated that sales accounted for 16 percent of the total migration of slaves. Tadman (1989, p. 31) argued that traders preferred to purchase prime-aged slaves. By comparing the ages of slaves sold to traders with those of all migrants, he concluded that at least 60 to 70 percent of the movement was due to the slave trade.

The estimates made by Fogel and Engerman and by Tadman are remarkably different, but their methodology is basically the same. In this paper, I show how their estimating equations are algebraically equivalent. Using additional information originally published by Tadman (1989), I provide alternative estimates of the share of sales in the interregional movement of slaves. These estimates differ because of measurement errors. I show that regression analysis is an appropriate way to account for these errors. I conclude by arguing that the slave trade accounted for

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3 Counting transactions, traders, or the number of migrants are alternative ways to estimate the share of sales in the interregional movement of slaves. For his study of the slave trade in Maryland, Calderhead (1972) counted the number of slaves sold to identified traders. Errors of omission create a downward bias in this methodology, however. Some sales to interregional traders were not recorded, or if they were recorded, these records no longer exist (Freudenberger and Pritchett, 1991, p. 467; Russell, 1993, pp. 57-64; Deyle, 1995, pp. 256-263).

Instead of counting the number of slaves sold to traders, Tadman (1989, p. 37) counts the number of traders operating in South Carolina during the 1850s. Since Tadman sought to establish that the interregional trade was large, omitting traders from his calculations tends to strengthen his conclusions. Other errors, however, create an upward bias in his estimates. Using information about the typical size of a slave coffle and assuming traders shipped one coffle per year, Tadman attributes an annual export of 30 to 40 slaves to each firm. For the decade, he attributes 300 to 400 slave exports to each firm. These estimates are probably too large. Some of the firms identified by Tadman may have specialized in the intra-state slave trade rather than the inter-state slave trade. Other firms may have sold fewer than thirty slaves annually. Finally, other firms may have been active for only part of the decade. These possible errors would cause Tadman to overestimate the extent of the slave trade in South Carolina.

approximately one-half of the interregional movement of slaves. Because of measurement error, however, the exact figure may have been substantially more or less than 50 percent.

**Literature Review**

*Fogel and Engerman*

Fogel and Engerman (1974b, p. 53) used information about the sex of the migrants to estimate the share of sales in the total migration of slaves. They assumed that male migrants either traveled with their owners or were sold to interregional traders:

$$T_i = S_i + M_i,$$  \hspace{1cm} (1)

Where $T_i$ is the number of male migrants, $S_i$ is the number of males sold to interregional traders, and $M_i$ is the number of males who migrated with their owners.\footnote{The superscript $i$ indicates that the value of the variable pertains to a cohort. In Fogel and Engerman’s equation, the cohort includes all males; in Tadman’s equation, the cohort includes older males. Some slaves in the exporting areas were purchased by southwestern planters on buying expeditions; other slaves migrated with their owners only to be sold on arrival in the importing areas. For the purposes of this analysis, these slaves are treated as if they were sold to interregional traders.}

(See Table 1 for a complete list of variable definitions.) Dividing both sides of (1) by $T$, the total number of migrants, results in the following identity:

$$\frac{T_i}{T} = \frac{S_i}{S} + \frac{M_i}{M}.$$

The male share of all migrants is equal to a weighted average of the male share of interregional sales and the male share of planter migrations, where the weights equal the shares of

$$\frac{T_i}{T} = \frac{S_i}{S} + \frac{M_i}{M}.$$  \hspace{1cm} (2)
sales and planter migrations in the total migration of slaves. After substituting symbols for the male shares and the share of sales, Fogel and Engerman’s equation is written as follows:

\[
\bar{\delta} = \gamma \delta_s + (1-\gamma)\delta_m, \tag{3}
\]

Where \( \delta \) is the male share of total interregional migration, \( \delta_s \) is the male share of interregional sales, \( \delta_m \) is the male share of the interregional movement of plantations, and \( \gamma \) is the share of sales in the interregional migration of slaves. For known values of the male shares, (3) can be solved for the share of sales in the total migration of slaves:

\[
\gamma = \frac{\bar{\delta} - \delta_m}{\delta_s - \delta_m}. \tag{4}
\]

Ideally, (4) should be estimated using gross migration data. Because these data are not available, Fogel and Engerman used net migration data instead. Using a statistical method known as the survivor technique, Goldin found that the male share of net migration equaled 0.511 for the time period between 1820 and 1860. Fogel and Engerman used this value as a proxy for \( \bar{\delta} \).

Three estimates of the male share of slave sales were estimated from three different sources. A smaller value for \( \delta_s \) decreases the denominator in (4) and increases the value of \( \gamma \). Because Fogel and Engerman wanted a upper-bound estimate of \( \gamma \), they chose to use their smallest estimate of \( \delta_s \), in their calculation. The smallest of these estimates, equal to 0.57, was derived from New Orleans sales records. By assumption, planters migrated with equal numbers of males and females. Consequently, Fogel and Engerman assumed \( \delta_m \) equaled 0.5. Substituting these values
into equation (4), they calculated $\gamma$ equaled 0.157. Using this calculation, Fogel and Engerman (1974a, p. 48) concluded that “about 84 percent of the slaves engaged in the westward movement migrated with their owners,” and only 16 percent were sold by traders.

Fogel and Engerman’s estimate of the share of sales is sensitive to the choice of initial assumptions. In deriving their estimate, Fogel and Engerman assumed that the male share of the movement of whole plantations equaled 50 percent. According to Lebergott (1975, p. 699), if they assumed “not 50 per cent, but say 51 per cent, they would have discovered that over 100 per cent (and not 84 per cent) of all slaves migrated with their owners.” Tadman (1989, p. 23) criticized Fogel and Engerman’s sales data. In particular, he argued that the male share of slave sales was approximately 50 percent, not 57 percent, as estimated by Fogel and Engerman. Under such circumstances, equation (4) would not be identified and any value for $\gamma$ would be consistent with these data. Carstensen and Goodman (1977) showed that small perturbations in any of the values of the male shares could result in absurd values for the share of sales in the total migration of slaves, such as negative values or values greater than one. They concluded that Fogel and Engerman’s linear equation “is simply too sensitive to generate reliable estimates even from reliable historical data” (Carstensen and Goodman, 1977, p. 318).
To estimate the share of sales in the interregional movement of slaves, Tadman uses information about the net migration rate of older males. He limits his estimates to the 1820s and the 1850s because census age categories ease the use of survival techniques for these decades. Tadman argues that most traders selected prime-aged slaves, whereas planters shipped both the young and old. “The key element in disaggregating the total movement into its two components is the fact that planter migrations would have drawn at the same percentage rate (though not, of course, in the same absolute numbers) from all age groups” (Tadman, 1989, p. 29). Because 2.91 percent of the males aged fifty-five years or more, migrated during the 1820s, Tadman contends that, at most, only 2.91 percent of the entire slave population would have migrated with planters. He calculates that 9.48 percent of the slave population migrated during this decade; consequently, Tadman infers that the slave trade accounted for the remaining 6.57 percentage points, or 69.3 percent of the interregional movement of slaves during the 1820s.

To calculate the share of sales during the 1820s, Tadman used the out-migration rate for males more than fifty-five years of age to approximate the rate for planter migrations. For the 1850s, he chose a different cohort with a lower out-migration rate, females more than fifty years of age. According to Tadman, this rate is still too high because sales to traders probably accounted for some exports for this age group. He contends “we must scale down the overall 4.97 percent rate for females aged 40+/50+, suggesting a rate of exportation by planter migrations of not more than about 4 percent.” Tadman calculates the net migration rate for all slaves was 10.25 percent, from which he concludes that the trade accounted for “at least some 61 percent” of exports during the 1850s (Tadman, 1989, p. 247).
The algebraic equivalence of Fogel and Engerman’s and Tadman’s equations

Although Tadman’s estimates of the share of sales are much larger than Fogel and Engerman’s estimate, his calculations are algebraically equivalent to theirs. Implicit in Tadman’s calculation is the following equation:

\[ \hat{\gamma} = \frac{T - T_i}{P - P_i} = \frac{\beta - \beta^i}{\beta} \]  \(5\)

Where \(\beta\) is the out-migration rate for slaves of all ages, and \(\beta^i\) is a cohort’s out-migration rate (see Table 1 for symbol definitions). A “hat” is placed over Tadman’s estimate of gamma to indicate that it is correct only making certain assumptions. Using these assumptions, Tadman’s equation is the algebraic equivalent of Fogel and Engerman’s.

In making his estimate, Tadman assumes that planter migrations were representative of the slave populations of the exporting areas. Consequently, a cohort’s share of planter migrations equaled their share of the slave population of the exporting areas (or \(M_i / M = P_i / P\)). Substituting these values into (4), the equation used by Fogel and Engerman, yields the following:

\[ \gamma = \frac{\delta - \delta_m}{\delta_s - \delta_m} = \frac{T_i}{M} - \frac{M^i}{M} = \frac{T_i}{P} - \frac{P^i}{P} \]  \(6\)

Multiply the numerator and the denominator of (6) by \(-T / P^i\), or
\[
\gamma = \frac{T}{P} - \frac{T_i}{P_i} = \frac{\beta - \beta_i}{\beta - \beta'_s}. \tag{7}
\]

Where \(\beta'_s\) is a cohort’s out-migration rate through the interregional slave trade.

Additional algebraic manipulation results in the following expression for the share of sales in the total migration of slaves:

\[
\gamma = \frac{\beta - \beta_i + \beta'_i}{\beta}. \tag{8}
\]

Because Tadman assumes traders refused to purchase older males, the migration rate of older males through the interregional slave trade equals zero (\(\beta'_s = 0\)). After making these assumptions, Tadman’s equation is a simplified version of Fogel and Engerman’s equation, with the exception that the shares now refer to the cohort of older males rather than males of all ages.

A numeric example illustrates the equivalence of Tadman’s equation (5) and Fogel and Engerman’s equation (4). Using data published by Tadman, males more than fifty-five years of age accounted for 1.12 percent of the total out-migration of slaves between 1820 and 1830. Males in this age group accounted for 3.66 percent of the movement of whole plantations and, by assumption, none of the interregional slave trade. Using equation (4), these statistics imply that the share of sales in the migration of slaves equaled 69.3 percent, the same estimate derived by
Arithmetically, \( \gamma = \frac{9.48 - 2.91}{9.48} = \frac{1.12 - 3.66}{0 - 3.66} = .693 \).
values could result in absurd estimates for the share of sales in the total migration of slaves. Because Tadman uses the same methodology, Carstensen and Goodman’s criticisms of Fogel and Engerman also apply to Tadman.

**Sources of Measurement Error**

Estimates of the share of sales in the total migration of slaves are not specific to a cohort. They apply to all migrants. Consequently, all estimates of \( \gamma \) derived from Tadman’s data should be the same. They vary because of errors in measuring the different migration shares.

**Gross Migration**

Gross migration data should be used to estimate \( \gamma \). Because they are not available, both Fogel and Engerman and Tadman use net migration data for their estimates. Net migration statistics are measured with error; Consequently, estimates of \( \gamma \) derived from net migration statistics will also be measured with error.

Using population data from consecutive censuses, net migration is calculated as the difference between the projected and the actual population of slaves surviving until the end of a decade. The projected population is estimated from survival rates of slaves living throughout the South. The actual population may differ from the projected population for reasons other than population flows. Although the international slave trade was banned in 1808, subsequent additions and subtractions to the population may have occurred because of slave smuggling, manumissions, and escapes. Furthermore, interregional variation in mortality, fertility, and census enumeration rates could cause measurement errors in the net migration rates. For example, a

Even if measure accurately, net migration statistics can be poor proxies for gross migration flows. Because gross in-migration can offset gross out-migration, net migration statistics can mask age-specific differences in the rates of emigration (Rogers, 1990). Tadman uses the net migration rate of older males to proxy the gross migration rate of slaves in whole plantations. Net migration statistics understate the gross out-migration rate of plantations, potentially biasing estimates of the share of sales in the total migration of slaves.

Age-specific net-migration rates can be affected by the level of aggregation. Tadman identified six southern states (and the District of Columbia) as supplying slaves to the interregional market during the 1820's. Each of these states had different net-migration rates for older males and for the entire slave population (see Table 3 for a list of the states and the net migration rates). Using Tadman’s methodology, these net-migration rates imply different estimates of the share of sales in the total migration of slaves. For example, these calculations indicate the slave trade accounted for only 27 percent of the net migration of slaves from the District of Columbia. In contrast, over 100 percent of the slaves who left North Carolina were

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6Using census data for 1870, Graves, Sexton and Vedder (1983) found that relatively few African Americans resided east of their recorded state of birth. Because most moves occurred prior to emancipation, their finding implies that owners rarely moved to the east with their slaves. A prevailing east-west migration of slaves, however, does not imply equal net and gross migration rates. For example, areas identified by Tadman as importing slaves during the 1820s also exported slaves to the New Orleans market. Slaves from these importing areas accounted for over 10 percent of the non-Louisiana slaves exported to New Orleans during 1830 (Freudenberger and Pritchett, 1991, p. 460).
Because of the small sample, the age and sex distribution used by Tadman is problematic. Fogel and Engerman (1974b, p. 53) estimated \( s \) from a random sample of sales invoices, representing more than 5,700 slaves who were sold in New Orleans between 1804 and 1862. In contrast, the age and sex distribution used by Tadman is derived from the trading records of four firms that sold a total of 510 slaves between 1830 and 1850 (Tadman, 1989, p. 26; Tadman, 1977, p. 55).

\[ \text{Falling transport costs or rising prices reduce trader selectivity, increasing the relative number of children and older adults eligible for shipment (Freudenberger and Pritchett, 1991, pp. 456-459; Pritchett, 1997, pp. 79-83). Legal restrictions and social approbation may have also affected the traders’ decisions to ship families or single children (Sweig, 1980; Fogel and Engerman, 1992). Finally, Tadman argued that New Orleans was not representative of the interregional slave trade because of the peculiar demands of buyers in this market. The cultivation of sugar, the primary crop of southeastern Louisiana, requires arduous labor. To satisfy the labor demands of sugar planters, Tadman (1989, pp. 64-70) argues that traders shipped prime-aged males. As shown in Figure 1, relatively more males aged 20 to 29 years were sold in New Orleans than were sold in other markets. Few children were sold there as well.}^{7} \]

\[ \text{Planter Migrations} \]

Both Fogel and Engerman (1974b, p. 53) and Tadman (1989, p. 25, 29) assume a non-
\[ \quad \]

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\[ ^{7} \text{Because of the small sample, the age and sex distribution used by Tadman is problematic. Fogel and Engerman (1974b, p. 53) estimated} \ s \text{ from a random sample of sales invoices, representing more than 5,700 slaves who were sold in New Orleans between 1804 and 1862. In contrast, the age and sex distribution used by Tadman is derived from the trading records of four firms that sold a total of 510 slaves between 1830 and 1850 (Tadman, 1989, p. 26; Tadman, 1977, p. 55).} \]
selective sex and age structure for planter migrations. Fogel and Engerman assume that males comprised one-half of the slaves migrating in whole plantations and Tadman assumes that planters took “an entire cross-section of ages.” These assumptions are wrong, however, if planters with females or older slaves moved less often than other planters or if migrating planters left some of these slaves behind. Unfortunately, the sex and age structure of slaves migrating in whole plantations is largely unknown. Tadman (1989, pp. 228-236) finds in letters and memoirs that planters included all of their slaves in their westward migrations. In contrast, Kulikoff (1992, p. 260) finds that planters migrating to Georgia chose to take younger slaves. Until there is more information, values for \( \delta_m \) are assumed to have equaled the cohort’s population share of the exporting areas. Most likely, these values for \( \delta_m \) are measured with error.

**Regression Analysis — An Errors in Variables Approach**

Regression analysis is an appropriate way to account for measurement errors in estimating

\[ \delta_m \]

8In calculating net-migration rates, Tadman (1989, p. 29) divides net exports by the beginning-period population of a cohort. Implicitly, Tadman assumes that the age structure of the beginning-period population is equal to the age structure of the slaves migrating in whole plantations. He makes an exception to this rule, however, in calculating the net migration rate for children aged less than ten years at the end of the decade. Because these children were not yet borne at the beginning of the decade, Tadman uses their ending-period population in calculating their net migration rate. Consequently, Tadman double counts children in calculating the age-structure of planter migrations: He counts them once for the cohort of children, aged less than ten years, at the end of the decade. He counts them twice for the cohort of children, aged less than ten years, at the beginning of the decade. Double counting the number of children adds error to Tadman’s estimates of \( \gamma \).

9Kulikoff’s result should be viewed with caution. The interstate slave trade was banned in Georgia, and some the state’s residents traveled to South Carolina to purchase slaves legally. Upon re-entry, buyers were required to register their imported slaves. These imported slaves, who were selectively purchased by residents of Georgia, are better classified as part of the trade rather than as part of planter migrations.
the value of \( \gamma \). Subtracting \( \delta_m \) from both sides of equation (3) and grouping terms results in the following equation:

\[
(\delta - \delta_m) = \gamma (\delta_s - \delta_m). 
\] (9)

Each variable in (9) is measured with error. (Measured variables are shown with *s, and the unobserved variables are shown without *s.)

\[
\delta^* = \delta - u, \quad \delta_s^* = \delta_s - v, \quad \text{and} \quad \delta_m^* = \delta_m - w,
\]

Where \( u, v, \) and \( w \) are independent, normally distributed, error terms. Substituting the measured variables for the unobserved variables in (9) results in the following estimating equation:

\[
(\delta^* - \delta_m^*) = \gamma (\delta_s^* - \delta_m^*) + \gamma (v-w)+(w-u).
\]

Or

\[
Y^* = \gamma X^* + \epsilon^*,
\] (10)

where \( Y^* = \delta^* - \delta_m^* \), \( X^* = \delta_s^* - \delta_m^* \), and \( \epsilon^* = \gamma (v-w)+(w-u) \). Because the measured variable \( X^* \) is correlated with the disturbance term \( \epsilon^* \), the estimated regression coefficient will be asymptotically biased toward zero (Kmenta, 1986, p. 349; Greene, 1993, p. 281). Consequently, estimating \( \gamma \) using regression analysis provides a lower bound estimate of the share of sales in the total migration of slaves.

An upper bound for \( \gamma \) is estimated by interchanging the roles of the dependent and independent variables. Equation (10) is solved for \( X^* \):
The least squares estimator of $1/\gamma$ is asymptotically biased toward zero because of errors in the measured variables ($1/\gamma$ appears in the disturbance term). Consequently, the inverse of the least squares estimator provides an approximate upper bound for $\gamma$ (Kmenta, 1986, p. 351).

Finally, the least squares estimates of the upper and lower bounds for $\gamma$ are measured with error. Confidence intervals for $\gamma$ are constructed to account for the imprecision of the estimates.

**X’Y’ Plots of Migration Data**

Plotting the $X’Y’$ pairs helps to illustrate the absurd values for $\gamma$ derived from Tadman’s data. The variable $Y’$ is interpreted as the over or under-representation of a cohort in the total migration of slaves. The variable $X’$ is the over or under-representation of a cohort among interregional slave sales. Observed $X’Y’$ pairs, calculated from Tadman’s data, are plotted in Figures 2 and 3. Without accounting for the error term, each pair implies a different value for $\gamma$, equal to the slope of a ray from the origin to the $X’Y’$ pair. Positive values of $\gamma$ are confined to $X’Y’$ pairs in the upper-right and the lower-left quadrants of the Figures. Negative (and absurd) values for $\gamma$ lie in the upper-left and the lower-right quadrants. For example, two negative estimates of $\gamma$ were calculated using Tadman’s data for the 1820s. These estimates, presented in Table 2, were calculated from data for two cohorts, males aged 24 to 35 years and females aged 24 to 35 years. Data from these cohorts correspond to the two observations in the upper-left quadrant of Figure 2. Values of $\gamma$ less than one should lie below a 45-degree line from the origin.

$$X^* = \frac{1}{\gamma} Y^* - \frac{\epsilon^*}{\gamma}.$$ (11)
Absurd values greater than one would lie above this line. For example, the 1,518 percent estimate of $\gamma$ for the 1850s, presented in Table 3, was calculated from data for the cohort, females aged 20 to 29 years. Data from this cohort corresponds to the observation in the upper-left quadrant of Figure 3, which lies next to the $Y^*$ axis.

**Empirical Results**

The regression model is estimated with Ordinary Least Squares using Tadman’s data for the 1820s. The results are presented in Table 5. The lower bound estimate of the share of sales in the migration of slaves is 0.513, and the implied upper bound estimate is 0.612. Because of the small sample size, these boundary estimates of $\gamma$ are approximations. Adjusting for statistical variation in these estimates yields a 95 percent confidence interval of 0.375 to 0.777. Tadman’s estimate for $\gamma$ of 0.693 lies within the confidence interval; Fogel and Engerman’s estimate of 0.157 does not. Consequently, the regressions show that, for the 1820s, Fogel and Engerman have underestimated the share of slave sales in the migration of slaves. Because Tadman’s estimate lies above the upper bound, the results suggest that Tadman overestimated the share of slave sales in the interregional migration of slaves. The difference between Tadman’s estimate and the upper bound estimate, however, is not statistically significant.

The model is also estimated using data published by Tadman for the 1850s. Apparently, these data are measured with greater error, as shown by the relatively poor fit of the regression ($R^2$ equals 0.484). Greater measurement error also results in wider bounds for the estimated value of $\gamma$; the lower bound estimate is 0.499, and the implied upper bound estimate is 1.031 (an absurd value greater than one). The estimated 95 percent confidence interval for $\gamma$ is 0.244 to
1.557. Tadman’s estimate of 0.610 for the 1850s lies within this interval; Fogel and Engerman’s estimate of 0.157 does not.

The estimated regression equations, presented in Table 5, are plotted in Figures 2 and 3. As required by the model, the regression lines go through the origin (the means of $X^*$ and $Y^*$ are zero). Observations deviate from the regression line due to measurement error. Without measurement error, all estimates of $\gamma$ are deterministic and identical, and all $X^*Y^*$ pairs would align on a common ray.

**New Orleans Sales Data**

As a test for robustness, an alternative age distribution for the slaves sold by traders is used in the regression analysis. To estimate the share of sales in the interregional movement of slaves, Fogel and Engerman used information about the slaves sold in New Orleans. If the New Orleans market were unrepresentative to the interregional market in slaves, then this might account for the small value of $\gamma$ estimated by Fogel and Engerman. Conversely, measurement error in Tadman’s sales data might account for the relatively large values of his estimates. The regression equations using New Orleans sales data are presented in Table 6. For both the 1820s and the 1850s, using New Orleans sales data improves the fit of the regression equations, as is evident from a comparison of the R²’s, or by comparing the $X^*Y^*$ plots (Figure 4 versus Figure 2 and Figure 5 versus Figure 3). As discussed previously, deviations from the estimated regression lines are caused by errors in measurement. The improved fit of the regression equations suggests that the New Orleans sales data is measured with less error than Tadman’s sales data.

The improved fit of the regression is also reflected in a smaller range of values for $\gamma$. For
the 1820s, the lower bound estimate is 0.482, and the implied upper bound estimate is 0.506,
suggesting that the slave trade accounted for approximately one-half of all migrants. Adjusting
for statistical variation in the regression coefficients results in a 95 percent confidence interval of
0.416 to 0.576. Both Tadman’s and Fogel and Engerman’s estimates lie outside of the confidence
interval. The regression results suggest that Fogel and Engerman have underestimated, while
Tadman has overestimated, the extent of the slave trade during the 1820s.

Regressions for the 1850s yield similar results. Using the New Orleans sales data, the
lower bound estimate for $\gamma$ is 0.421, and the implied upper bound estimate is 0.529. The 95
percent confidence interval for $\gamma$ is 0.316 to 0.661. These results again suggest that sales
accounted for approximately one-half of the movement of slaves during the 1850s. They also
suggest a wide margin of error for the estimate.

The upper and lower bounds for $\gamma$, estimated for the 1820's using New Orleans sales data,
are relatively close to each other (see Figure 4). The confidence interval for the estimate is wide
because the regression has relatively few observations (as there are only ten cohorts). Tadman
identifies seven areas as supplying slaves to the interregional trade. Disaggregating migration data
to the state level would increase the number of observations sevenfold. Such disaggregation does
not improve the precision of the estimate, however. As discussed previously, each of the
exporting state had different age-specific net-migration rates. Aggregation masks this variation.
As shown in unreported regressions, using state-level data increased the width of the confidence
interval around $\gamma$. This lack of precision in the estimate of $\gamma$ reflects measurement error.

Summary
The selective buying habits of traders provide a method for estimating the share of sales in the interregional movement of slaves. Estimates of the share of sales are derived by comparing information about the slaves chosen by traders with information about all migrants. To derive their estimate, Fogel and Engerman used information about the sex of the migrants. Tadman derived his estimate from information about one cohort of migrants. As shown in this paper, using information from all cohorts results in multiple quantitative estimates of the interregional slave trade. These multiple estimates vary because of measurement error.

Fogel and Engerman used a linear equation to estimate the share of sales of the interregional movement of slaves. Their equation can be estimated using regression analysis. Using New Orleans sales data, the regression results show that the slave trade accounted for approximately one-half of the interregional movement of slaves. Apparently, the New Orleans sales data are measured with less error than the sales data used by Tadman, as suggested by the improved fit of the model. In addition, the model fits the data better for the 1820s than for the 1850s. Finally, the regression results suggest a wide margin for error in estimating the share of sales in the interregional movement of slaves. The lack of precision is the result of measurement error.
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Bancroft, Frederic (1931), *Slave-Trading in the Old South*, Baltimore.


Table 1: Definitions of Symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>the number of interregional slave migrants</td>
</tr>
<tr>
<td>S</td>
<td>the number of interregional sales</td>
</tr>
<tr>
<td>M</td>
<td>the number of slaves migrating in whole plantations</td>
</tr>
<tr>
<td>i</td>
<td>a superscript which indicates that variable pertains to a specific cohort. In Fogel and Engerman’s equation, the cohort includes all males; in Tadman’s equation, the cohort includes older males.</td>
</tr>
<tr>
<td>$\tilde{\delta}$</td>
<td>a cohort’s share of interregional migration ($\tilde{\delta} = \frac{T^i}{T}$)</td>
</tr>
<tr>
<td>$\delta_s$</td>
<td>a cohort’s share of interregional sales ($\delta_s = \frac{S^i}{S}$)</td>
</tr>
<tr>
<td>$\delta_m$</td>
<td>a cohort’s share of the interregional movement of plantations ($\delta_m = \frac{M^i}{M}$)</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>the share of sales in the interregional migration of slaves</td>
</tr>
<tr>
<td>P</td>
<td>slave population of the exporting areas</td>
</tr>
<tr>
<td>$\beta$</td>
<td>out-migration rate ($\beta = \frac{T}{P}$)</td>
</tr>
<tr>
<td>$\beta^i$</td>
<td>a cohort’s out-migration rate ($\beta^i = \frac{T^i}{P^i}$)</td>
</tr>
<tr>
<td>$\beta^i_s$</td>
<td>a cohort’s out-migration rate through interregional sales ($\beta^i_s = \frac{S^i}{P^i}$)</td>
</tr>
<tr>
<td>*</td>
<td>a superscript which indicates that variable is measured with error</td>
</tr>
<tr>
<td>u, v, &amp; w</td>
<td>independent, normally distributed, error terms</td>
</tr>
<tr>
<td>X</td>
<td>$\tilde{\delta} - \delta_m$</td>
</tr>
<tr>
<td>Y</td>
<td>$\delta_s - \delta_m$</td>
</tr>
</tbody>
</table>
Table 2: Estimated Shares of Sales in Total Migration, 1820-1830; calculations based on Tadman’s data.

<table>
<thead>
<tr>
<th>Age/sex category, Age in 1830</th>
<th>(1) Net-migration, 1820-1830</th>
<th>(2) Share of Net-migration</th>
<th>(3) Total population in 1820</th>
<th>(4) Share of population</th>
<th>(5) Net-Migration rate</th>
<th>(6) Share of slave sales</th>
<th>(7) Share of sales in migration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males 0 to 9 years</td>
<td>15497</td>
<td>0.1005</td>
<td>246219</td>
<td>0.1514</td>
<td>0.0629</td>
<td>0.090</td>
<td>0.8288</td>
</tr>
<tr>
<td>Females 0 to 9 years</td>
<td>15497</td>
<td>0.1005</td>
<td>246219</td>
<td>0.1514</td>
<td>0.0629</td>
<td>0.088</td>
<td>0.8027</td>
</tr>
<tr>
<td>Males 10 to 23 years</td>
<td>35804</td>
<td>0.2322</td>
<td>256227</td>
<td>0.1576</td>
<td>0.1397</td>
<td>0.301</td>
<td>0.5205</td>
</tr>
<tr>
<td>Females 10 to 23 years</td>
<td>35051</td>
<td>0.2273</td>
<td>241478</td>
<td>0.1485</td>
<td>0.1452</td>
<td>0.330</td>
<td>0.4344</td>
</tr>
<tr>
<td>Males 24 to 35 years</td>
<td>18912</td>
<td>0.1227</td>
<td>146218</td>
<td>0.0899</td>
<td>0.1293</td>
<td>0.084</td>
<td>-5.5315</td>
</tr>
<tr>
<td>Females 24 to 35 years</td>
<td>16787</td>
<td>0.1089</td>
<td>144037</td>
<td>0.0886</td>
<td>0.1165</td>
<td>0.066</td>
<td>-0.8992</td>
</tr>
<tr>
<td>Males 36 to 54 years</td>
<td>6854</td>
<td>0.0445</td>
<td>119144</td>
<td>0.0733</td>
<td>0.0575</td>
<td>0.027</td>
<td>0.6228</td>
</tr>
<tr>
<td>Females 36 to 54 years</td>
<td>6335</td>
<td>0.0411</td>
<td>111570</td>
<td>0.0686</td>
<td>0.0568</td>
<td>0.027</td>
<td>0.6614</td>
</tr>
<tr>
<td>Males over 55 years</td>
<td>1733</td>
<td>0.0112</td>
<td>59557</td>
<td>0.0366</td>
<td>0.0291</td>
<td>0.000</td>
<td>0.6931</td>
</tr>
<tr>
<td>Females over 55 years</td>
<td>1708</td>
<td>0.0111</td>
<td>55430</td>
<td>0.0341</td>
<td>0.0308</td>
<td>0.000</td>
<td>0.6750</td>
</tr>
<tr>
<td>Column Summation</td>
<td>154178</td>
<td>1.0000</td>
<td>1626099</td>
<td>1.0000</td>
<td>0.0984</td>
<td>1.013</td>
<td></td>
</tr>
</tbody>
</table>


Note: Column (3) reflects the 1830 population of males and females, aged 0 to 9 years (see Tadman, 1989, p. 242). The net-migration rate, column (5), equals the number of migrants listed in column (1), divided by the total population in 1820, listed in column (3). Using Fogel and Engerman’s equation, column (7) equals the difference between columns (2) and (4) divided by the difference between columns (6) and (4), or \( \gamma = \frac{\delta - \delta_m}{\delta_s - \delta_m} \). Tadman’s estimate of \( \gamma \), presented in the shaded box in column (7), equals the difference between the net migration rate...
for all slaves and that for males, aged 55 years, divided by the net migration rate for all slaves (the last entry minus the ninth entry, divided by the last entry, of column (6). Algebraically, Tadman’s estimate for \( \gamma = \frac{\beta - \beta'}{\beta} \). As shown in the text, Tadman’s estimate and Fogel and Engerman estimate are algebraically equivalent, assuming no older males were sold to interregional traders.
Table 3: Estimated Shares of Sales in Total Migration, 1850-1860; calculations based on Tadman’s data.

<table>
<thead>
<tr>
<th>Age/Sex Category</th>
<th>Age in 1860</th>
<th>(1) Net Migration, 1850-1860</th>
<th>(2) Share of Net-Migration</th>
<th>(3) Total population in 1850</th>
<th>(4) Share of population</th>
<th>(5) Net Migration rate</th>
<th>(6) Share of Slave Sales</th>
<th>(7) Share of sales in migration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males 0 to 9 years</td>
<td>25234</td>
<td>0.0813</td>
<td>401385</td>
<td>0.1335</td>
<td>0.0629</td>
<td>0.090</td>
<td>1.2003</td>
<td></td>
</tr>
<tr>
<td>Females 0 to 9 years</td>
<td>25235</td>
<td>0.0813</td>
<td>401385</td>
<td>0.1335</td>
<td>0.0629</td>
<td>0.088</td>
<td>1.1476</td>
<td></td>
</tr>
<tr>
<td>Males 10 to 14 years</td>
<td>20212</td>
<td>0.0651</td>
<td>185306</td>
<td>0.0616</td>
<td>0.1091</td>
<td>0.103</td>
<td>0.0844</td>
<td></td>
</tr>
<tr>
<td>Females 10 to 14 years</td>
<td>19576</td>
<td>0.0631</td>
<td>189485</td>
<td>0.0630</td>
<td>0.1033</td>
<td>0.106</td>
<td>0.0013</td>
<td></td>
</tr>
<tr>
<td>Males 15 to 19 years</td>
<td>22247</td>
<td>0.0717</td>
<td>166981</td>
<td>0.0555</td>
<td>0.1332</td>
<td>0.117</td>
<td>0.2626</td>
<td></td>
</tr>
<tr>
<td>Females 15 to 19 years</td>
<td>24151</td>
<td>0.0778</td>
<td>167476</td>
<td>0.0557</td>
<td>0.1442</td>
<td>0.137</td>
<td>0.2719</td>
<td></td>
</tr>
<tr>
<td>Males 20 to 29 years</td>
<td>50034</td>
<td>0.1612</td>
<td>278842</td>
<td>0.0927</td>
<td>0.1794</td>
<td>0.160</td>
<td>1.0176</td>
<td></td>
</tr>
<tr>
<td>Females 20 to 29 years</td>
<td>46804</td>
<td>0.1508</td>
<td>277088</td>
<td>0.0921</td>
<td>0.1689</td>
<td>0.096</td>
<td>15.1833</td>
<td></td>
</tr>
<tr>
<td>Males 30 to 39 years</td>
<td>22230</td>
<td>0.0716</td>
<td>192346</td>
<td>0.0640</td>
<td>0.1156</td>
<td>0.031</td>
<td>-0.2322</td>
<td></td>
</tr>
<tr>
<td>Females 30 to 39 years</td>
<td>18335</td>
<td>0.0591</td>
<td>187608</td>
<td>0.0624</td>
<td>0.0977</td>
<td>0.037</td>
<td>0.1307</td>
<td></td>
</tr>
<tr>
<td>Males 40 to 49</td>
<td>10215</td>
<td>0.0329</td>
<td>113563</td>
<td>0.0378</td>
<td>0.0900</td>
<td>0.022</td>
<td>0.3080</td>
<td></td>
</tr>
<tr>
<td>Females 40 to 49 years</td>
<td>8448</td>
<td>0.0272</td>
<td>116793</td>
<td>0.0388</td>
<td>0.0723</td>
<td>0.015</td>
<td>0.4876</td>
<td></td>
</tr>
<tr>
<td>Males over 50 years</td>
<td>9461</td>
<td>0.0305</td>
<td>163350</td>
<td>0.0543</td>
<td>0.0579</td>
<td>0.000</td>
<td>0.4389</td>
<td></td>
</tr>
<tr>
<td>Females over 50 years</td>
<td>8237</td>
<td>0.0265</td>
<td>165709</td>
<td>0.0551</td>
<td>0.0497</td>
<td>0.000</td>
<td>0.5184</td>
<td></td>
</tr>
<tr>
<td>Column Summation</td>
<td>310419</td>
<td>1.0000</td>
<td>3007317</td>
<td>1.0000</td>
<td>0.1032</td>
<td>1.002</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Columns (1) and (2), Tadman, 1989, p. 242; column (5), Tadman, 1989, p. 30; column

Note: Column (3) reflects the 1860 population of males and females, aged 0 to 9 years (see Tadman, 1989, p. 242). The net-migration rate, column (5), equals the number of migrants listed in column (1), divided by the total population in 1850, as listed in column (3). Using Fogel and Engerman’s equation, column (7) equals the difference between columns (2) and (4) divided by the difference between columns (6) and (4), or

\[ \gamma = \frac{\delta - \delta_m}{\delta_s - \delta_m}. \]

Using Tadman’s methodology and the assumption that no females, aged more than 50 years, were sold to traders, yields an estimate of \( \gamma \) equal to 0.5184. This estimate, presented in the shaded box in column (7), equals the difference between the net migration rate for all slaves and that for females, aged 50 years, divided by the net migration rate for all slaves (the last entry minus the ninth entry, divided by the last entry, of column (6)). Algebraically, Tadman’s estimate for \( \gamma = \frac{\beta - \beta'}{\beta} \). As shown in the text, Tadman’s estimate and Fogel and Engerman estimate are algebraically equivalent, assuming no older females were sold to interregional traders.
Table 4: Decennial net-migration rates and implied estimates of the share of sales in the total migration of slaves.

<table>
<thead>
<tr>
<th>State</th>
<th>(1) Net-migration rate, all ages and sex, $\beta$</th>
<th>(2) Net-migration rate, Males, aged 55 years, $\beta^i$</th>
<th>(3) Share of sales in migration, $\gamma$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delaware</td>
<td>0.4250</td>
<td>0.2508</td>
<td>0.4098</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>0.2845</td>
<td>0.2081</td>
<td>0.2690</td>
</tr>
<tr>
<td>Kentucky</td>
<td>0.0241</td>
<td>0.0164</td>
<td>0.3198</td>
</tr>
<tr>
<td>Maryland</td>
<td>0.2217</td>
<td>0.0988</td>
<td>0.5545</td>
</tr>
<tr>
<td>North Carolina</td>
<td>0.0655</td>
<td>-0.0085</td>
<td>1.1300</td>
</tr>
<tr>
<td>South Carolina</td>
<td>0.0524</td>
<td>0.0359</td>
<td>0.3150</td>
</tr>
<tr>
<td>Virginia</td>
<td>0.1237</td>
<td>0.0226</td>
<td>0.8170</td>
</tr>
<tr>
<td>Combined</td>
<td>0.0984</td>
<td>0.0291</td>
<td>0.6931</td>
</tr>
</tbody>
</table>


Note: Column 3 equals the difference between columns 1 and 2, divided by column 1 ($\gamma = \frac{\beta - \beta^i}{\beta}$). See text for further explanation of Tadman’s calculation.
Table 5. Ordinary Least Squares Estimates of the Share of Sales in the Interregional Migration of Slaves, estimated using Tadman’s Data

<table>
<thead>
<tr>
<th>Boundary Estimates for 1820s:</th>
<th>Boundary Estimates for 1850s:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) $0.513 \leq \gamma \leq 0.612$</td>
<td>(2) $0.499 \leq \gamma \leq 1.031$</td>
</tr>
<tr>
<td>$0.075$</td>
<td>$0.143$</td>
</tr>
<tr>
<td>$0.090$</td>
<td>$0.295$</td>
</tr>
</tbody>
</table>

F-value = 46.6, $R^2 = 0.838$, n=10.  
F-value = 12.2, $R^2 = 0.484$, n=14.

A 95% confidence interval:

- 0.375 $\leq \gamma \leq 0.777$
- 0.244 $\leq \gamma \leq 1.557$

Source: Equation (1), Table 1; equation (2), Table 2.

Note: $Y^* = \delta - \delta_\gamma, \ X^* = \delta_\gamma - \delta_\gamma$. standard errors are in parentheses.
Table 6. Ordinary Least Squares Estimates of the Share of Sales in the Interregional Migration of Slaves, estimated using New Orleans’ Sales Data

<table>
<thead>
<tr>
<th>Year</th>
<th>Estimated Share of Sales</th>
<th>Confidence Interval</th>
<th>F-value</th>
<th>R²</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>1820s</td>
<td>(3) 0.482 (0.036) (\leq) (\gamma) (\leq) 0.506 (0.038)</td>
<td>0.416 (\leq) (\gamma) (\leq) 0.576</td>
<td>181.8</td>
<td>0.953</td>
<td>10</td>
</tr>
<tr>
<td>Boundary Estimates for 1850s:</td>
<td>(4) 0.421 (0.059) (\leq) (\gamma) (\leq) 0.529 (0.074)</td>
<td>0.316 (\leq) (\gamma) (\leq) 0.661</td>
<td>51.0</td>
<td>0.797</td>
<td>14</td>
</tr>
</tbody>
</table>

Source: Equation (3), Table 1 and Figure 1; equation (4), Table 2 and Figure 1.

Note: \(Y^* = \delta_0 - \delta_1^* X^*\), \(X^* = \delta_0 - \delta_1\). standard errors are in parentheses.
Figure 1 — A comparison of age distributions for slaves sold by interregional traders: Tadman’s data versus New Orleans sales data
Figure 2 – $X^* Y^*$ plots of interregional migration data from the 1820s. Includes Tadman’s sales data. Source: Table 2.
Figure 3 – X"Y" plots of interregional migration data from the 1850s. Includes Tadman’s sales data. Source: Table 3.
Figure 4 — $X^*Y^*$ plots of interregional migration data from the 1820s. Includes New Orleans’ sales data. Source: Table 2 and Figure 1.
\[ X^* = \delta_s - \delta_m \]

\[ Y^* = \delta - \delta_m \]

\[ \gamma = 0.421 \]

\[ \gamma = 0.529 \]

Figure 5 — \( X^*Y^* \) plots of interregional migration data from the 1850s. Includes New Orleans' sales data. Source: Table 3 and Figure 1.