Slave Productivity in Cotton Picking

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Abstract: Social scientists have devoted much effort to measuring and analyzing gender and age productivity differentials. In American economic history, gender productivity differentials have important implications for key issues ranging from the relative efficiency of plantations compared to free farms and the pace of industrialization. We use a new data set to estimate direct physical measures by gender and age of productivity in cotton picking—the peak activity and largest use of labor in cotton production. Based on archival data, we have constructed a sample of 755,005 individual observations of daily cotton picking performed by 7,022 enslaved African-Americans on 140 different plantations over 512 plantation-years during the period 1801-1862. Our specific findings include that (1) in the plantation sector, females and males performed essentially equal shares of the picking work over the ante bellum period; (2) before 1840, adult females picked about 2 percent more per day than adult males; (3) after 1840, the differentials reverse and adult males picked 7-11 percent more per day; (4) productivity in picking, performed on an individual basis, was higher on larger-scale units; and (5) the micro picking data raise severe problems for the "pushing" hypothesis recently advanced in the New History of Capitalism literature.

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Social scientists have devoted considerable effort to measuring and analyzing gender and age productivity differentials. This paper adds to this broad literature by offering a fresh look at the gender productivity gap in antebellum cotton production. We use a vast new data set to provide direct physical measures by gender and age of productivity in cotton picking—the largest user of labor and the critical peak activity of a cotton plantation's production cycle. The goal is to provide a better understanding of the day-to-day regiment of enslaved African Americans and of the performance of antebellum plantations. It has long been known that slave owners made intensive use of female and child labor. Indeed, Gavin Wright (2006, p. 112) argued that the planters' ability to direct female labor into cotton production was crucial to the economic success of southern plantations. Gender/age productivity differentials also had important ramifications off the plantation, affecting the dynamic allocation of the labor force across sectors. Claudia Goldin and Kenneth Sokoloff (1982, 1984) emphasized that early manufacturing used the labor of women and children intensively and that the ratio of female-to-male productivity was much higher in cotton production than in grain production. This relatively narrow female-to-male productivity gap (as measured by slave "earnings" profiles) delayed industrialization in the Cotton South compared with the northeastern United States by offering a highly competitive non-industrial outlet for women (and children).

Coming to grips with male and female picking productivity is complicated because the gap may have changed over time due to the introduction of new cotton varieties. Our previous work (Olmstead-Rhode 2008abc, 2010) demonstrated the dramatic increase in cotton picking rates between 1800 and 1862. These changes appear chiefly associated with biological learning, specifically the introduction, adaptation, and diffusion of Mexican cotton varieties. There is little doubt that these biological innovations dramatically increased overall picking efficiency and had significant distributional effects across regions by increasing productivity in the New South relative to the Old South (Olmstead and Rhode 2008ab, 2010). Here we explore the possibility that the new technologies also had distributional effects altering the relative productivity of different segments of the slave labor force. For example, did the new varieties shift

the relative efficiency of the men and women, boys and girls? Did they change the peak-load problem in ways that may have increased the comparative advantage by gender in picking? And did the higher picking rates serve to draw men (or women) disproportionally out of other tasks into cotton production? The plantation records shed light on these fundamental questions slave management and southern development.

During the slave era, cotton picking was an unusual farm activity because females participated as fully as males. In the 1801-39 period, adult females picked 2 percent more cotton per day than adult males. But the productivity differentials flipped over time. During the 1840-62 period, adult females picked from 7-11 percent less cotton per day than adult males. Compared with gender gap estimates in other activities, the picking differentials are relatively narrow. One of our results shows that there were scale effects on picking rates—this was not expected given picking was an individually tasked rather than a gang activity. This finding raises the possibility that something else besides gangs was causing the productivity advantages traditionally associated with scale in both picking and non-picking activities. The micro picking data also raise severe problems for the "pushing" hypothesis recently advanced in the New History of Capitalism literature.

Worker-to-Hand and Marginal Product Comparisons

The literature offers a wide range of ratios to convert workers in various gender/age categories into prime-age male (or "full hands") equivalents. As Wright (2006, p. 106) has emphasized, the main findings of the cliometrics literature regarding the efficiency of larger plantations relative to smaller units rest critically on assumptions on the relative importance of female slave labor. The conversion ratio also has important consequences for our understanding of the lives of the people who toiled daily on southern plantations.[1]

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[1] Wright (2006) highlights the importance of the labor weights for the empirical outcome of the productivity analysis standard in the cliometrics literature. He argues that "the primary effect is to reduce the 'hand equivalence' of female slaves by about 30 percent (p. 106)." His investigation "demonstrates the sensitivity of total factor productivity estimates to … the application of age-sex weights to convert the labor force into 'equivalent hands.' The entire finding on the efficiency advantage for large-scale plantations rests on this procedure…. When an unweighted measure of the labor force is used (i.e. all free males and

In their influential and pioneering analysis, Conrad and Meyer (1958, p. 107) asserted "The prime field wench was one-half to two-thirds as productive as a prime field hand when she was actually at work in the field." This ratio was based on hiring rates and did not reflect time lost due to pregnancies.[2] Taking the lost time into account reduced their ratio of female-to-male productivity to one-half. A number of other scholars, including Yasuba (1961), Battalio and Kagel (1970, p. 27) and Vedder and Stockdale (1975), have adopted the female-to-male productivity ratio of one-half. In the 1970s, estimating the relative productivity of slaves by age and gender became something of a cottage industry. Figure 1 displays the estimates from Foust and Swan (1970), Battalio and Kagel (1970), Vedder and Stockdale (1975), Ransom and Sutch (1977, p. 223), Fogel and Engerman (1977), and Fogel (1988, Vol. 3, *Evidence and Methods*, p. 206) of the productivity of slave by age and gender relative to active prime-age males.[3] In these series the productivity of adult females ranges between 43 to 80 percent of that of adult males.

As an alternative to weighing different categories of workers to create a single labor input, other scholars have treated the different types of labor as imperfect substitutes and compared their prices, "earnings," or marginal products. Goldin and Sokoloff (1984), Craig and Field-Hendrey (1993), Toman (2005), and Wright (2006) have modeled slave and free men, women, and children as separate inputs in cotton production and generated a range of estimates of their relative productivities in southern agriculture.

To support their industrialization hypothesis, Goldin and Sokoloff (1984, p. 472) provide evidence on the relative wages for females and for boys relative to men in the North and South. For the South, they use estimated "earnings" in the Old South in 1850

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slaves aged fifteen to sixty-four, retaining the assumption that free females were not in the labor force), only the middle-size plantations of the Southwest would have any productivity edge."

[2] Conrad and Meyer assume (1958, p. 107) "three months' productive field time was lost for each successful pregnancy." Nursery costs were $50 per successful pregnancy" (p. 108) and annual maintenance cost per child was $10 per year for those 1-6 years old, $15 per year for 7-12 years old; and $20 per years for those 13 and older (p. 109). Successful pregnancies occurred every two years.

[3] Fogel and Engerman (1977, Table 1, p. 277) do not report explicitly the female ratios, instead noting they are "70-78 percent of corresponding weights for males." Vedder and Stockdale (1975) utilize the labor force participation ratio from Lebergott, which are less than unity for every age group.

for adult slaves (aged 15-29 years) and for boys (aged 10-14).[4] The "earnings" ratio of slave women relative to men ranged between 0.57 and 0.76 and that of boys relative to men ranged between 0.25 and 0.43. These ratios were roughly double the earnings ratio in the rural North. Goldin and Sokoloff attribute the differences chiefly to the greater relative productivity of females and children in cotton and tobacco than in grain crops.[5]

In a critique of the Goldin-Sokoloff hypothesis, Craig and Field-Hendrey (1993) estimate the marginal product of farm workers by age and gender in 1860 using the Bateman-Foust sample for the North and the Parker-Gallman sample for the South. Their main finding is that ratio of female-to-male marginal products was 0.599 for adult slaves in the South (p. 71). This was slightly below the 0.611 ratio that they report for free farmers in the North. The gap is very small and of the wrong sign to support the gender-gap industrialization hypothesis. Toman (2005) also provides marginal product estimates of labor in cotton plantations in 1860. Her results indicate that the productivity of males and females varied with scale. Using a broad gender division, she finds the marginal product of females relative to males of 40 percent on small units and 60 percent on large units. Using narrow age/gender categories, she finds that the marginal product of adult females relative to adult males was 32 percent on small units, but the ratio jumped to 75 percent on large units. Teenagers of both genders also had higher productivity relative to adult males on large plantations than on small units.[6]

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[4] These are based on Figures 19 and 22 found in Fogel and Engerman, (1974, Vol. I, pp. 76 and 82). The earnings estimates are intended to include only the value of field work, exclude the value of offspring, and net out the costs of board, clothing, and medicine. The earnings profiles rest on Fogel and Engerman's estimates of the lifecycle profile of slave prices from probate records in the Old South.

[5] Goldin and Sokoloff (1984, p. 473); Metzer (1975). Continuing this line of inquiry, Sokoloff and Tchakerian (1997, p. 243) find that the South's low levels of manufacturing value added per capita in 1860 was "largely attributable to very low levels of outputs in counties specialized in cotton production." Female-intensive industries, such as textiles and boots-and-shoes, were especially uncommon in cotton producing areas (pp. 250, 254). Other avenues of economic development were also affected. Sokoloff and Dollar (1997) argue that proto-industrialization was more prevalent in places with highly uneven seasonal demands for labor-- high harvest peaks and long periods of slack employment. In the era before mechanization, sharp swings in labor demand would characterize the production of small grains but not of cotton. Our examination of the antebellum plantation records suggests home production-- for example the spinning of yarn and weaving of cloth--was less common in the times and places were cotton cultivation was most intense. The extended cotton harvest also raised the opportunity cost of attending school in areas or times when free labor prevailed.

[6] Some have questioned the interpretation of changes in output associated with changes in changes in the labor force/household composition as a pure measure of marginal product of labor.

Serious concerns remain. Most telling, Wright (2006, pp. 106-113) shows that marginal product by gender estimates are not robust over space and time. Using the 1859/60 Parker-Gallman sample, he found the marginal product of females relative to males in the Southeast was 73 percent, in line with other research. But in the Southwest, it was 113 percent, favoring females. Using the 1849/50 Foust sample, Wright obtained 127 and 307 in the Southeast and Southwest, respectively, suggesting females were vastly more productive than males. Such findings stretch the bounds of credulity, which of course was Wright's point. Clearly, after decades of research on the slave economy, the relative productivity of females to males remains highly contested.

We will take a more direct approach to assess how productivity varied by gender and age by employing a new micro data set measuring the output per worker in cotton picking. These data are particularly relevant because as most labor intensive of all cotton production activities and picking represented the binding constraint on cotton plantations (see Appendix). Scholars including Jacob Metzer (1975), John Campbell (1988), Marie Schwartz (2000) have examined picking productivity across age and gender categories for a small number of plantations.[7] They generally find that gender differentials were narrow and, according to Campbell, the gap was closing over time. We investigate relative productivity in a vastly larger sample of plantations over a longer time period.

Assembling a New Data Set

To assess the performance of their workers and overseers, many masters kept logs detailing the daily work activity, including the amount of cotton picked, of individual

[7] Metzer analyzed on cotton picking by age and gender on one plantation, specifically the north-central Mississippi holdings of Francis Terry Leak. He reported "that females were better pickers than males in the four to twelve or thirteen to sixteen age group, but fell behind in adulthood. The relative decline in adult female picking performance was probably due to a considerable extent to the lower physical capacity during pregnancy and nursing periods (1975, pp. 201-202)." Campbell's (1988) studied eight upland cotton plantations in the Old South. He found in the early 1800s, women picked on average 80 to 90 percent as much per day as men. He reckoned that the introduction of Mexican cotton varieties increased the relative productivity of women (Campbell, 1988, pp. 49-65). Schwartz (2000, p. 136) examined records from the Sturdivant plantation near Selma Alabama.

slaves. Absentee owners often required their overseers to keep such records in order to better assess day-to-day farm activities, but many resident owners also caught the record-keeping bug. The data allowed for comparisons with past years and helped set expectations for picker performance. Over time record keeping became more formalized with many planters employing bound account books with printed templates designed especially for this purpose. The most popular cotton account book was produced by Thomas Affleck, beginning in 1847 (Williams 1957, Rosenthal 2018). In addition to the pages efficiently laid out for recording picking, the Affleck books provided forms for listing the slaves' names, ages, and values, births and deaths, stock and equipment inventories, the weight of individual bales, and other valuable information. The entries often provide a detailed sense of the pulse of plantation life, including the days lost to rain, absences due to sickness, and the like. Figure 2 shows an example of a "user friendly" page from the Affleck book of the Eustatia Plantation in Mississippi.

Our sample for the period 1801-1862 includes data from 140 different plantations and a total of 512 plantation-years, covering 755,005 individual observations of daily cotton picking performed by 7,022 enslaved African Americans. This sample contains only individual-level observations for plantations producing Upland cotton (as opposed to Sea Island cotton). It excludes the aggregate plantation-level averages that we reported in our previous work. A full list of the plantation records that we consulted appears at the end of the References.

Table 1 presents selected statistics of our sample variables. Our sample is concentrated in the New South (the states not touching the Atlantic Ocean). Some 666,980 observations are from this region; 88,025 are from the Old South. The data become more abundant over time. For all of the states, we have 15,996 daily observations for the years before 1820; 24,422 for the decade of the 1820s; 52,323 for the 1830s; 161,138 for the 1840s; 375,809 for the 1850s; and 125,317 for the early 1860s.

Aggregate Results from the Daily Picking Sample

An examination of the aggregate data from our sample yields several noteworthy findings. A robust feature of cotton production on the antebellum slave plantations in our

sample was its intensive use of the labor of women and children. In this regard, cotton was an unusual staple crop. As Panel A of Figure 3 indicates, adult females typically performed more cotton-picking labor—working more days in the operation—than their male counterparts. (The one exception is the 1800-09 period.) The difference was especially pronounced in the 1820s, 1830s, and 1840s with the gap closing substantially in the 1850s and early 1860s. The data for the 1820s on also suggest that children accounted for an increasing share of picking days.[8] Seen in a different light, the degree of gender segregation of cotton picking was remarkably small. Adult males and females and even young children all picked cotton.

Many observers note that adult males on average picked more cotton per day than adult females or children (see Panel B). However, among adults the differences were neglectable until the 1840s and 1850s. Among children, the changes in the gender ratios were more uneven, but as a general pattern, girls picked more per day than boys. Panel C combines the information on picking days with picking rates to calculate shares by gender and age group of total cotton picked. Again, the crop's characteristic intensity in using the labor of women and children comes through. Collectively women and children picked a majority of the cotton crop in every period except 1800-09. Moreover, the gender balance of picking output was virtually even.

Individual Level Results from the Daily Picking Sample

Employing our sample, we can investigate picking productivity at the individual level. Table 2 reports results of the determinants of (the log of) daily picking rates for various age and gender categories. It also includes indicators for the days of the week, whether the day was a half day, the time of the season (July 1=day 1), and the crop year. The robust standard errors are reported in the parenthesis. The sample is subdivided between the 1801-39 and 1840-62 periods. The 1840-62 period subsample is divided between the Old and New South regions.

[8] But note the patterns in the earliest period need to be treated with care. The data for the pre-1820 period are relatively sparse–totaling about 16,000 observations or 2.1 percent of the total—and the coverage is not as full as the later sample. For slaves in the sample for whom we have information about their date of birth, we are treating those of age 14 and younger as children.

In all the regressions, adult females picking productivity was quite close to that of adult males. For the entire sample over the 1840-62 period, adult females picked about 11 percent less cotton per day as adult males. This differential is even smaller than that suggested by Goldin and Sokoloff based on gender "earnings." It is much narrower than the conventional view that women were only one-half as productive as men in southern agriculture, taken as a whole. Our finding of a small but positive gap, based on a data set covering over 662,000 worker days on 121 plantations, is more-or-less in line with most anecdotal sources. The productivity differentials for children are less definitive although girls were often more productive than boys.[9]

In the 1801-39 estimates, adult female picking rates were about 2 percent higher than adult male picking rates. The premium was statistically different from zero at conventional significance levels. The initial female picking premium may appear small, but it contrasts with the deficit in the later period and with the position of women in the market economy in general. The finding of an initial premium is particularly relevant to the Goldin-Sokoloff argument because early manufacturing took root in this formative era. Our finding that the gap widened after 1840 is contrary to Campbell's conjecture that the spread of Mexican varieties increased the relative productivity of women. The growth in the height of the cotton plants ("high cotton") along with heavier picking loads may have given an advantage to males. But again, one should not lose sight of the main result: the gender differentials remained small while the productivity of both groups soared.

The day-of-the-week effects displayed in Table 2 differ from what one might expect. Mondays are the omitted category; all results are relative to that day.[10] Sundays was typically observed as the Sabbath, and no picking was performed. One might expect that peak picking would occur on Monday (or Tuesday) after the extra day for cotton bolls to open. Thus, it is a surprise that peak picking occurred mid-week. Saturdays were typically the lowest day, even when an indicator is included to reflect the plantation

[9] A further complication to consider in future work is the labor force participation rate for children – this will require a fuller accounting on potential workers.

[10] Technically Sundays are lumped with Monday. Sunday work picking the plantation fields is rare – accounting for 1.6 percent of the observations or about one-tenth the fraction of other days of the week. Sunday picking was associated with the harvest rush and its inclusion raises the Sunday/Monday average.

owner or overseer's explicit notation that only "a half day" of picking occurred.[11] The contrast in the days-of-the-week patterns between the Old and New regions is also intriguing. In the Old South, rates continue to rise later into the week. This pattern is consistent with the assignment of weekly quotas.

The results in Table 2 regarding with the seasonality of picking suggest little difference in peak picking over space or across time. The peak was 21 September in the 1840-62 period and 27 September in the 1801-39 period—a shift earlier by about a week. But during each span of years, the amount picked per person on the 21 and 27 September differed by less than one-half of one percent. The peak in the Old South and New South in the 1840-62 period differed only by one day.[12] It is notable that the peak occurred in September, within a month of the typical start of the picking season and three months before it fully ended. The 1840-62 coefficients reveal that for a period of two months (63 days) from the 24 August to 26 October, the estimates were within 10 percent of the peak.[13] The spread was not meaningfully different from that prevailing in the 1801-1839 sample. As the cubic specification captures, there was a quick rise in picking rates in the month prior to the peak and then a slow decline in the two-three months after the peak. Figure 4 shows the typical seasonal pattern (using an adult male in 1850 as the reference worker).

To provide context, Figure 4 presents three histograms documenting the seasonal distribution of daily picking observations, binned by weeks. As a point of reference, day 100 is the 8th of October. The notch down in all the histograms is the week including Christmas (seasonal day 178). This information can be combined with statistics of medians, means, and measures of dispersion. The first histogram compares the distributions before and after 1840. The post-1840 distribution shifts earlier and is little more dispersed. The median picking observation in the 1840-62 period is 7 days earlier than in the 1801-41 period; the mean shifts by about 5 days. These changes are in line

[11] It is likely that many managers did not note a partial day's work on Saturdays.
[12] Note this discussion refers to picking on picking days allowing for interruptions (rainy days, Sundays, and other non-picking days) during the picking season.
[13] The estimates were within 20 per cent on the peak for about three months (93 days). These estimates were to averages and at for picking data. They are subject to sample selection. For example, the pickers were not be sent to the field unless sufficient cotton is open. There were also occasions (for example, on broken days) when the picking performance is not recorded on an individual basis.

with the shift of the peak in picking rates. In general, picking activity is most intense in the weeks when daily picking rates are highest, suggesting both are driven by crop availability. The second histogram compares the distribution for females and males (combining adults and children) in the 1840-62 period. Male picking is slightly more concentrated in the peak period, but the differences appear trivial. The area of overlap predominates. The medians and means are essentially identical. The third histogram contrasts the distributions for the Old South and New South in the 1840-62 period. The observations for the New South are more dispersed than for the Old South. More picking is done earlier and later in the New South than in the Old South. But the medians differ by no more than a day or two.

The rate of growth of the picking rate, as captured in the crop_year coefficient in Table 2, was more rapid in the total sample over the 1801-39 period than in the 1840-62 period. In the second period, growth was more rapid in the Old South than in the New South. But picking levels (for adult males) were about twice as high in the New South as in the Old South circa 1840. As a result, the faster growth in the Old South after 1840 may be interpreted as part of a "catching-up" process as biological innovations created in the New South were adapted for the Old South (Olmstead and Rhode 2010).

Table 3 presents results of quantile regressions of the individual picking data over the 1840-62 period. This approach allows us to check the robustness of the findings to outliers and to examine the effects of the independent variables at points of the distribution away from the mean. The Table reports results for the determinants of the conditional median for the whole sample and for the Old and New South separately. It also presents results for the 10, 25, 75, and 90 percentiles for the whole 1840-62 sample. Focusing on adult females, the coefficients for the whole sample and the sub-regions for the conditional medians conform to those reported above for the conditional means. Furthermore, in the sample as a whole, the adult female coefficients are remarkably stable across the 10-90 percentile range. As relates to a different matter, the crop-year effects in the quantile regressions do show more rapid growth in the top of the distribution than at the bottom.

Figure 5 displays the distributions of picking rates for adult females and males over the 1840-62 period. (These distributions are truncated at 400 pounds for the sake of

clarity of presentation.) Two points stand out. First, there is considerable overlap between the two densities. They both have a mode at 100 pounds per day. Second, round numbers such as 100, 200, and 300 pounds have higher masses, suggesting the presence of targets, possibly fixed quotas, or other sources of record-keeping lumping.

Table 2 showed that adult females out-picked males by a small percentage before 1840 and that adult males out-picked females by a more sizeable margin after 1839. One can gain insights into this shift by investigating the changes in a differences-in-differences framework. This will also reveal an interesting interaction between the gender and seasonality in which picking rates rose differently rapidly for adult males, in the final months of the peaking season. To focus the comparison, we will restrict the analysis to adults, dropping for now the observations for children. We will start by taking the picking performance of adult males in the 1801-39 period as the baseline to be captured in the intercept and estimate the coefficients for females, for the 1840-62 period, and for females in the 1840-62 period, as in the equation:

$$Lpick=\alpha+ \psi*female+\rho*post\_1839+\delta*female\_post\_1839+\beta X$$

Table 4a shows the results without and with the controls employed in Table 2. The coefficient for (adult) females is positive and significant, reflecting the initial picking premium. Picking rates are higher for both genders after 1839 but they rose much faster for adult males; the estimate for ρ is very large while that for δ is negative.

We can add a seasonal component – highlighting changes late in the season – in a triple-differences framework. Here we contrast changes in picking performance before and after 1 November, which marked the typical date of the first killing frost. The estimating equation is:

$$Lpick=\alpha+ \psi*female+\lambda*late\_season+\theta*female\_late\_season$$
$$+\rho*post\_1839+\delta*female\_post\_1839+\gamma*late\_season\_post\_1839$$
$$+\Delta*female\_late\_season\_post\_1839+\beta X$$

In the results shown in Table 4b, the baseline is the adult male picking rate before November 1 in the 1801-39 period; this is captured in the intercept, α. Adult females picked more in this time frame; the estimate of ψ is positive. Picking rates dropped in the

late season; the estimate of λ is negative. The decline was greater for females; the estimate of θ is also negative, though not so negative as to offset the general advantage captured in ψ. Picking rates in the early season are higher for both genders after 1839 though the rise is not so great for females. The estimate of ρ is very large and δ is negative. Picking rates in the late season rise after 1839; the estimate for γ is positive (though still smaller in magnitude than λ). But picking rates for adult females in the late season do not rise as much as for males after 1839. The estimate of Δ is negative and statistically significantly different from zero. These results show differential increases in the performance of adult males late in the season, that is, when the "top crop" comes in.

We are able to assign the pickers' age for about 40 percent of our daily picking observations. For this group, the plantation records include family registers, ages, and sales receipts allowing us to infer the slave's year of birth. The more specific age information allows a refinement of the analysis by breaking up the broad age categories (used in Table 2) and by preventing differences in age-composition of the population within the categories from obscuring the differences over time or across space.[14] Figure 6 displays histograms of the fraction of picking observations for each gender binned by age categories. Over 90 percent of observations are for those below 40 years on age. (Given the size of the total sample, a small share still contains a large number of observations.)

Table 5 fits a cubic function in age for males and females. The patterns of effects implied by coefficients on days of the week indicators and the "half day," "crop year," and seasonal variables are not sufficiently different from those in Table 2 to warrant extensive discussion. Let us focus on the age-gender effects. In the 1840-62 period, the picking rates for females slightly exceed those for males up to age 12. For both genders, picking rates grow rapidly over the pre-teen and teen years. The female profile peaks at age 27; the male profile at age 29. Thereafter males pick about 25 pounds per day more than females.[15]

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[14] An appendix includes Table A1 which displays the results for the specifications employed in Table 2 on the sample for which ages are available.

[15] In this period, the ratio of seed-cotton-to-lint was between 4-to-1 and 3-1. The value of lint cotton was in the range of 6-8 cents per pound. Taking the mid-points, 25 pounds of seed cotton was worth 50 cents; 15 pounds is worth 30 cents.

Given the fit of the cubic functional form, the profiles reach a local minimum in the late-40s- to early-50s-age range and then turn up. This upturn among the elderly obviously could be an artifact of extrapolating from parameters fit using abundant data at younger ages. Employing the more flexible functional specification allowed by the Lowess locally-weighted regression helps us address this concern. See Figure 7. The upturn for the elderly disappears. The cross-point where males out-pick females occurs between 15 and 16 years of age; the differences before this age are small. The female peak occurs at age 28 at 117 pounds per day whereas the male peak occurs at age 29 at about 132 pounds. The gap between adult males and females was typically in the 12-15 pound range. The Lowess profiles for adults are flatter than those implied by the cubic specification. This observation suggests that small differences in the age composition among the adult labor force will not create great distortions, and we can thus use our broader adult categories without introducing significant biases.

In line with the work of Fogel and Engerman, Field, Toman, Wright, and others we can also consider plantations of different scales. Table 5 conducts an investigation analogous to Table 2 for sub-sample of plantations with different-sized picking forces. We utilize a breakdown of plantations with 14 or fewer different pickers recorded in the year, 15 to 50 different pickers, and 51 and more. It is notable that observations are scarce for small operations. Indeed, why would a small owner-operator bother to record such information? For understanding antebellum cotton production, it is clearly the larger operators that matter most.[16] The results for picking differ across scale, though not as the existing literature suggests. For example, female adults appear more productive on the smallest units, contra to Toman (2005).

The key point that comes out of this exercise is that scale is important even for picking, an activity which by all account was performed, and often tasked, on an individual basis.[17] The last two columns run specifications including, respectively, the (log of the) number of pickers appearing in the records that crop year and appearing that

[16] Based on statistics compiled from the 1860 Parker-Gallman sample reported in Foust (1975), p. 161, slave-less farms accounted for 4.0 percent of cotton production, those with 1-9 slaves for 9.9 percent, plantations with 10-19 slaves for 12.7 percent, 20-49 slaves for 27.7 percent, 50-99 slaves for 23.2 percent, and 100 and more slaves for 24.1 percent.
[17] Fogel (1989), p. 27; Metzer (1975), pp. 123-50; Fogel and Engerman (1974), Vol. I, p. 206.

day. In both cases, the coefficients are positive, significant, and in the range around 0.12 and 0.18. The coefficient is higher for the (log of the) daily number of pickers; this finding is consistent with the notion that more workers will be allocated to picking if there is more cotton in the field. The finding is not completely transparent because the regressions include controls for season, and it is conceivable that adding more workers would cause them to interfere with one another and reduce average individual picking rates. Moreover, a significant positive coefficient appears in the specification using the total number of different pickers appearing at any time during the crop-year. This implies economies of scale in cotton picking. These findings direct us to explore further the role (both correlative and causal) of scale on productivity more generally to re-evaluate of the impact of gang system in non-picking activities.

One might worry that the balances/scales used to weigh cotton varied across plantations or over time. In our past research, we conduct a series of selected checks, comparing the total weight of the cotton picked in the field with the total weight of the ginned cotton bales (also reported in the plantation logs). In all cases, the ratios were within reasonable bounds of the prevailing seed-cotton to lint conversion rates. The regressions reported in Table 7 provide more direct reassurance. They include (a) plantation fixed effects to control from difference across units and (b) plantation crop year fixed effects to control for difference across units and within units over crop years. Clustered standard errors are reported as well in the < > brackets. The gender differentials remain small in the 1840-62 period and are non-existence in the 1801-39 period.

Labor Allocation and Selection Issues

Another important robustness concern arises due to the unbalanced nature of our panel, or rather of the plantation work routines. Most of the slave labor force, including many house hands, picked at some time during the harvest season. But not all pickers picked each day. Pickers were missing because they were ill, had run away, or were called off to perform other work such as ginning, hauling, repairing roads, and so on. The effect of the differential allocation of labor to other activities raises concerns about

selection in line with the standard Roy model. It is possible, for example, that the workers most skilled in picking were also the most productive at the gin.[18] As the season progressed, the picked seed cotton that required ginning would build up and the gin workers were called out of the fields. If this occurred during the high picking season, their highest potential picking days are censored from the sample. Given gin workers were typically male, this practice could lead to an understatement of the relative productivity of males.

An examination of the evidence suggests the selection problem is not likely to lead to large biases, at least in this direction. The plantation records indicate in many cases the cause of the workers' absences. If one includes in the picking regression (results not shown) an indicator variable for cotton pickers who ever ginned on plantations recording ginning activity, the coefficient is negative and significant. This suggests the ginning status (controlling for adult status and gender) is not positively correlated with potential picking productivity. This result is consistent with many explanations. Perhaps owners/overseers allocated the top pickers to ginning, or the gin workers held a higher status and did not feel a strong compulsion to pick at full speed to avoid punishment or earn rewards. In any case, ginning was also relatively uncommon, accounting for about 2 percent of absences for these plantations. Sickness was a much more common cause of absence.

In addition, the largest differences in the gender composition of the picking labor force occur at the beginning or end of the season, not in the peak period of high picking. It was in August and early September that women and children picked while men prepared the gin and drying scaffolds, hauled, plowed, and labored on roads and bridges.

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[18] Metzer (1975) emphasizes that exploitation of comparative advantages as a sign of planter rationality. The most able workers, those with an absolute advantage in picking, are assigned to other more difficult tasks where they possess even greater advantage. He noted it was at first puzzling "that females on Leak plantation were engaged more intensively in picking (in terms of days per season) than males in the seventeen and older age group despite their inferior performance in this operation. This apparent contradiction between actual and efficient resource allocation is easily resolved by examining work routines records for the cotton-picking season (1975, p. 202)." The records of the Capell and Killona plantations (Leak offered no data on this issue) showed that although males were heavily engaged in picking, many were assigned to other, more strenuous jobs that competed with picking. Thus, according to Metzer, planters utilized the principle of comparative advantage.

Male labor was also withdrawn in early December at slaughter time. The adult male share is quite stable over the picking season. (See the histogram in Figure 4.) Again, picking was an operation that was not meaningfully segregated by gender.

Our main strategy to address the allocation problem is to include plantation-picking-day fixed effects in the regression. That is, we include one indicator for each picking day on each plantation. This captures conditions on each specific day such as the amount of cotton available to be picked (and soaks up seasonal and days-of-the-week effects). The measurements then become relative to the other pickers in that plantation's field on that day. Workers who are differentially absent in high picking period are not penalized; those absent during low period are not rewarded.[19]

Table 8 presents the results for the major gender/age divisions including plantation-day fixed effects. Table 9 presents the results for the age-gender cubic specification. Two sets of standard errors are reported—the White-robust standard errors in the parenthesis and Robust-Cluster-corrected standard errors clustered on the plantation year in the < > brackets. The latter attempt to control for correlation among the picking observations on a specific plantation for a given crop year. Gender differences remain small. For the entire sample over the 1840-62 period, the estimated gender differential is 6.9 percent. If anything, controlling for allocation/selection issues by adding plantation-day fixed-effects implies the female adult productivity was even closer to the male adult productivity than in our results presented earlier. Adding controls for women who are pregnant or likely nursing infants, would probably result in even smaller estimates of the gender gap for women not with child.

Controlling for Individual Fixed Effects

The picking records are amazing rich. They can be paneled by individual with the plantation crop year and across crop years. The overall sample has information on some

[19] The idea is this: suppose there are two pickers, A and B. Suppose A always picks X percent more than B when both are present. Suppose there are two days—Low and High—and B picks Qlo and Qhi. Were A present he would, by assumption, pick XQlo and XQhi. But A is allocated to gin on High days, so is only observed to pick XQlo. Comparing XQlo and 0.5(Qlo+Qhi) understates A's relative productivity.

7,000 individuals. In some cases, there is picking data from the same person for up to two decades. This allows a deeper analysis of the picking performance over the life cycle, as the individual ages and makes the transition from childhood to adulthood. Table 10 reports results of regressions including individual fixed effects in the 1840-62 sample. The specifications include the full sample and females and males separately. One important caveat in the analysis is that for specific individuals, aging and the passage of time is perfectly correlated. For this reason, we do not include time trends (as previously captured in the crop-year variable) in the regressions with individual fixed effects. Panel A reports results for the transitions across the broad age categories (as in the analysis in Table 2). In contrast to Table 2, the penalty for being a child is less pronounced in the regressions in Panel A. The differences for males was smaller than for females. Panel B bridges the Panels A and C by showing results for the transition across broad age categories (as in Panel A) for the sample with ages (investigated in Panel C). The results in Panel B are virtually identical to those in Panel A. This should allay some concerns about selection into the sample with ages. Panel C reports results for aging in the sample with ages (as in the analysis in Table 5). These results indicate the effect of aging on males and females was very similar, the plots lie on top of one another (excepting the intercept). Panel D restricts the sample to the individual below 25 years of age. The same pattern emerges. These results help provide a baseline for the much more detailed analysis of the individual-level data in the future.

The Pushing System

Before concluding, we must deal with Edward Baptist's recent claims. He is a leading contributor to new historical literature on slavery and capitalism. Baptist accepts our estimates that the quantity of cotton picked per slave per day rose significantly over a half century. He rejects our evidence that this change was primarily due to a *succession* of improved cotton varieties. Instead, he argues that masters became ever more efficient torturers, extracting more labor from their chattel under the so-called "pushing system." He reaches this conclusion by stringing together a few statements by ex-slaves asserting that as soon as they reached a quota the target was raised and then raised again and again. If an individual even fell even a little short of the target, the punishment was immediate

and severe.[20] It was this ever evolving "whipping machine" that largely accounted for the growth in picking output per slave—as individuals learned to pick cotton faster and faster (Baptist 2014, pp. 111-144, esp. 126-28, 134). Baptist's claims about the "pushing system" has an important following in the New History of Capitalism (NHC) literature. As an example, Sven Beckert (2014, p. 116) cites Baptist's assertion that "torture … was at the root of the ability of American planters to produce ever more cotton."

The NHC literature has embraced the ratcheting hypothesis apparently unaware of the work by economist on this issue. Economists have extensively studied the quota-setting process—what became known in the twentieth century as the "ratchet effect."[21] Martin Weitzman's classic analysis (1980) found that the agent's (in this case a slave's) optimal level of production does not depend on the prevailing quota. Rather it depends on the current-period reward (punishment) for exceeding (falling short) of the quota, the extent to which the future quota would be adjusted, and the interest rate. In a static deterministic environment, the agent's optimal level of production is constant over time. And in general, the ratcheting of quotas creates a dynamic disincentive that diminishes output in each period. The agent holds back on costly effort that would decrease the prospect of being punished today because working harder today increases the prospect of being punished in every period in the future.[22]

Records detailing cotton picking rates are common; explicit records of quotas are rare. Out of the thousands of plantation books we have examined, we have seen only a

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[20] Solomon Northup (1853) offers the clearest statement of dynamic ratcheting.

[21] Berliner (1957). See Laffont and Tirole (1994), Ch. 9 for a modern theoretical treatment of these issues; and Indjejikian, Matějka, Schloetzer (2014), pp. 1259-67 for a recent survey.

[22] Weitzman consider an environment without technical change. The agent's optimal production is independent of the current quota and is constant over time. It depends on long-run incentive parameters—the rewards (punishments) for exceeding (falling short) of the quotas, the extent of adjustment of future quotas, and the interest rate. The bonus/penalty applies on either side of the quota and the future quota can be adjusted down as well as up. In Weitzman's model in the non-stochastic setting without technological change, the agent received a linear bonus (penalty) if current production exceeded (fell short of) the current quota, q_t: $B=b(y_t-q_t)$. The future quota was adjusted by a factor, λ: $q_{t+1}=\lambda(y_t-q_t)+ q_t$. The agent produced subject to a cost function, $C(y_t)$, where $C'>0$, $C''>0$. At the optimum, the agent sets production, y^*, where $C'(y^*)=b/(1+\lambda/r)$. Production with the ratchet, $\lambda>0$, is lower than without it ($\lambda=0$). The results do not require long foresight—Weitzman labels the solution myopic.

The incentive structure that Baptist posits is even starker. There are no positive incentives, only negative consequences from producing less than the quota, $B =f(\min(y_t-q_t, 0))$. And the quota can only go up $q_{t+1}=\max((y_t, q_t)$. The agent in this setting has no incentive ever to deviate the initial quota, q_o.

handful of plantations where picking tasks were recorded.[23] The Hillyer plantation near Augusta, Georgia kept cotton books from 1817 to 1819.[24] The books reported both individual picking rates for three years and the tasks for 1818. They allow us to investigate how prior picking performance was related to the tasks, and how the tasks were related to subsequent performance. The tasks varied across individuals. But they were large round numbers which showed no variation during the picking season. The tasks were more closely correlated with 1817 *mean* picking rates than with the 1817 *maximum* rates. The tasks were correlated with both the 1818 mean and maximum amounts picked. But the 1818 mean picking rates were below the tasks in all 11 cases where comparisons are possible; the maximum was below in 8 of the 11 cases. In only 6 percent of daily individual picking observations did the quantity picked equal to or exceed the individual's daily task on the Hillyer plantation.

The memorandum books of James A. Tait's plantation in Wilcox County, Alabama also listed picking tasks for individual slaves for 1823, 1824, 1826 and 1850.[25] Tait's books did not record individual-level picking performance, but they did have multiple lists of individual quotas. Tait's records have demographic detail on the specific slaves that allow us to investigate how the quotas varied across individuals, over time, and between different varieties of cotton.[26] Tait reported separate picking tasks for regular Green Seed cotton and for the newly-introduced Mexican cotton in 1823. In line with our statements regarding the greater ease of picking the new variety, individual slaves were expected, on average, to pick 25 percent more Mexican cotton than Green Seed cotton per day. The tasks listed for 1824 were lower than either of the 1823 Mexican or Green Seed numbers: that is, tasks were ratcheted down. The documentary

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[23] The records of W. S. Hamilton (UNC SHC) may contain quotas in 1819. There are numbers next to the workers names in the introductory material in the picking records. These numbers appear to be used to calculate overages, perhaps to reward slaves. There is no explicit reference to quotas and no sign of ratcheting.

[24] The Hillyer accounts (ca. 1797-1860) also include extensive records of payments to slaves for cotton. The tasks listed may have been used in calculations for overwork or to assist in planning production. Our research indicates that picking tasks or quotas rarely appear in the surviving plantation records.

[25] James A. Tait papers, Auburn University and Alabama Department of Archives and History.

[26] Sellers (1950), p. 68 errs in his discussion of Tait's tasks. He writes: "Tait lists the tasks for picking Mexican cotton…." He continues: "The above tasks seem small, but Tait notes that this was due to the poor crop of cotton after the long rains." This discussion mixes different years. The tasks for picking Mexican cotton were for 1823. The reduced tasks to pick the rain-damaged crops relate to 1824.

evidence makes the reason clear: "These tasks are small on account of the badness of cotton from long rains 30th Sept." The 1823 and 1824 records do not show changes, or any sign of ratcheting up over the crop year.[27] The tasks varied by gender and age but were not fine-tuned to individuals. The tasks again were large, round numbers, differing by increments of 10 pounds.[28]

Our data show that actual picking rates varied enormously, over the lifecycle, the season, and even from day-to-day.[29] Rates changed from day-to-day depending on many factors beyond human control: the weather and the condition of the crop (such as, how many bolls were open and whether the cotton was damp from morning dew). Daily picking rates changed over season. Contributing variations with the season was the progressive opening of the cotton bolls from the bottom of the plant to the top. Morning frost was more common later in the season shorting the picking day. The time between sun-up and sun-down of course grew shorter as picking progressed from August to December.[30]

One can use our picking data to conduct another exercise. We examine samples for all pickers over the pre-1840 and 1840-62 periods. Suppose every picker's quota was ratcheted up as Baptist suggested. How frequently did the realized picking rate fall below the hypothetical individual quota? We can add cases where the target was reset each season, where the adjustment occurred only if the increment was above specified thresholds (0, 10, and 20 pounds), and where the adjustment occurred with a probability of less than one (50 percent chance, 90 percent chance).

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[27] The 1826 record did show internal adjustments during the season. Based on our best efforts to understand the records, the numbers were revised downward for 10 or 11 individuals and upward in 2 or 3 cases. Tait clearly was adjusting picking tasks up and down to meet conditions and slave performance—there is no support for the claim that quotas only increased. Tait also reports tasks for 1850, for picking to 12 noon. The numbers imply higher picking rates per hour of work than in the 1820s. But they have the same general patterns—large round numbers. The increments are 5 pounds instead of 10.

[28] An experienced cotton picker probably could have judged whether he or she was close to quota that was defined in 10-pound increments. Overshooting the target significantly seems unlikely, especially if disposing of the picked cotton (by giving it to others with low weights or leaving it in the field to collect later) was easy.

[29] Baptist's own sources testify to this fact: Charles Ball (1837, p. 212) noted that a "day's work" depended on the quality and condition of the crop: "In a good field of cotton, fully ripe, a day's work is sixty pounds; but where the cotton is of inferior quality…, fifty pounds is the day's work; and where the cotton is poor, or in bad order, forty, or even thirty pounds, is as much as one hand can get in a day."

[30] At the latitude of Natchez, MS, there are three more hours of sunlight per day on the 22 of August, about when the picking season began, than on the 22 of December, near when the season ended.

The statistics are derived as follows. For each person, the amount of cotton picked each day is listed in sequence. Then a hypothetical target is calculated.

$$Target_{t+1}=Target_t+ p*max(0, Picking_t-Target_t-Increment).$$

The target ratchets up (with probability p) if the amount picked exceeds the previous target by the specified increment. The initial target is either reset every season or is carried over from the past season. So, if the increment is 0, the probability is 1, and the process resets, the target always rises to equal the maximum amount picked that season. If the increment is 10 pounds, the probability is 0.5, and the process resets, the target has a 50 percent chance of rising to the current picking amount if that amount exceeds the previous target by 10 pounds.

Table 11 indicates the fraction of days in the actual picking data that individual slave performance fell below quota ratcheting target under various specifications. The conclusion is that even in the less aggressive scenario (new season reset, 20-pound increments, 50 percent probability of adjustment), a deficit occurred *three* days out of *four*. Unless owners intended to whip virtually every slave almost all of the time, planters and overseers who assigned quotas to individual slaves would have had to change them regularly, sometimes daily, over the course of the season to reflect the health of the slave, abundance of the crop, the weather, and the condition of the fields.

Conclusion

It has long been asserted that antebellum cotton production relied to an unusual extent on labor of women and children, that the productivity differentials between females and males were lower than in most other activities, and that productivity was higher on larger-scale units. This paper adds new details and insight related these general notions focusing on cotton picking. Given that picking was the binding constraint in cotton production, our data are particularly relevant to understanding labor and gender productivity when it mattered most. We show that in the plantation sector, females and males performed essentially equal shares of the picking work; and that, in thepre-1840era, the daily picking rates for adult females were about 2 percent higher than for

adult males. In the later antebellum period (after 1840), the differentials reversed, and adult makes picked about the 7-11 percent more cotton per day than adult females. These estimates of the gender productivity gap are much smaller than previously posited. The 9-13 percent shift in the relative gender productivity most likely reflects a case of gender-biased technological change; the new Mexican cottons grew considerably higher than the varieties they replaced and thus gave an advantage to men. The greater weight that could be picked in a day may also have favored men who could move the cotton more easily than women. Nevertheless, compared with other estimates of the gender gap, the picking differentials were small and varied by relatively slight magnitudes over time and space.[31] This gives added support to the Goldin-Sokoloff hypothesis on early industrial development. We further show that productivity in picking was higher on larger-scale units. This is an unexpected finding because picking was not a gang activity; it was conducted on an individual basis. Something else besides gangs was at work. Our analysis also offers serious question of the recent claims for the purported "pushing system."

[31] This differential is close to the 9.1 percent gender differences in prices that Kotlikoff (1979) found in the New Orleans slave market. He also observed the male premium tended to increase over time, roughly in line with our picking results.

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reel 3.

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Barnes-Willis Family Papers, 1783–1840. RASP, Ser. G, pt. 5, reels 15-17.

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Green C. Duncan Papers, 1850-1865. RASP, Ser. G, pt. 1, reel 33.

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James A. Gillespie Papers, RASP. Series I, Pt 3, Reel 14.

John H. Randolph Papers, 1822-1865. RASP, Ser. I, pt. 1, reels 14-15.

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Benjamin Franklin Little Papers, 1806-1935. RASP, Ser. J, pt. 13, reels 38-39.

Branch Family Papers, 1788-1866. RASP, Ser. J, pt. 4, reels 45-47.

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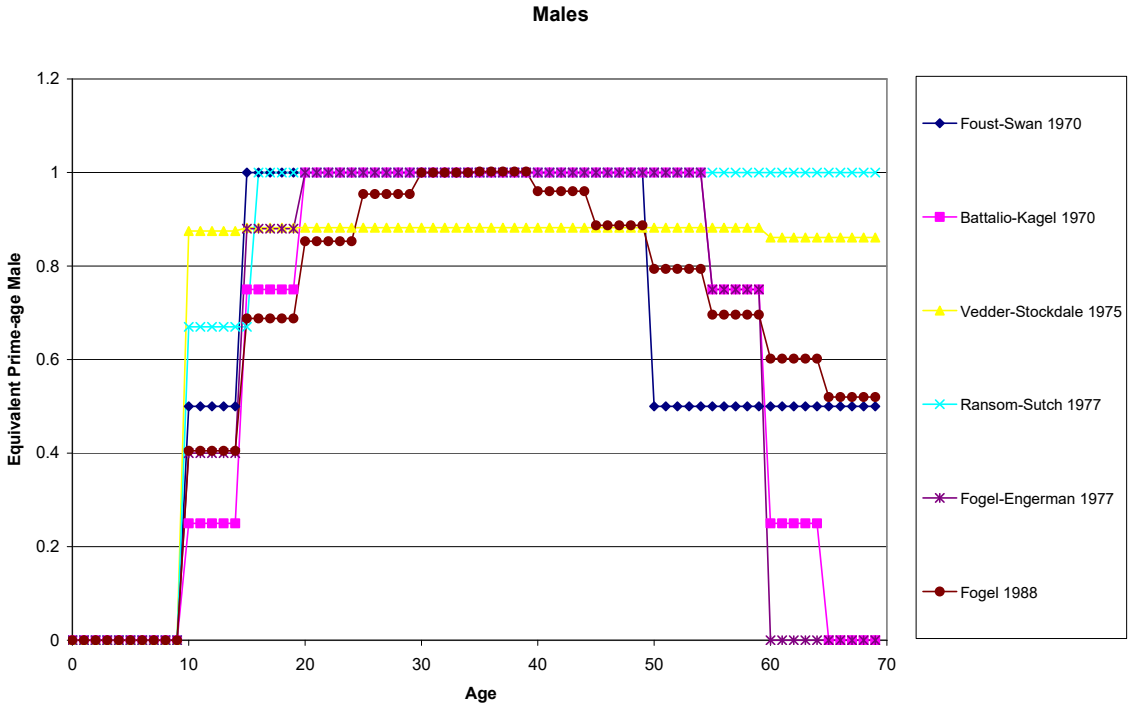
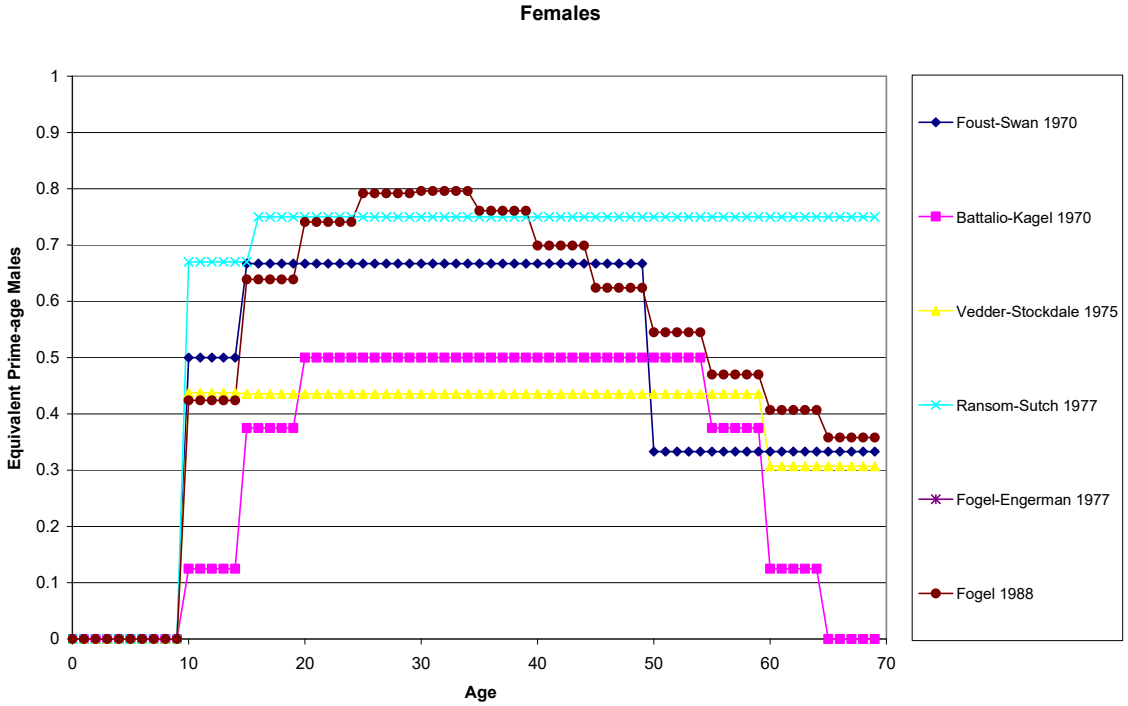
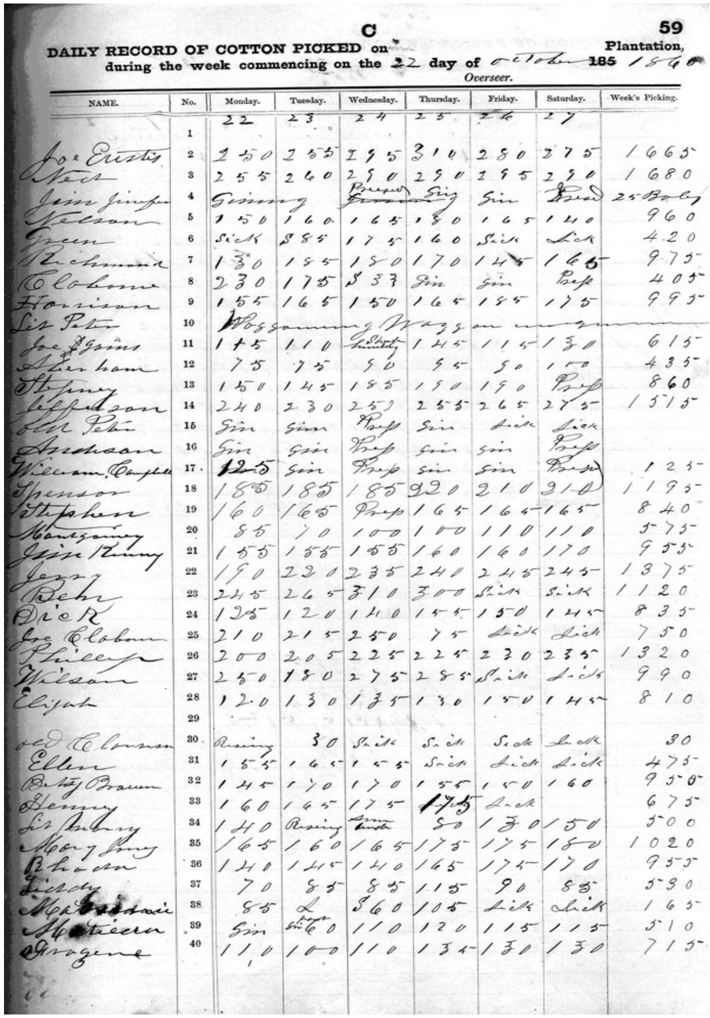
Figure 1: Estimates of age/gender conversion ratios into equivalent prime-age males





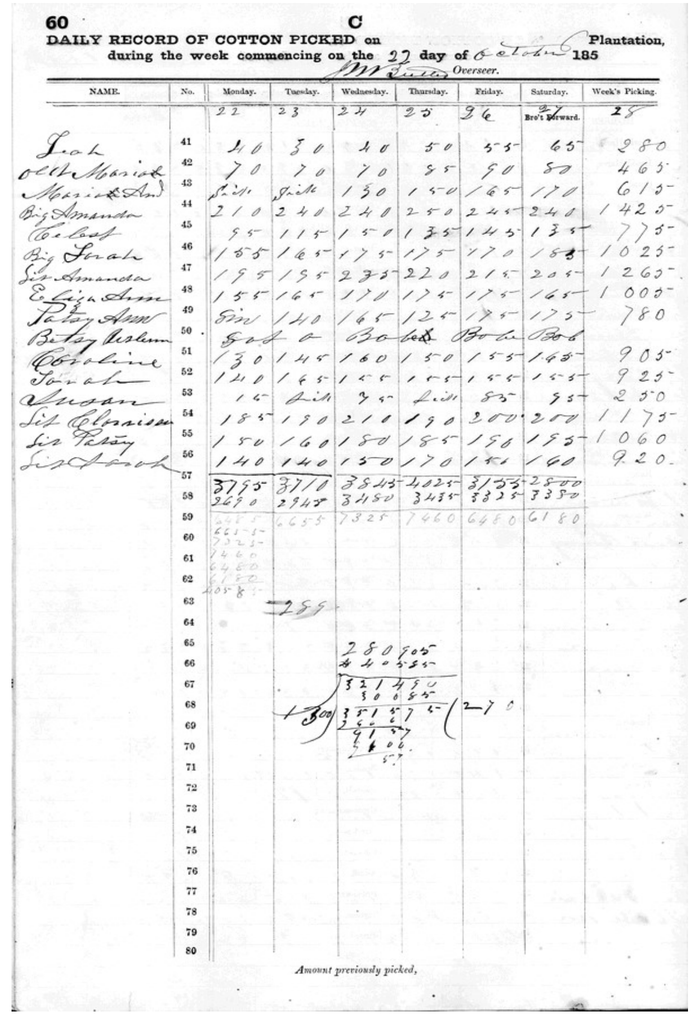


C 59

DAILY RECORD OF COTTON PICKED on Plantation, during the week commencing on the 22 day of October 185 1860

Overseer.

NAME.	No.	Monday. 22	Tuesday. 23	Wednesday. 24	Thursday. 25	Friday. 26	Saturday. 27	Week's Picking.
	1							
Joe Eustis	2	250	255	195	310	280	275	1665
Ned	3	255	260	250	250	195	230	1680
Jim Jim…	4	Ginning		Pressed	Gin	Gin	Pressed	25 Bales
Nelson	5	150	160	165	180	165	140	960
Green	6	Sick	85	175	160	Sick	Sick	420
Richmond	7	130	155	180	170	145	165	975
Claiborne	8	230	175	[illegible]	Gin	Gin	Press	405
Harrison	9	155	165	150	165	185	175	995
Lit Peter	10	Waggoning						
Joe Grimes	11	145	110	[illegible]	145	115	130	615
Abraham	12	75	75	50	55	50	100	435
Stepney	13	150	145	185	150	190	Press	860
Jefferson	14	240	230	250	255	265	275	1515
Old Peter	15	Gin	Gin	Press	Gin	Sick	Sick	
Anderson	16	Gin	Gin	Press	Gin	Gin	Press	
William Campbell	17	125	Gin	Press	Gin	Gin	Press	125
Spenser	18	185	185	185	220	210	210	1195
Stephen	19	160	165	Press	165	165	165	840
Montgomery	20	85	70	100	100	110	110	575
Jim Perry	21	155	155	155	160	160	170	955
Jerry	22	190	220	235	240	245	245	1375
Beln…	23	245	265	310	300	Sick	Sick	1120
Dick	24	125	120	140	155	150	145	835
Joe Claiborne	25	210	215	250	75	Sick	Sick	750
Phillip	26	200	205	225	225	230	235	1320
Wilson	27	250	180	275	285	Sick	Sick	990
Elijah	28	120	130	135	130	150	145	810
	29							
Old Clemon…	30	Raining	30	Sick	Sick	Sick	Sick	30
Ellen	31	155	165	155	Sick	Sick	Sick	475
Betsy Brown	32	145	170	170	155	150	160	950
Henry	33	160	165	175	175	Sick		675
Lit Aubry	34	140	Raining	[illegible]	50	130	150	500
Mary Perry	35	165	160	165	175	175	180	1020
Rhoda	36	140	145	140	165	175	170	935
Liddy	37	70	85	85	115	90	85	530
[illegible]	38	85	[illegible]	560	105	Sick	Sick	165
Matilda	39	Gin	60	110	120	115	115	510
Imogene	40	110	100	110	135	130	130	715



60 C

DAILY RECORD OF COTTON PICKED on Plantation, during the week commencing on the 22 day of October 185

Overseer.

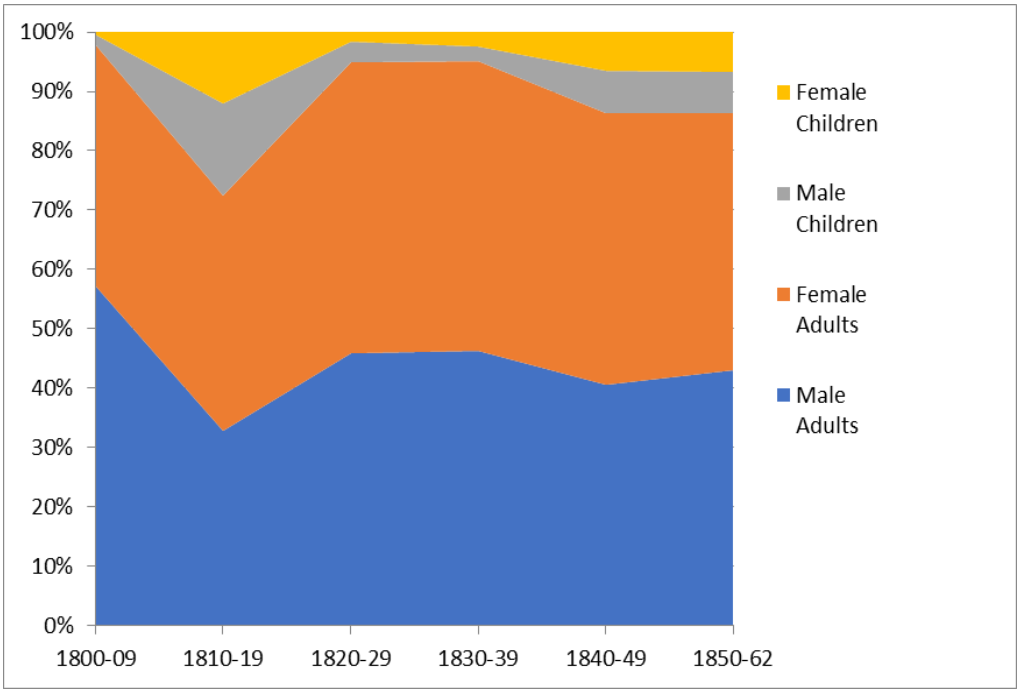
NAME.	No.	Monday. 22	Tuesday. 23	Wednesday. 24	Thursday. 25	Friday. 26	Saturday. 27 Bro't Forward.	Week's Picking.
Leah	41	40	30	40	50	55	65	280
Old Maria	42	70	70	70	85	90	80	465
Maria Ann	43	Sick	Sick	130	150	165	170	615
Big Amanda	44	210	240	240	250	245	240	1425
Celeste	45	95	115	150	135	145	135	775
Big Sarah	46	155	165	175	175	170	185	1025
Lit Amanda	47	195	195	235	220	215	205	1265
Eliza Ann	48	155	165	170	175	175	165	1005
Patsy Ann	49	Gin	140	165	125	175	175	780
Betsy Arlem	50	Gone to Bob						
Caroline	51	130	145	160	150	155	165	905
Sarah	52	140	165	155	155	155	155	925
Susan	53	15	Sick	75	Sick	85	75	250
Lit Clarissa	54	185	190	210	190	200	200	1175
Lit Patsy	55	150	160	180	185	190	195	1060
Lit Sarah	56	140	140	150	170	160	160	920
	57	3755	3710	3845	4025	3155	2800	
	58	3690	2945	3450	3435	3325	3380	
	59	6665	6655	7325	7460	6480	6180	

Amount previously picked,

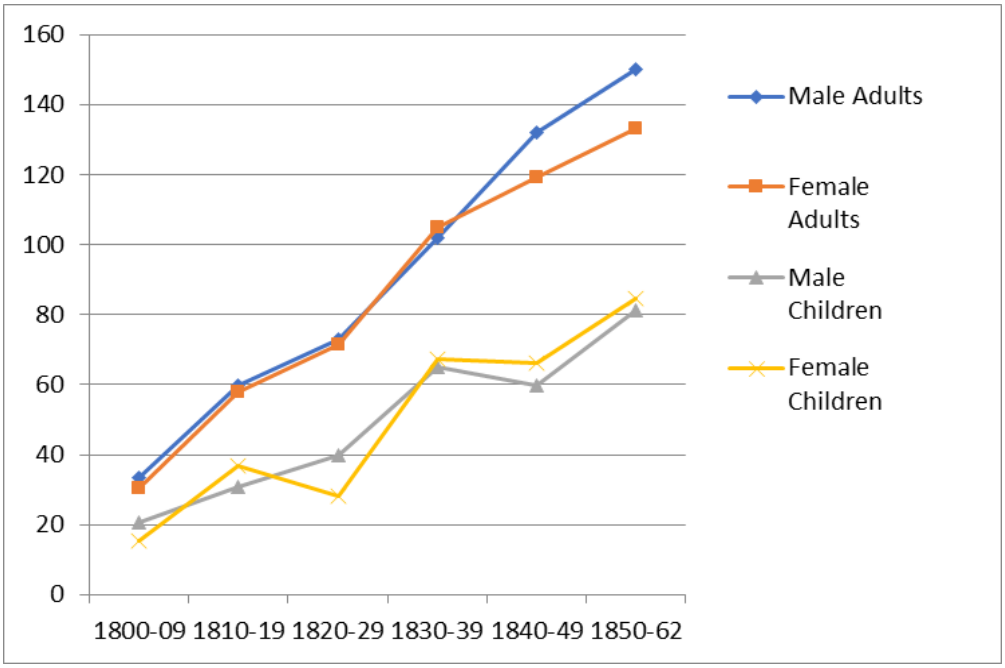
Figure 2: Record from Eustatia Cotton Book

Figure 3:

Panel A: Percent of Total Days Picking Cotton by Age and Gender, 1801-62



Panel B: Cotton Picked Per Day by Age and Gender, 1801-62



Panel C: Percent of Total Cotton Picked by Age and Gender, 1801-62

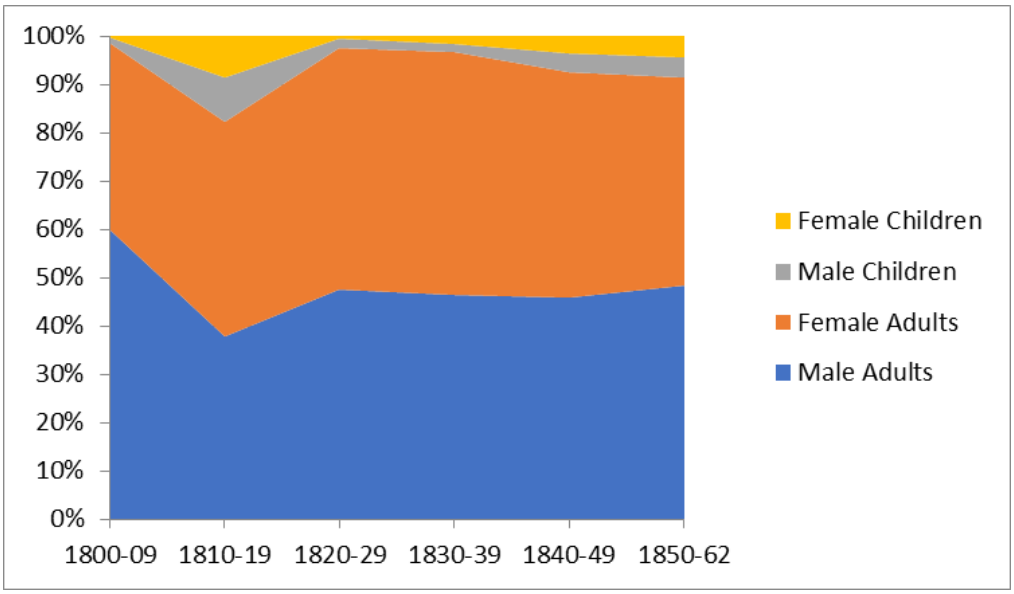
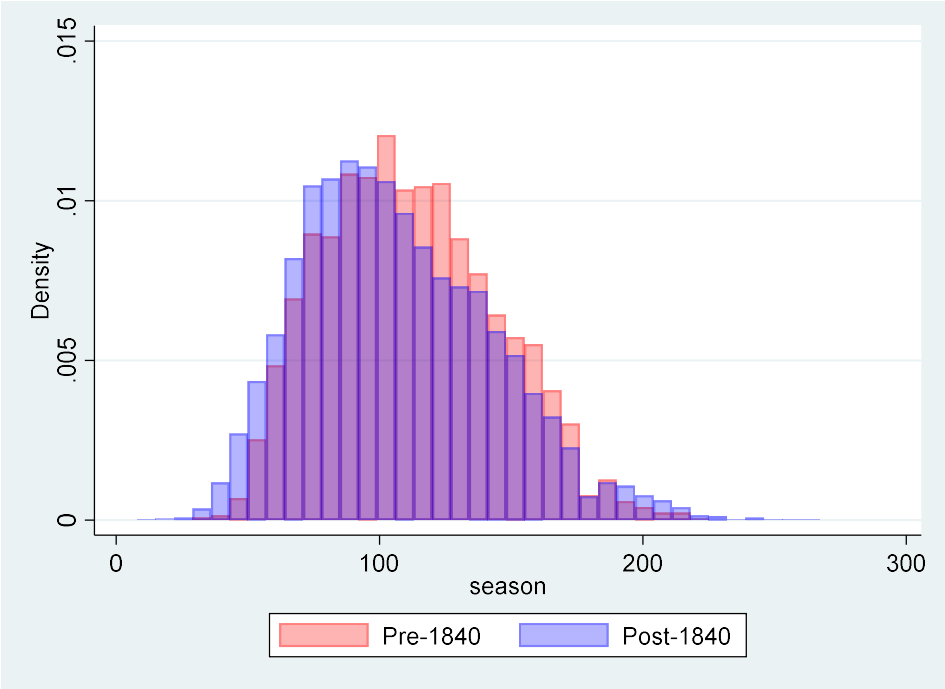
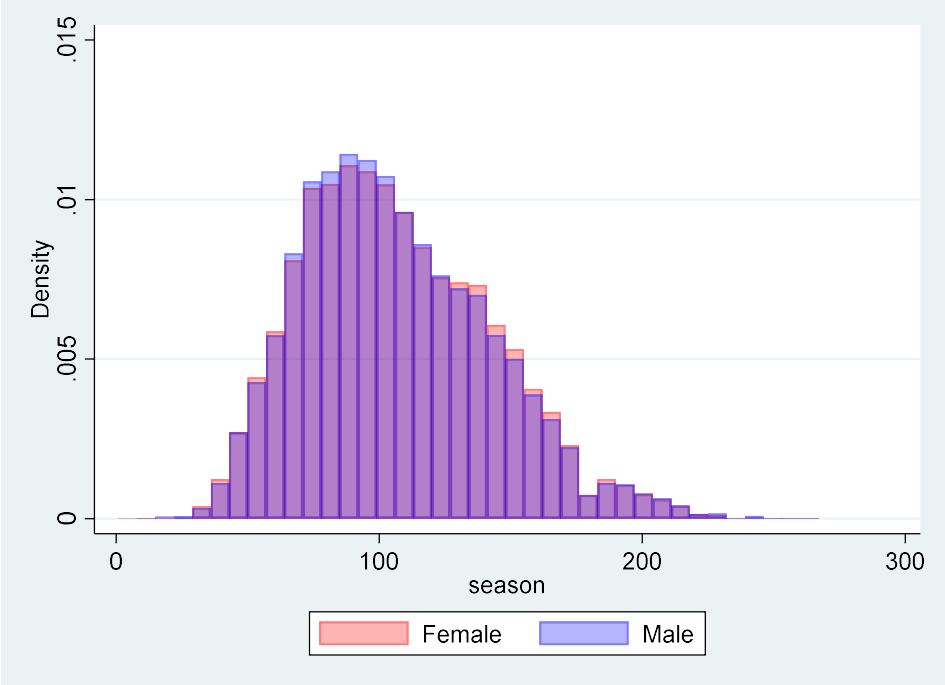


Figure 4: Histograms of Picking Day Distributions by Weeks

Panel A: Comparing 1801-39 and 1840-62 samples



Panel B: Comparing Females and Males



Panel C: Comparing Old and New South

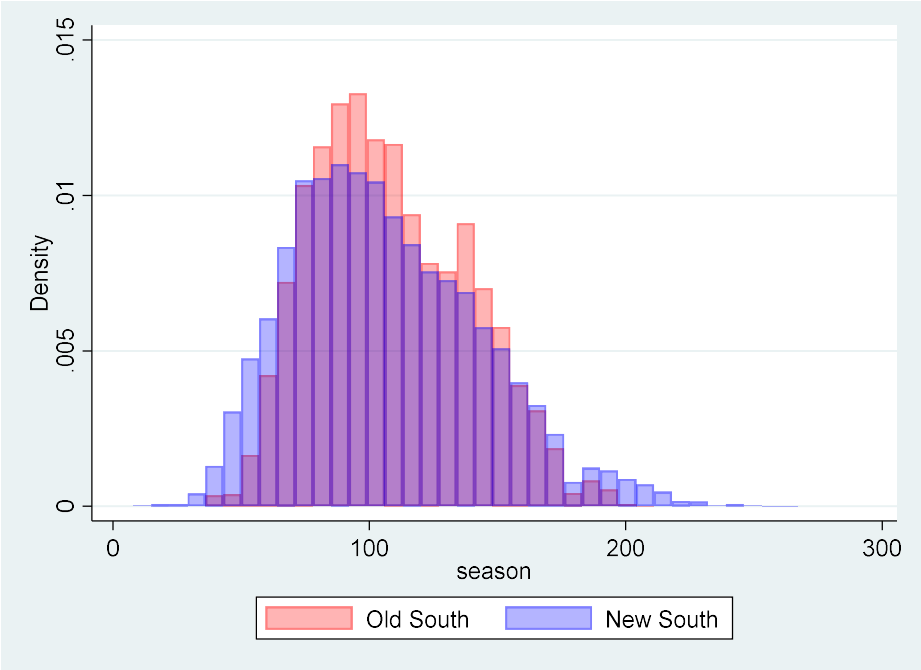


Figure 5: Picking Output Distributions for Adult Females and Males for 1840-62 Sample

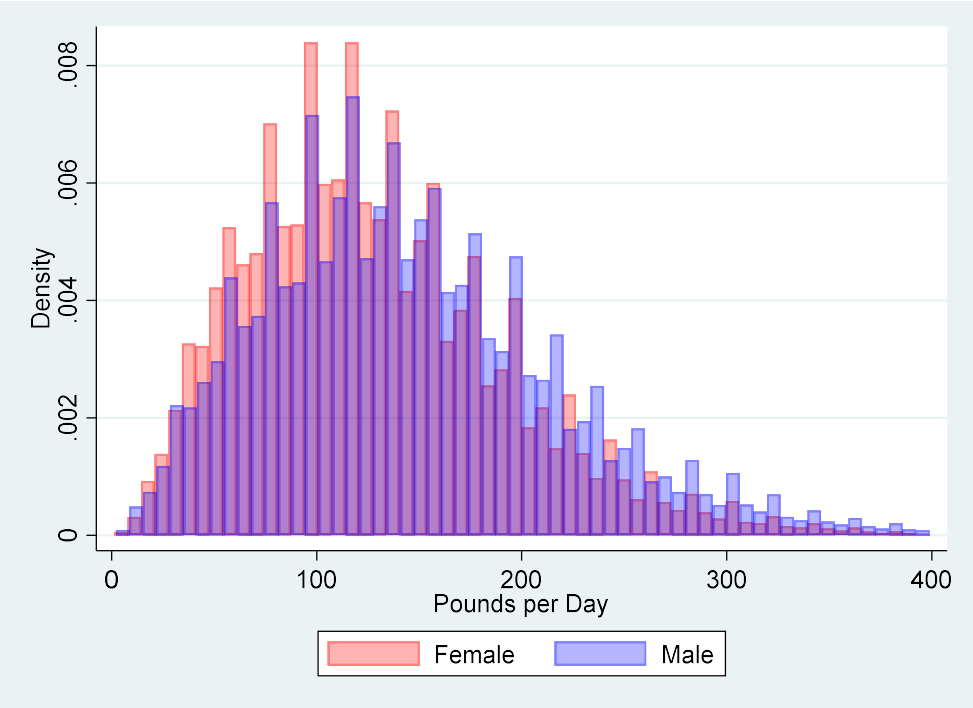


Figure 6: Distribution of Picking Observations by Age for 1840-62 Sample

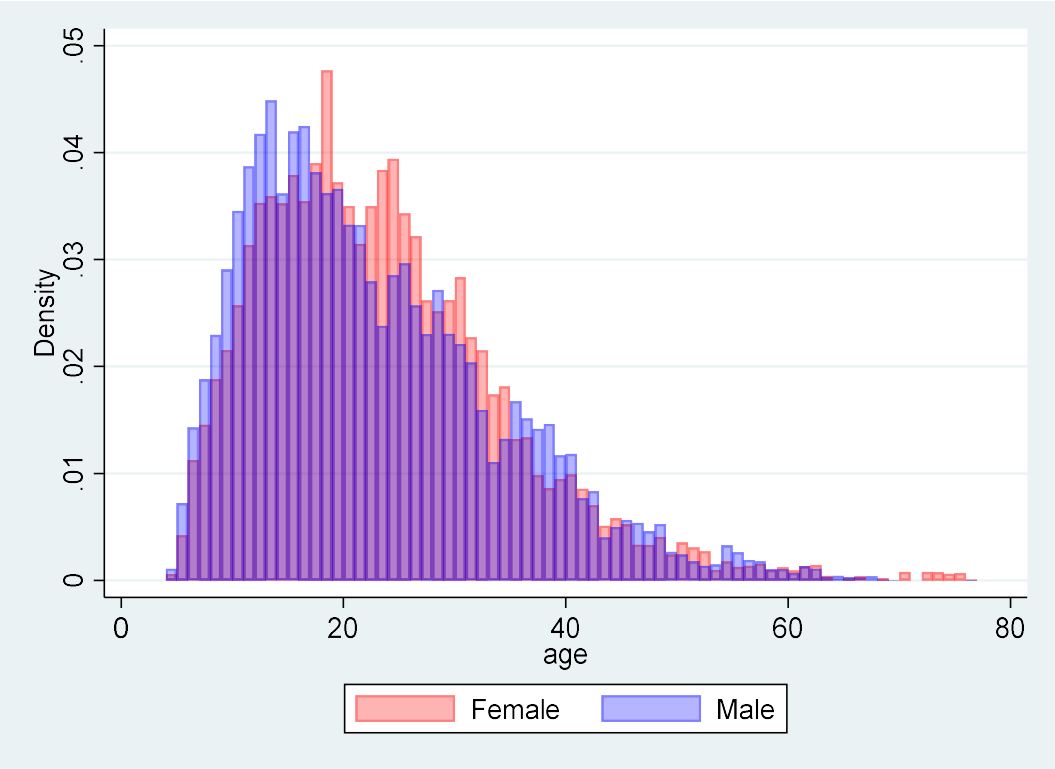


Figure 7: Lowess Regression Estimates of Age-Gender Picking Rate Profiles

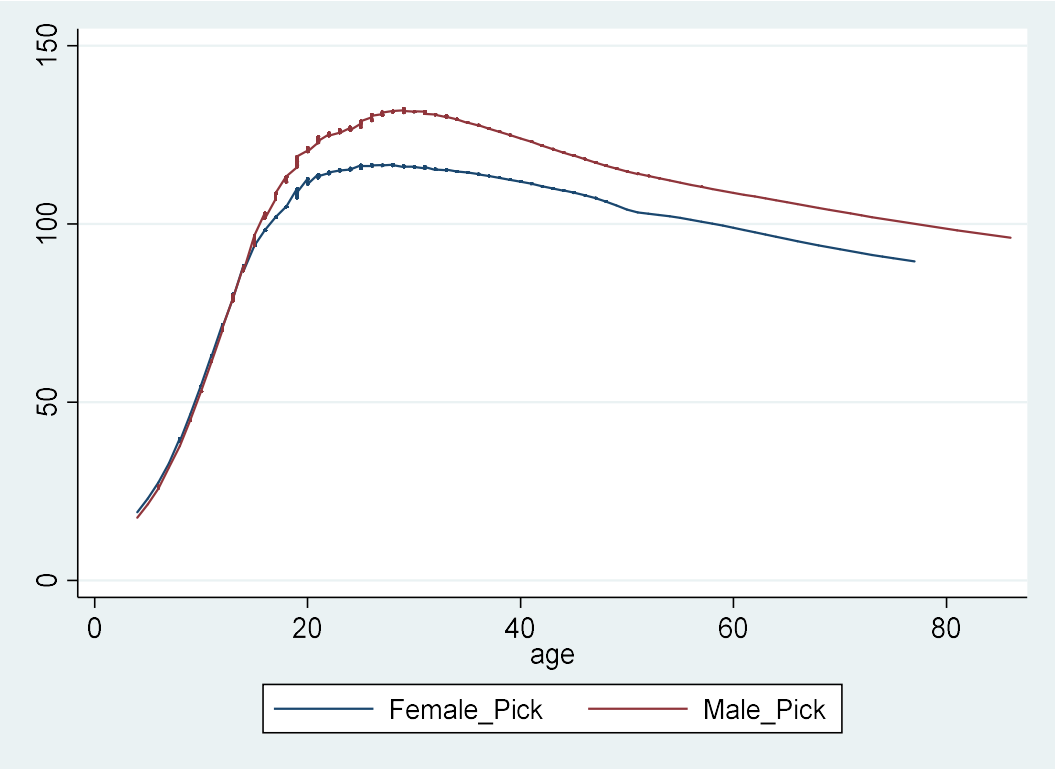


Figure 8: Variations in Picking Rates over the Lifecycle and Season

Panel A: Creesy (born 1836)

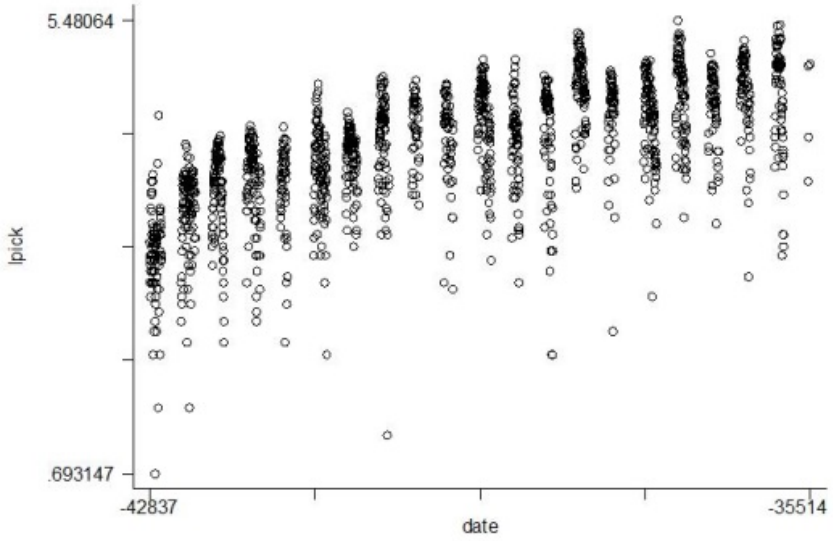


Table 1: Selected Statistics of Sample Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Daily Pick	755005	123.9621	70.62924	1	2725
Log of Pick	755005	4.637849	0.654755	0	7.910223
Female_Adult	755005	0.443987	0.496853	0	1
Female_Child	755005	0.063536	0.243924	0	1
Male_Adult	755005	0.425842	0.494470	0	1
Male_Child	755005	0.066635	0.249390	0	1
Year	755005	1850.606	10.3498	1801	1862
Crop_year	755005	1850.578	10.5351	1801	1862
New South	755005	0.883411	0.320930	0	1
YOB	755005	1830.255	14.1544	1751	1858
Age	299441	22.1741	14.0084	0	86
Monday	755005	0.165410	0.373580	0	1
Tuesday	755005	0.167677	0.375407	0	1
Wednesday	755005	0.169743	0.375407	0	1
Thursday	755005	0.170613	0.376171	0	1
Friday	755005	0.164909	0.371099	0	1
Saturday	755005	0.151181	0.358224	0	1
Sunday	755005	0.016073	0.146354	0	1
Half_day	755005	0.007197	0.084531	0	1
Season	755005	106.9345	35.7278	1	268
Pickers_Day	755005	37.3774	19.1168	1	101
Pickers_Year	755005	50.3200	23.2052	4	106

Table 2: Determinants of Daily Picking Rates

Dependent Variable: Log of Daily Picking Quantity				
Time Period	1840-62	1840-62	1840-62	1801-39
Region	All	Old	New	All
Constant	-10.501	-32.010	-12.215	-49.076
	(0.201)	(0.605)	(0.209)	(0.349)
Female Adult	-0.1107	-0.1488	-0.1017	0.0251
	(0.0014)	(0.0046)	(0.0014)	(0.0034)
Female Child	-0.6854	-0.2648	-0.7467	-0.4872
	(0.0034)	(0.0103)	(0.0037)	(0.0107)
Male Child	-0.749	-0.3597	-0.8062	-0.5542
	(0.0035)	(0.0103)	(0.0037)	(0.0104)
Tuesday	0.0252	0.0338	0.0174	0.0184
	(0.0024)	(0.0075)	(0.0024)	(0.0055)
Wednesday	0.0422	0.0743	0.0360	0.0263
	(0.0024)	(0.0073)	(0.0024)	(0.0055)
Thursday	0.0440	0.0746	0.0380	0.0137
	(0.0024)	(0.0073)	(0.0024)	(0.0056)
Friday	0.0303	0.0915	0.0198	0.0294
	(0.0024)	(0.0075)	(0.0024)	(0.0056)
Saturday	-0.0134	0.0384	-0.0224	-0.0126
	(0.0025)	(0.0076)	(0.0026)	(0.0058)
Half-Day	-0.4931	-0.6004	-0.4645	-0.5542
	(0.0073)	(0.0186)	(0.0076)	(0.0413)
Season	0.0276	0.0414	0.0290	-0.0002
	(0.0003)	(0.0018)	(0.0003)	(0.00001)
Season^2	-0.0002	-0.0003	-0.0002	-0.0002
	(2.9E-06)	(1.6E-05)	(3.0E-06)	(1.0E-05)
Season^3	5.34E-07	7.97E-07	5.34E-07	3.72E-07
	(7.9E-09)	(4.4E-08)	(8.0E-09)	(2.8E-08)
Cropyear	0.0078	0.0189	0.0087	0.0286
	(0.0001)	(0.0003)	(0.0001)	(0.0002)
No. of Obs.	662,264	83,970	578,294	92,741
R^2	0.193	0.110	0.230	0.374

Table 3: Quantile Regression Analysis of the Determinants of Median Daily Picking Rates

Time Period	1840-62	1840-62	1840-62	1840-62	1840-62	1840-62	1840-62
Region	All	Old	New	All	All	All	All
Quantile	50%	50%	50%	10%	25%	75%	90%
Constant	-9.1521	-25.794	-10.874	4.8722	-3.897	-15.922	-22.311
	(0.245)	(0.882)	(0.254)	(0.498)	(0.331)	(0.232)	(0.267)
Female Adult	-0.1207	-0.1816	-0.1121	-0.0936	-0.1091	-0.1164	-0.1162
	(0.0017)	(0.0058)	(0.0018)	(0.0035)	(0.0024)	(0.0016)	(0.0019)
Female Child	-0.6926	-0.2994	-0.7399	-0.8870	-0.8117	-0.5780	-0.4765
	(0.0033)	(0.0111)	(0.0034)	(0.0068)	(0.0044)	(0.0031)	(0.0036)
Male Child	-0.7324	-0.3305	-0.7800	-1.000	-0.9034	-0.6010	-0.5203
	(0.0033)	(0.0104)	(0.0034)	(0.0067)	(0.0044)	(0.0031)	(0.0036)
Tuesday	0.0247	0.0298	0.0164	0.0329	0.0351	0.0173	0.0142
	(0.0027)	(0.0092)	(0.0028)	(0.0056)	(0.0037)	(0.0026)	(0.0030)
Wednesday	0.0411	0.0677	0.0354	0.0548	0.0478	0.0357	0.0308
	(0.0027)	(0.0090)	(0.0028)	(0.0056)	(0.0037)	(0.0026)	(0.0030)
Thursday	0.0433	0.0724	0.0371	0.0573	0.0541	0.0373	0.0304
	(0.0027)	(0.0089)	(0.0028)	(0.0055)	(0.0037)	(0.0026)	(0.0030)
Friday	0.0272	0.0898	0.0180	0.0333	0.0354	0.0272	0.0254
	(0.0028)	(0.0090)	(0.0029)	(0.0055)	(0.0037)	(0.0026)	(0.0030)
Saturday	-0.0163	0.0334	-0.0214	-0.0288	-0.0300	-0.0011	0.0103
	(0.0028)	(0.0092)	(0.0029)	(0.0057)	(0.0037)	(0.0026)	(0.0031)
Half-Day	-0.5243	-0.5863	-0.4964	-0.4476	-0.4870	-0.4986	-0.4866
	(0.0090)	(0.0265)	(0.0095)	(0.0182)	(0.0121)	(0.0085)	(0.0098)
Season	0.0272	0.0356	0.0280	0.0393	0.0360	0.0198	0.0135
	(0.0004)	(0.0024)	(0.0004)	(0.0007)	(0.0004)	(0.0003)	(0.0004)
Season^2	-0.00022	-0.00030	-2.3E-04	-3.4E-04	-3.1E-04	-2.0E-04	-1.0E-04
	(3.1E-06)	(2.1E-05)	(3.1E-06)	(6.3E-06)	(4.2E-06)	(3.0E-06)	(3.4E-06)
Season^3	5.19E-07	7.15E-07	5.1E-07	8.2E-07	7.2E-07	3.5E-07	2.0E-07
	(8.35E-09)	(6.06E-08)	(8.3E-09)	(1.7E-08)	(1.1E-08)	(7.9E-09)	(9.1E-09)
Crop_year	0.0071	0.0157	0.0080	-0.0011	0.0039	0.0111	0.0147
	(0.0001)	(0.0004)	(0.0001)	(0.0003)	(0.0002)	(0.0001)	(0.0001)
No. of Obs.	662,264	83,970	578,294	662,264	662,264	662,264	662,264
Pseudo-R^2	0.098	0.059	0.116	0.135	0.123	0.081	0.070

Table 4: Difference-in-Differences Analysis

Panel A Changes in Picking Rates by Gender in Sample of Adults

Time Period	All	All	All
Constant	4.322	-16.697	-19.074
	(0.029)	(0.184)	(0.174)
Post_1840	0.5193	0.2544	0.2636
	(0.0031)	(0.0038)	(0.0034)
Female	0.0182	0.0229	0.0206
	(0.0040)	(0.0035)	(0.0034)
Female_	-0.1339	-0.1332	-0.1284
Post_1840	(0.0042)	(0.0038)	(0.0037)
Controls			
From Table 2	No	Yes	Yes
Plus New South	No	No	Yes
No. of Obs.	662,264	662,264	662,264
R^2	0.098	0.144	0.194

Panel B: Changes in Picking Rates by Gender and Season

Time Period	All	All	All
Constant	4.429	-16.454	-18.849
	(0.0033)	(0.184)	(0.174)
Female	0.0300	0.0296	0.0288
	(0.0046)	(0.0043)	(0.0042)
Late_Season	-0.1227	-0.1227	-0.1108
	(0.0061)	(0.0061)	(0.0060)
Female_	-0.0212	-0.0158	-0.0205
Late_Season	(0.0083)	(0.0074)	(0.0073)
Post_1839	0.4724	0.2227	0.2356
	(0.035)	(0.0040)	(0.0039)
Female_	-0.1300	-0.1273	-0.1241
Post_1839	(0.0049)	(0.0046)	(0.0044)
Post_1839_	0.1087	0.1038	0.0918
Late_Season	(0.0066)	(0.0061)	(0.0059)
Female_Post_1840	-0.0209	-0.0268	-0.0214
_Late_Season	(0.0090)	(0.0082)	(0.0080)
Controls			
From Table 2	No	Yes	Yes
Plus New South	No	No	Yes
No. of Obs.	662,264	662,264	662,264
R^2	0.111	0.145	0.194

Table 5: Determinants of Daily Picking Rates, with Age-Gender Profile for Sample with Ages

Dependent Variable: Log of Daily Picking Quantity				
Time Period	1840-62	1840-62	1840-62	1801-39
Region	All	Old	New	All
Constant	-31.698	-84.144	-23.829	-35.313
	(0.3583)	(1.021)	(0.3770)	(0.976)
Age	0.2118	0.0991	0.2209	0.0723
	(0.0023)	(0.0048)	(0.0023)	(0.0080)
Age^2	-0.0055	-0.0024	-0.0057	-0.0019
	(0.0001)	(0.00016)	(0.00009)	(0.00027)
Age^3	0.000042	0.000016	0.000043	0.000014
	(9.1E-07)	(1.6E-06)	(9.4E-07)	(2.9E-06)
Female	0.1538	0.553	0.1608	-0.0614
	(0.0215)	(0.0675)	(0.0217)	(0.1160)
Female Age	-0.0153	-0.0783	-0.0138	0.0432
	(0.0027)	(0.0080)	(0.0027)	(0.0147)
Female Age^2	0.00014	0.00254	0.00055	-0.0027
	(0.0001)	(0.00028)	(0.0001)	(0.0006)
Female Age^3	8.45E-07	-0.00002	0.0000019	0.000035
	(1.04E-06)	(2.9E-06)	(1.07E-06)	(6.9E-06)
Tuesday	0.0217	0.0298	0.0233	0.0300
	(0.0036)	(0.0119)	(0.0037)	(0.0154)
Wednesday	0.0544	0.0477	0.0457	0.0300
	(0.0035)	(0.0116)	(0.0037)	(0.0149)
Thursday	0.0484	0.0572	0.0474	0.0219
	(0.0035)	(0.0115)	(0.0037)	(0.0152)
Friday	0.0301	0.1121	0.0234	0.0480
	(0.0036)	(0.0117)	(0.0037)	(0.0151)
Saturday	-0.0353	0.0564	-0.0421	-0.0470
	(0.0038)	(0.0119)	(0.0039)	(0.0167)
Half-Day	-0.5361	-0.9406	-0.4674	-0.7917
	(0.0111)	(0.0226)	(0.0122)	(0.1247)
Season	0.0374	0.0709	0.0356	0.0636
	(0.00052)	(0.0032)	(0.00053)	(0.0029)
Season^2	-3.08E-04	-5.79E-04	-2.95E-04	-4.6E-04
	(4.45E-06)	(2.8E-05)	(4.52E-06)	(3.2E-05)
Season^3	7.05E-07	1.43E-06	6,77E-07	9.48E-07
	(1.2E-08)	(7.94E-08)	(1.21E-08)	(8.2E-08)
Crop_year	0.0178	0.0460	0.0134	0.0199
	(0.0002)	(0.0005)	(0.0002)	(0.0005)
No. of Obs.	289,954	26,729	263,255	9,487
R^2	0.344	0.281	0.362	0.377

Table 6: Determinants of Daily Picking Rates, with Breakdowns by Size of Picking Labor Force

Dependent Variable: Log of Daily Picking Quantity, All Regions, 1840-62:						
Size	All	Small (<15)	Medium (15-50)	Large(>50)	All	All
Constant	-10.501	-19.727	0.5011	-20.030	-9.227	-8.254
	(0.201)	(1.556)	(0.3001)	(0.2747)	(0.1994)	(0.1977)
Female Adult	-0.1107	-0.0636	-0.1293	-0.1081	-0.1146	-0.1123
	(0.0014)	(0.0081)	(0.0021)	(0.0020)	(0.0014)	(0.0014)
Female Child	-0.6854	-0.4553	-0.5112	-0.8367	-0.6951	-0.6987
	(0.0034)	(0.0280)	(0.0050)	(0.0047)	(0.0035)	(0.0035)
Male Child	-0.7486	-0.4914	-0.5870	-0.8892	-0.7568	-0.7593
	(0.0035)	(0.0157)	(0.0053)	(0.0047)	(0.0036)	(0.0036)
Tuesday	0.0252	0.0716	0.0289	0.0186	0.0242	0.0231
	(0.0024)	(0.0132)	(0.0035)	(0.0033)	(0.0024)	(0.0024)
Wednesday	0.0422	0.0809	0.0484	0.0350	0.0417	0.0413
	(0.0024)	(0.0132)	(0.0034)	(0.0033)	(0.0024)	(0.0024)
Thursday	0.0440	0.0462	0.0423	0.0462	0.0438	0.0430
	(0.0024)	(0.0131)	(0.0034)	(0.0033)	(0.0024)	(0.0024)
Friday	0.0303	0.0733	0.0321	0.0255	0.0299	0.0300
	(0.0024)	(0.0132)	(0.0035)	(0.0033)	(0.0024)	(0.0025)
Saturday	-0.0134	0.0192	0.0006	-0.0272	-0.0134	-0.0101
	(0.0025)	(0.0136)	(0.0036)	(0.0035)	(0.0025)	(0.0025)
Half-Day	-0.4931	-0.592	-0.5192	-0.3744	-0.4671	-0.4556
	(0.0073)	(0.0376)	(0.0090)	(0.0119)	(0.0072)	(0.0071)
Season	0.0276	0.0195	0.0201	0.0413	0.0274	0.0255
	(0.0003)	(0.0018)	(0.0005)	(0.0004)	(0.00033)	(0.00033)
Season^2	-0.00023	-0.00016	-0.0002	-0.0003	-0.0002	-0.0002
	(0.000003)	(0.0001)	(0.000004)	(0.000004)	(0.000003)	(0.000003)
Season^3	5.34E-07	3.13E-07	4.84E-07	7.61E-07	5.26E-07	4.94E-07
	(7.9E-09)	(2.95E-08)	(1.3E-08)	(1.0E-08)	(7.7E-09)	(7.6E-09)
Crop_year	0.0078	0.0127	0.0020	0.0127	0.0069	0.0063
	(0.0001)	(0.0008)	(0.0002)	(0.00014)	(0.0001)	(0.00011)
L_pickers_cropyear					0.1206	
					(0.0014)	
L_pickers_day						0.1756
						(0.0013)
No. of Obs.	662,264	16,043	299,402	346,819	662,264	662,264
R^2	0.193	0.173	0.123	0.271	0.202	0.219

Table 7: Determinants of Daily Picking Rates with Plantation and Plantation Crop Year Fixed Effects.

	Dependent Variable: Log of Daily Picking Quantity			
Time Period	1840-62	1840-62	1801-39	1801-39
Region	All	All	All	All
Constant	-8.355	3.583	-25.311	3.014
	(0.3699)	(0.0114)	(0.748)	(0.0431)
	<8.395>	<0.1409>	<9.214>	<0.3385>
Female Adult	-0.0830	-0.0832	0.0092	0.0117
	(0.0012)	(0.0012)	(0.0031)	(0.0030)
	<0.0130>	<0.0070>	<0.0263>	<0.0167>
Female Child	-0.5890	-0.5728	-0.540	-0.5484
	(0.0030)	(0.0028)	(0.0094)	(0.0092)
	<0.0746>	<0.0247>	<0.0911>	<0.0528>
Male Child	-0.6259	-0.6131	-0.5468	-0.5410
	(0.0030)	(0.0029)	(0.0097)	(0.0092)
	<0.0917>	<0.0274>	<0.0547>	<0.0487>
Tuesday	0.0316	0.0290	0.0131	0.0128
	(0.0020)	(0.0019)	(0.0050)	(0.0049)
	<0.0066>	<0.0054>	<0.0130>	<0.0082>
Wednesday	0.0465	0.0433	0.0299	0.0299
	(0.0020)	(0.0019)	(0.0050)	(0.0048)
	<0.0064>	<0.0062>	<0.0160>	<0.0119>
Thursday	0.0491	0.0449	0.0171	0.0172
	(0.0020)	(0.0019)	(0.0051)	(0.0048)
	<0.0077>	<0.0066>	<0.0189>	<0.0130>
Friday	0.0369	0.0349	0.0265	0.0269
	(0.0020)	(0.0019)	(0.0051)	(0.0049)
	<0.0076>	<0.0067>	<0.0108>	<0.0108>
Saturday	0.0002	-0.0010	-0.0221	-0.0220
	(0.0021)	(0.0020)	(0.0053)	(0.0051)
	<0.0112>	<0.0076>	<0.0128>	<0.0140>
Half-Day	-0.5507	-0.5611	-0.6193	-0.6055
	(0.0063)	(0.0062)	(0.0425)	(0.0466)
	<0.0315>	<0.0240>	<0.0673>	<0.1070>
Season	0.0332	0.0358	0.0320	0.0363
	(0.00031)	(0.00031)	(0.0012)	(0.0012)
	<0.0046>	<0.0038>	<0.00053>	<0.0087>
Season^2	-2.73E-04	-2.94E-04	-2.41E-04	-2.74E-04
	(2.7E-06)	(2.6E-06)	(1.1E-05)	(1.1E-05)
	<3.8E-05>	<3.2E-05>	<5.3E-05>	<7.2E-05>
Season^3	6.27E-07	6.71E-07	4.54E-07	5.36E-07

	(7.2E-09)	(7.1E-09)	(3.0E-08)	(3.0E-08)
	<9.6E-08>	<8.1E-08>	<1.5E-07>	<1.9E-07>
Crop_year	0.0064		0.0156	
	(0.00020)		(0.00041)	
	<0.00457>		<0.0042>	
Fixed Effects				
Plantation	X		X	
Pl Crop year		X		X
Plantation	121		28	
Pl Crop year		409		103
No. of Obs.	662,264	662,264	92.741	92,741
R^2	0.447	0.494	0.482	0.525

Table 8: Using Plantation-Day Fixed Effects to Control for Allocation Issues, Broad Age-Gender Categories

Time Period	1840-62	1840-62	1840-62	1801-39	1801-39	1801-39
Region	All	Old	New	All	Old	New
Constant	4.799	4.504	4.842	4.300	3.629	4.331
	(0.00068)	(0.00185)	(0.00074)	(0.00172)	(0.0081)	(0.00176)
	<0.00484>	<0.00995>	<0.00520>	<0.0096>	<0.0244>	<0.0099>
Female Adult	-0.0694	-0.0246	-0.0760	0.0229	-0.0897	0.0280
	(0.00093)	(0.00253)	(0.00099)	(0.00228)	(0.0111)	(0.0024)
	<0.00715>	<0.01893>	<0.00765>	<0.01761>	<0.0485>	<0.0181>
Female Child	-0.5549	-0.4324	-0.5746	-0.5264	-0.6483	-0.5229
	(0.00239)	(0.00593)	(0.00260)	(0.00734)	(0.0391)	(0.0074)
	<0.02516>	<0.04170>	<0.02715>	<0.05147>	<0.0645>	<0.0528>
Male Child	-0.6012	-0.4871	-0.6211	-0.5216	-0.4489	-0.5237
	(0.00249)	(0.00549)	(0.00277)	(0.0076)	(0.0424)	(0.0077)
	<0.02723>	<0.04351>	<0.02966>	<0.05456>	<0.1323>	<0.0562>
Plantation Day Controls						
R^2	0.697	0.764	0.677	.0.721	0.643	0.706
No. of Obs.	662,264	83,970	578,294	92,741	4,055	88.686
Plantation						
Dates	23,153	3,930	19,223	5,995	484	5,511
Clusters	409	83	326	103	14	89

Table 9: Using Plantation-Day Fixed Effects to Control for Allocation Issues, Age-Gender Profiles

Time Period	1840-62	1840-62	1840-62	1801-39
Region	All	Old	New	All
Constant	2.770	3.414	2.717	3.051
	(0.0120)	(0.0262)	(0.0122)	(0.0650)
	<0.1017>	<0.0845>	<0.1012>	<0.1420>
Age	0.1830	0.1488	0.1850	0.0942
	(0.0015)	(0.0030)	(0.0015)	(0.0071)
	<0.0118>	<0.0093>	<0.0120>	<0.0176>
Age^2	-0.0047	-0.0041	-0.0048	-0.0026
	(0.00006)	(0.0001)	(0.00006)	(0.00024)
	<0.0004>	<0.00031>	<0.00041>	<0.00067>
Age^3	0.000036	0.000032	0.000036	0.000021
	(0.0000006)	(0.000001)	(0.0000001)	(0.0000024)
	<0.000004>	<0.000003>	<0.000004>	<0.0000076>
Female	0.1136	0.6015	0.0972	0.1526
	(0.0143)	(0.0441)	(0.0146)	(0.0919)
	<0.0836>	<0.2194>	<0.0848>	<0.2116>
Female Age	-0.0066	-0.0742	-0.0034	-0.0108
	(0.0018)	(0.0052)	(0.0018)	(0.0111)
	<0.0102>	<0.2569>	<0.0104>	<0.0271>
Female Age^2	-0.00017	0.00226	-0.00029	-0.00008
	(0.00006)	(0.0052)	(0.00006)	(0.00042)
	<0.00036>	<0.00085>	<0.00037>	<0.00104>
Female Age^3	0.000004	-0.00002	0.00001	0.000005
	(0.0000007)	(0.0000019)	(0.000001)	(0.0000048)
	<0.000004>	<0.0000087>	<0.0000039>	<0.000012>
Plantation Date Control				
R^2	0.762	0.788	0.760	0.754
No. of Obs.	289,954	26,729	263,255	9.487
Plantation Dates	11,621	1,080	10,541	913
Clusters	202	24	178	19

Table 10 Individual Fixed Effect Estimates

Panel A: Full Sample, 1840-62 period

	All	Female	Male
Constant	3.585	3.492	3.684
	(0.011)	(0.014)	(0.015)
Child	-0.486	-0.492	-0.482
	(0.004)	(0.004)	(0.005)
Season	0.0343	0.0357	0.0327
	(0.0003)	(0.0004)	(0.0004)
Season^2	-0.00028	-0.00029	-0.00027
	(2.4E-06)	(3.4E-06)	(3.5E-06)
Season^3	6.46E-07	6.70E-07	6.17E-07
	(6.6E-09)	(9.1E-09)	(9.4E-09)
Tuesday	0.0319	0.0304	0.0334
	(0.0017)	(0.0024)	(0.0024)
Wednesday	0.0462	0.0447	0.0478
	(0.0017)	(0.0024)	(0.0024)
Thursday	0.0479	0.0500	0.0458
	(0.0017)	(0.0024)	(0.0024)
Friday	0.0353	0.0354	0.0352
	(0.0017)	(0.0024)	(0.0024)
Saturday	-0.0029	0.0009	-0.0071
	(0.0018)	(0.0024)	(0.0026)
Half-day	-0.544	-0.541	-0.547
	(0.0057)	(0.0080)	(0.0081)
Categories	6379	2933	3446
No. of Obs.	662,264	335,952	326,312
R^2	0.597	0.577	0.612

Panel B: Sample with Age, 1840-62 Period

	All	Female	Male
Constant	3.549	3.480	3.627
	(0.018)	(0.025)	(0.026)
Child	-0.484	-0.492	-0.474
	(0.004)	(0.0056)	(0.0058)
Season	0.0348	0.0358	0.0335
	(0.0004)	(0.0007)	(0.0007)
Season^2	-0.00028	-0.00029	-0.00027
	(4.2E-06)	(5.8E-06)	(6.0E-06)
Season^3	6.48E-07	6.64E-07	6.28E-07
	(1.1E-08)	(1.5E-08)	(1.6E-08)
Tuesday	0.0417	0.0394	0.0441
	(0.0029)	(0.0040)	(0.0041)
Wednesday	0.0557	0.0529	0.0588
	(0.0028)	(0.0040)	(0.0041)
Thursday	0.0579	0.0600	0.0558
	(0.0029)	(0.0040)	(0.0041)
Friday	0.0400	0.0378	0.0422
	(0.0029)	(0.0040)	(0.0042)
Saturday	-0.0146	-0.0134	-0.0160
	(0.0031)	(0.0042)	(0.0044)
Half-day	-0.567	-0.582	-0.554
	(0.0089)	(0.0124)	(0.0128)
Categories	1748	825	923
No. of Obs.	289,954	149,392	140,562
R^2	0.576	0.549	0.599

Panel C: Aging Estimates in Sample with Ages, 1840-62 Period

	All	Female	Male
Constant	0.9008	0.8364	0.9699
	(0.0228)	(0.0320)	(0.0325)
Age	0.2492	0.2467	0.2528
	(0.0016)	(0.0023)	(0.0023)
Age^2	-0.00691	-0.00685	-0.00703
	(6.3E-05)	(9.0E-05)	(8.9E-05)
Age^3	5.86E-05	5.89E-05	5.92E-05
	(7.3E-07)	(1.1E-06)	(1.0E-06)
Season	0.0349	0.0359	0.0338
	(0.00048)	(0.00067)	(0.00070)
Season^2	-0.00028	-0.00029	-0.00027
	(4.1E-06)	(5.7E-06)	(5.9E-06)
Season^3	6.46E-07	6.63E-07	6.28E-07
	(1.1E-08)	(1.5E-08)	(1.6E-08)
Tuesday	0.0409	0.0388	0.0433
	(0.0027)	(0.0038)	(0.0039)
Wednesday	0.0556	0.0527	0.0587
	(0.0027)	(0.0038)	(0.0039)
Thursday	0.0569	0.0594	0.0545
	(0.0027)	(0.0038)	(0.0039)
Friday	0.0401	0.0380	0.0424
	(0.0028)	(0.0038)	(0.0040)
Saturday	-0.0143	-0.0134	-0.0153
	(0.0029)	(0.0040)	(0.0043)
Half-day	-0.566	-0.582	-0.553
	(0.0088)	(0.0122)	(0.0126)
Categories	1748	825	923
No. of Obs.	289,954	149,392	140,562
R^2	0.618	0.592	0.641

Panel D: Aging Estimates in Sample with Ages, 1840-62 Period, Restricted to Ages Below 25

	All	Female	Male
Constant	0.1194	-0.0118	0.2333
	(0.0406)	(0.0590)	(0.0562)
Age	0.3876	0.3857	0.3939
	(0.0072)	(0.0105)	(0.0101)
Age^2	-0.0144	-0.0140	-0.0151
	(0.00050)	(0.00071)	(0.00071)
Age^3	0.000173	0.000160	0.000193
	(0.000011)	(0.000015)	(0.000016)
Season	0.0382	0.0404	0.0361
	(0.00064)	(0.00089)	(0.00092)
Season^2	-0.000304	-0.000321	-0.000288
	(5.40-06)	(7.48E-06)	(7.77E-06)
Season^3	6.77E-07	7.15E-07	6.40E-07
	(1.43E-08)	(1.97E-08)	(2.07E-08)
Tuesday	0.0404	0.0381	0.0429
	(0.0034)	(0.0048)	(0.0049)
Wednesday	0.0578	0.0533	0.0625
	(0.0034)	(0.0048)	(0.0049)
Thursday	0.0594	0.0593	0.0596
	(0.0034)	(0.0048)	(0.0060)
Friday	0.0441	0.0394	0.0491
	(0.0035)	(0.0049)	(0.0049)
Saturday	-0.0164	-0.0158	-0.0171
	(0.0037)	(0.0051)	(0.0054)
Half-day	-0.544	-0.583	-0.512
	(0.0119)	(0.0163)	(0.0170)
Categories	1096	531	565
No. of Obs.	178,017	91,298	86,719
R^2	0.670	0.646	0.692

Table 11: Percent of Days of Deficit when Hypothetical Target Exceeds Picking

Pre-1840 Period	Lifetime			New Season Reset		
Increment (Adjust if picking exceeds target by)						
	0	10	20	0	10	20
Probability						
0.5	90.1	88.1	84.4	80.4	78.1	73.8
0.9	92.7	91.0	87.8	84.8	82.1	77.6
1	93.1	91.4	88.1	85.4	82.7	78.2

1840-1860 Period	Lifetime			New Season Reset		
Increment (Adjust if picking exceeds target by)						
	0	10	20	0	10	20
Probability						
0.5	89.3	88.1	85.9	79.2	77.4	74.4
0.9	92.2	91.1	89.0	83.9	82.2	78.9
1	92.6	91.6	89.5	84.7	82.9	79.7

Appendix Table 1 presents results for the sub-sample including ages.

Table A1: Determinants of Daily Picking Rates, for Sample with Ages

Time Period	1840-62	1840-62	1840-62	1801-39
Region	All	Old	New	All
Constant	-32.843	-79.954	-24.962	-38.869
	(0.382)	(0.974)	(0.4036)	(0.9356)
Female Adult	-0.1036	-0.1432	-0.0999	0.0592
	(0.0023)	(0.0080)	(0.0024)	(0.0101)
Female Child	-0.6765	-0.3343	-0.7202	-0.0135
	(0.0042)	(0.0112)	(0.0044)	(0.0153)
Male Child	-0.699	-0.3837	-0.7484	-0.0973
	(0.0041)	(0.0104)	(0.0044)	(0.0247)
Tuesday	0.0206	0.0278	0.0219	0.0082
	(0.0038)	(0.0120)	(0.0039)	(0.0159)
Wednesday	0.0447	0.0459	0.0452	0.0266
	(0.0037)	(0.0116)	(0.0039)	(0.0154)
Thursday	0.0489	0.0557	0.0478	0.0169
	(0.0037)	(0.0117)	(0.0039)	(0.0156)
Friday	0.0300	0.1100	0.0232	0.0436
	(0.0037)	(0.0117)	(0.0040)	(0.0156)
Saturday	-0.0361	0.0548	-0.0434	-0.0483
	(0.0040)	(0.0120)	(0.0042)	(0.0171)
Half-Day	-0.5102	-0.9452	-0.4319	-0.8224
	(0.0114)	(0.0227)	(0.0126)	(0.1201)
Season	0.0368	0.0700	0.0351	0.0654
	(0.0005)	(0.0032)	(0.0005)	(0.0040)
Season^2	-3.06E-04	-5.80E-04	-2.94E-04	-4.69E-04
	(4.58E-06)	(2.84E-05)	(4.66E-06)	(3.2E-05)
Season^3	7.07E-07	1.43E-06	6.81E-07	9.46E-07
	(1.24E-08)	(7.95E-08)	(1.26E-08)	(8.31E-08)
Cropyear	0.0197	0.0444	0.0154	0.0221
	(0.0002)	(0.0005)	(0.0002)	(0.0005)
No. of Obs.	289,954	26,729	263,225	9.487
R^2	0.271	0.271	0.283	0.337

Table A1 uses the same specification as Table 2, but restricts the analysis to the sample where we can assign ages. The most notable differences between the Tables appear for the Old South sub-sample where relatively few of the upland cotton operations reported information allowing inference of age. Those that did so had picking rates exceeding those in the New South. This pattern inverts both the regional relationship found in the overall micro sample, in the picking rate data including plantation-level aggregates, and in the bales-to-cotton worker ratio we have derived based on state- or county-level labor force and production data (Olmstead-Rhode 2008ab, 2010). This hints at differing degrees of selectivity in the contemporaneous keeping of accounts and in the survival of such records. Such considerations indicate the importance of applying proper care in interpreting the statistical results based on the disaggregated age data.

Southeast plantations, as a rule, were neither deficit in neither keeping nor donating them to archives. But many of the available records are for operations producing Sea Island cotton and /or rice. In fact, operations on the Georgia and Carolina coasts have been cited to an extent unequal to their importance. This casts a shadow over the understanding of antebellum economy of the Southeast. As but one example, the cliometrics literature frequently cites data on the monthly employment of labor in cotton, corn, and other activity on the George Kollock's Ossabaw, Georgia plantation. But Kollock specialized in Sea Island cotton production, which differed in important specific ways from upland cotton production.