Chapter Title: Revised Estimates of the United States Workforce, 1800-1860

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12   Revised Estimates of the United States Workforce, 1800–1860

Thomas Weiss

12.1   Introduction

Economic historians are wont to set the record straight. In part, this desire stems from the aesthetic value of seeing each jot and tittle in its proper place, and from the comfort found in believing that nothing is askew. We sleep a little better at night knowing that sound data are in the computer terminal. There is also a bit of the detective in each of us, and our risk aversion leads us to sleuth among wayward estimates rather than among hardened criminals. There is, of course, the more practical, and we suspect more valuable, purpose of assuring the users of historical time series that the data are accurate and consistent.

The accuracy and consistency of any time series rest on the replicability of the original estimates and procedures, and on a masochistic streak which occasionally compels some of us to examine in detail the original estimates, replicating the various parts and rendering an assessment of the data. In some cases revisions are forthcoming and the record is set straight again—at least for a while.

It has been almost 20 years since Stan Lebergott's estimates of the nineteenth-century workforce appeared in print and some initial revisions were suggested (Lebergott 1966; David 1967). These estimates

are still the most recent comprehensive reconstruction of the labor force statistics, and are the only series to extend over the entire nineteenth century. Lebergott's work pushed our knowledge backward in time so we would have a picture of the changing industrial structure of a consistently defined workforce over a much longer period than could be found in previous work. His series was designed to link up with the Bureau of Labor Statistics data for the post-1940 period, giving a combined series which spans the nineteenth and twentieth centuries. Obviously, this evidence is a basic foundation of any analysis of long-term change in income and productivity, and it can serve as a starting point for more detailed investigations of labor force changes. It is my intention to extend Lebergott's series to the state and regional level. The assessments and small revisions in this paper are the first steps in that longer-term effort.

Previous work raised some doubts about the procedures, the execution, and the results of Lebergott's original work. Near the time of their publication, Paul David (1967) used the Lebergott figures to construct his conjectural estimates of economic growth before 1840. In the course of that work he discovered some "minor inconsistencies" in the implementation of the described procedures and revised the figures accordingly, and the revisions have been adopted by Lebergott (1984, p. 66). The chief alteration was a reduction in the 1800 workforce of 10.5% (200,000 workers), all of which occurred in the nonfarm sector. The main reason for this change was an adjustment in the number of workers aged 10–15 years. In constructing the 1800 estimate, Lebergott had used an 87.2% participation rate for males aged 10–15 years, while David substituted 25%, the rate Lebergott had used in other years. David also questioned Lebergott's ratios of farm laborers to farmers and the secondary worker ratio which prevailed among rural nonfarm workers. He also made minor revisions in 1820, 1840, and 1860, years in which Lebergott indicated he had used a slave participation rate of 87.2% instead of the 90% used in 1810, 1830, and 1850.[1]

A number of other ambiguities have been noted (Weiss 1983). Chief among these are the inconsistent treatment of adult female worker estimates, and the use of establishment based counts of workers in some industries rather than gainful worker estimates. Lebergott's detailed description of his estimation methods suggested other possible biases; among these are the double-counting of 15-year-olds in some years, the omission of free colored persons in 1810, an upwardly biased participation rate for males aged 10–15 years, the inclusion of females aged 10–15 years in 1860, an upwardly biased estimate of the 1800 urban population, and a downwardly biased estimate of the number of slaves in nonfarm activities.

This list is not meant to be exhaustive, but only illustrative of the possible biases and inconsistencies in the original estimates. An ex-

haustive list would serve no purpose, for we would have no idea whether that list was unusually long or short. More important, we would not know whether the items on it were of any consequence. In a work as complex, technical, and monumental as the estimation of the labor force for a century or more, there are bound to be some slips 'twixt the cup and the lip. Some zealot may wish to compile a complete listing and assess the significance of each flaw, but this seems unnecessary. As can be seen in the abbreviated menu, there are possibilities for offsetting biases. A more pertinent assessment would seem to be an estimate of the net effect of all the biases and inconsistencies, regardless of whether they are listed. This is the approach I have taken.

12.2   Reconstruction of Lebergott's Estimates

I have attempted to gauge the net effect of the known and possible errors or biases in the original estimates, and indirectly as well, the early revisions suggested by Paul David. I did this, not by replicating each of Lebergott's figures or assessing the magnitude of individual biases, but instead by following his procedures and revising the input data where appropriate. In some cases I had additional demographic detail that was unavailable to Lebergott.[2] In other instances, the revisions corrected some inconsistencies between the described procedure and the execution. I did have the immeasurable benefit of access to the original worksheets, which Lebergott generously made available. What I have produced with all this is a set of revised workforce figures for the antebellum years. While these revisions seem desirable, they are in fact fairly small and thus attest to the solidity of the original estimates.

The revisions have relied on the procedures set forth by Lebergott, which in principle are sound and efficient. Basically, his workforce figures are the sum of the estimates for four demographic groups: free males aged 16 years and over, free males aged 10–15 years, free females, and slaves. The estimates for the free male groups and slaves were derived as the product of the estimate of the population in each group times an appropriate participation rate.[3] The estimates of free female workers were the sums of estimates of workers in selected industries in which women predominated.

I made one substantial change of a conceptual nature in implementing the procedures, namely, I used a slightly different age breakdown for free males. Instead of using his groupings of ages 10–15 years and those 16 years and over, I used a 10–14-year age group and those 15 years and over. This seems more consistent with the data reported in the 1850 and 1860 censuses.

To be sure, there is some ambiguity surrounding the treatment of 15-year-old gainful workers in the 1850 and 1860 censuses. The census of

1850 called for reporting the occupation of all free males "over 15 years of age." The 1860 census apparently did likewise. At face value, these directives suggest that the census count of free male gainful workers is for those aged 16 and above. And, previous researchers seem to have interpreted the statistics this way. Whelpton made estimates of those aged 10–15 in certain industries, indicating clearly that he was dealing with the group "under 16 years of age" (1926, p. 338). Lebergott likewise made estimates of gainful workers aged 10–15 to supplement the figures for those 16 years and over. Paul David (1967) followed Lebergott's convention; and my own earlier interpretation accorded with these (Weiss 1975).

While Lebergott generally referred to the group of males 16 and over, he occasionally mentioned those "aged fifteen and over" (pp. 141, 144). More important, he estimated male workers in 1860 using the ratio of the 1850 census count of workers (presumably free males 16 years and over) to the free male population "fifteen and over" (p. 144). He did this for the obvious reason that the census reported the population figures that way.

Occasionally the census has engaged in some mischievous behavior, but it seemed strange that they would have categorized the population as being 15 and over but have recorded gainful workers 16 and over. This implies more work for the bureaucrats who were compiling these statistics by hand. Whatever the legislation had in mind, the key empirical issue is whether the census enumerators interpreted the category "over fifteen" to mean 16 and over, or as being one or more days over 15.

Two sets of evidence are available to shed light on this matter, a random sample of the manuscript census data for rural northern households in 1860 (Bateman and Foust 1976), and an unsystematic sample gleaned from the manuscript census records readily available to me for both 1850 and 1860. In the latter approach I looked at the records for only nine counties in five states in 1850, and three counties in three states in 1860. The 1860 sample of northern households is the more systematic evidence and has greater geographic coverage. My nonrandom search of selected counties, while less systematic, did produce evidence for 1850.

Although the evidence is incomplete and pertains to rural areas it does show clearly that 15-year-olds were reported as gainful workers in all states. In the broader sample, 36% of the males and 19% of the females reported occupations, while the selected county data show figures of 45% for males in 1860 and 30% in 1850.[4] These rates seem reasonable in light of evidence for later years. For 1900, the rate for 14- and 15-year-olds was 43% for males and 18% for females (Miller and Brainerd 1957, table L-3).

Given the incompleteness of the evidence, its rural bias, and the evident wide variation across states, it seems inappropriate to use this sample evidence to estimate a precise figure for 15-year-old workers in the United States. Instead I have chosen to assume that the census included 15-year-olds in the 1850 count with a tolerable degree of accuracy. This means that the participation rates derived from that census pertain to those aged 15 years and above, and should therefore be applied to a similar age grouping in earlier years. So instead of estimating the 15-year-old workers in 1850, my revisions required instead that I estimate the number of 15-year-olds in the population in the years 1800 through 1820. These estimates are described in appendix A. While this approach may contain inaccuracies, the series is consistent over time in its treatment of 15-year-old workers.

The interesting thing is that Lebergott's estimate for 1850 takes the 15-year-olds as being included in the census figure. His estimate of 280,000 boys was derived using the free male population aged 10–14, which the census reported. Thus if the census counted accurately 15-year-old workers and included them in the published total, Lebergott's 1850 figure would be an unduplicated count of gainful workers. To the extent the census undercounted 15-year-old workers or excluded them from the published figures, his total will be lower than the true value.

Unfortunately, the other years appear to have been treated differently by Lebergott. For the years 1800–1840, the 1850 participation rate for those 15 and over was applied to the population base 16 and over. Since the inclusion of 15-year-olds, even if counted accurately, would lower the participation rate, the estimated workforce for those 16 and over is too low in each of these years. The size of the bias depends on how accurately 15-year-old workers were counted in 1850.[5] The 1860 result is somewhat different. The population base used was 15 and over, so the accuracy and age coverage of male workers above age 15 would be comparable to the 1850 figure. But Lebergott then makes an estimate of the number of workers aged 10–15 years thereby double counting some 15-year-olds.

12.3 Total Labor Force

The original and revised figures are presented in table 12.1. I have also assembled there the revised estimates for each of the demographic components making up the labor force.

In the aggregate these comparisons enhance the credibility of Lebergott's estimates. The consequences of the inconsistencies and flaws in execution apparently did not cumulate to a substantial degree. The only difference of note is that for 1800. I have in fact used Paul David's estimate for that year, and while this minimizes the discrepancy there

Table 12.1   **Estimates of the Labor Force, 1800–1860**

| Year | Total Labor Force (Thousands of Workers) | | | Composition of the Present Estimates (Thousands of Workers) | | | |
	Lebergott	Present Estimates	Percentage Difference	Free Males 15+	Free Males 10–14	Females 10+	Slaves 10+
1800	1,700ᵃ	1,658	− 2.5	1,016	56	63	523
1810	2,330	2,358	+ 1.2	1,393	75	150	740
1820	3,135	3,126	− .3	1,904	99	160	963
1830	4,200	4,172	− .7	2,634	126	235	1,177
1840	5,660	5,686	+ .5	3,652	164	390	1,479
1850	8,250	8,199	− .7	5,330	228	675	1,966
1860	11,110	11,063	− .5	7,395	195	920	2,452

Sources: Lebergott 1966, table 1; David 1967, table A-1; appendix table 12.A.2, below.

ᵃThis is David's revision of Lebergott's estimate. Legergott's estimate for this year was 1,900,000 workers. In his recent textbook, Lebergott has incorporated the David estimate into his series (1984, p. 66).

is still a difference of 2.5% between the two figures. Surprisingly, this does not reflect our use of different participation rates for those aged 10–14 and those 15 years old.[6] Instead the difference represents an overestimate of the number of free colored workers in the original figures. Both David and Lebergott used an estimate of the free colored male population 10 years and over of about 78,000. The census of 1800 reported a total free colored population of 108,000 (United States Census 1800, p. a). After deducting females (estimated as 52%) and males aged 0–9 (32% of the males), one is left with only 35,000 males aged 10 and over. The current estimate is a labor force of only 27,000 in comparison to the 57,000 estimated by David.[7] The present estimate of slaves is also lower than David's. For slaves, David believed Lebergott had underestimated by using a participation rate of 87.2%, so he increased the slave force to 547,000. The current figure is only 523,000, close to Lebergott's original figure which was in fact 91% of the slave population. These upward biases in David's figures are partially offset by his lower estimate of workers aged 10–15 years.

In other years, while the totals are extremely close, there are some observable differences among the component figures. In all years, the revised estimate of males aged 10–15 is higher than the original. A comparison of the estimates for this age group is beset by the problem that the revised estimates do not contain an explicit figure for 15-year-olds. The revised figures are biased upward in this comparison by my use of the average rate for all males 15 years and over, solely for the purpose of making these comparisons. My imputed rate for 15-year-olds is 87% versus Lebergott's figure of 25%. This bias shows up clearly

in the years 1800–1830 where the revised figures are above Lebergott's. For the years 1840–60, however, this known bias serves to highlight an estimation problem. For those years I used the same participation rates as I did in the other years, whereas Lebergott used smaller rates in those years, and in 1850 also used the smaller population base of those aged 10–14 years. In that year his estimate of free male workers aged 10–15 is only 70% of the implicit revised value. Ironically, while he referred to his 280,000 estimate as pertaining to those aged 10–15 years, the figure in fact refers to those aged 10–14 years, and its addition to the census figure gives an unduplicated total. When confined to this smaller 10–14-year age group, the revised figure is below the original, reflecting my use of an 18.2% participation rate and his use of a higher rate 22.4% based on data for the broader 10–15 age group.

The other notable differences show up in the 1860 figures and affect every component. Since some of the differences are offsetting, the aggregate figures are quite close. A comparison of the two series for that year is presented in table 12.2. The revised slave figure was derived by applying the same formula as was used in other years, specifically, 90% of the slave population aged 10 years and over. For some reason, Lebergott chose to use a different method in this one year, using the participation rates for free males that prevailed in 1850 (p. 146). He did this on a state-by-state basis, carefully evaluating each state's ratio and adjusting those which seemed out of line. But given that the ratios were well below the 90% figure used in other years, ranging between 84% and 88%; and given that he did not think it appropriate to apply these same rates in 1850 when they originated (p. 143), it seemed desirable to drop this variation in making the revisions. The consequence is that the revised slave workforce is 113,000 greater than the original.[8]

The discrepancies in the 10–14 age groups reflect our use of different participation rates for males (22.6 vs. 18.2), while for females it reflects a difference in rates (6.2 vs. 5.1) and the use of the larger age group,

Table 12.2   **Comparison of the 1860 Estimates**

1860 Workforce	Lebergott	Present Estimates	Difference	Ratio
Total	11,110	11,061	49	1.00
Slaves	2,340	2,453	– 113	.95
Males, 15 and over	7,397	7,395	2	1.00
Males, 10–14	365	293	72	1.25
Females, 15 and over	895	841	54	1.06
Females, 10–14	113	79	34	1.43

Source: Appendixes below; Lebergott 1966, pp. 144–47. The figure for males 15 and over was not reported in Lebergott but was derived to make the total consistent with the sum of the components.

10-15 years, in the original estimates. In both estimations the figures for females aged 15 and over were derived by subtracting an estimate of free male workers from the reported census total for 1860. The estimate of male workers was obtained by weighting the free male population by the 1850 participation rates. The difference appears due to an arithmetical error, where some negative numbers were inadvertently treated as positive in Lebergott's calculations.[9]

12.4 Farm Workforce

I have also constructed a revised series on the farm workforce that is consistent with the revised total workforce figures, again following Lebergott's procedures but using new evidence where appropriate. The farm workforce was intended to be the sum of estimates for slaves and for free males. In principle, females were to be excluded in all years, but in fact some unknown, but small number were included in several years.[10]

Several dates are crucial in Lebergott's construction of the antebellum farm workforce figures. One of these is 1860, which provides some of the basic parameters used to derive the estimates in the earlier years. Fortunately, the census provided reasonably complete and detailed figures for that year. More critical is the estimation for 1800. Without this figure the series would likely have terminated in 1820, and would then not be such a substantial advance on the work of Whelpton. The estimate for 1820 is also important, for it influences heavily the estimation by interpolation of the figures for 1810 and 1830. The revised figures are presented in table 12.3.

In most years, but not all, there are only small differences in the number of workers and in the workforce shares. Again this exercise seems to confirm the solidity of the original figures. In spite of a number of potential biases in the original estimation, those figures approximated closely the corrected values. As with the totals, there were some offsetting revisions. For example, the revised 1860 slave workforce is 30,000 greater than the original, but this upward change is more than offset by an 86,000-worker decrease in the free farm workforce. The latter decline reflects entirely the elimination of the duplicate counting of 15-year-olds and the lower participation of those 10-14 years of age.[11]

In all years, except 1860, there is a slight reduction in the slave farm workforce. Lebergott specified that the slave farm workforce was to be derived by dividing the slave population 10 years of age and over into an urban share of 5% and a rural one of 95%; and then weighting the rural population by an assumed participation rate of 87% (pp. 150, 151). While this would appear to be inconsistent with the 90% rate

Table 12.3 Estimates of the Agricultural Workforce, 1800–1860

Year	Farm Workforce (Thousands of Workers)			Workforce Shares		Components of the Present Series (Thousands of Workers)	
	Lebergott	Present Estimates	Difference (%)	Lebergott	Present Estimates	Free Males	Slaves
1800	1,400[a]	1,263	−10.2	82.4	76.8	783	480
1810	1,950	1,797	−7.8	83.7	76.2	1,117	680
1820	2,470	2,462	−.3	78.8	78.8	1,577	885
1830	2,965	2,944	−.7	70.6	70.6	1,862	1,082
1840	3,570	3,520	−1.4	63.1	61.9	2,160	1,360
1850	4,520	4,394	−2.8	54.8	53.6	2,587	1,807
1860	5,880	5,822	−1.9	52.9	52.6	3,570	2,252

Sources: Lebergott 1966, table 1; appendixes below.

[a]Paul David's revisions affected largely the total labor force, and the farm share, but not the farm workforce.
His revised farm figure was 1,406,500 (David 1966, p. A-17).

used to estimate the total slave workforce, it is reconciled by Lebergott on the grounds that this lower 87% figure would "partially [compensate] for the inclusion of domestic servants, carpenters, etc., employed on the plantations and small slaveholdings" (p. 152). His execution, however, used the 90% figure, so that by following the described procedures one derives a lower slave farm workforce in each year, except 1860. In that year he estimated the number of slaves on a state-by-state basis using the participation rates for free males that prevailed in each state in 1850 (p. 152, n. 92). As noted earlier, this seems inappropriate, so I revised the slave estimate for the total and the farm workforce.

The estimates for 1800 and 1810, however, are substantially different, with important implications for our understanding of long-term changes in productivity and income. Since the 1810 figure is essentially an interpolation between 1800 and 1820, it is only necessary to examine the 1800 figure carefully.

The estimate of the 1800 farm workforce is quite simply the sum of agricultural slaves plus free colored farm workers plus the residual of free workers not allocated to other occupations. Lebergott made important distinctions among farmers, farm laborers, and family heads, but these were for use in assessing his results and were not necessary to derive the free farm workforce. The free white farm workforce is just the difference between the total number of white workers and those engaged in navigation, urban activities, and rural nonfarm occupations. A comparison of the components is contained in table 12.4.

There are several major differences in the estimation of the original and revised farm figures. The total number of white workers is sub-

Table 12.4   Gainful Workers by Occupation, 1800 (Thousands of Workers)

	Lebergott	Present Estimates	Difference
	White Males		
Total	1,240	1,047	193
Navigation	50	50	—
Urban occupations	116	75	41
Rural nonfarm	227	158	69
Agriculture[a]	847	764	83
	Agriculture		
White males	847	764	83
Free colored males	63	21	42
Slaves	490	480	10
Total in agriculture	1,400	1,265	135

Sources: Lebergott 1966, table 1, pp. 134–37; appendixes below and text

[a]The agriculture figure equals the total number of white males less those in navigation, urban occupations, and rural nonfarm occupations.

stantially smaller, as explained in the previous section. Additionally, the revised figures for urban and rural nonfarm occupations are lower, as is the estimate of free colored farm workers. Of less importance is a minor revision in the estimate of the slave workforce.[12]

Lebergott derived his urban/rural breakdowns using the 1790 evidence for five cities (p. 135). I have used the 1800 census data to construct the urban/rural distribution for each demographic component, with the white population being disaggregated by age and sex. This latter detail provides more pertinent information on the geographic location of family heads. The 1790 figure Lebergott used to estimate the urban free male workforce is higher than the more pertinent 1800 figures. He estimated the urban workforce as 9.1% of free males 10 years of age and older. Additionally, he used a much higher participation rate for those aged 10–15 years. The 1800 census data show that only 7.3% of the free males aged 16 and over, and 5.5% of those aged 10–15 years, lived in cities. The differences in these urban shares accounts for approximately three-fourths of the 41,000-worker discrepancy, and the higher participation rate accounts for the remainder.

The difference between the estimates of rural nonfarm workers reflects a revision in the ratio used in the calculation. The number of rural nonfarm workers was derived as the product of the population base (free white males 10 years and over) times a ratio of rural nonfarm workers to population, the ratio being obtained from the 1840 census evidence for southern states. It appears that Lebergott's ratio of 17.6% referred to the male population 15 years of age and over, not to those aged 10 and over. As such, the ratio he used is very close to the 1840 United States figure for males 10 and over (19.7%). It is quite unlikely that the 1840 United States figure, or any ratio close to it, would be representative of the 1800 economy. The southern ratio is lower than the United States figure, and thus may be more representative of the 1800 economy. But even the southern ratio seems too high because it includes a very high ratio for Virginia, where 26.4% of the free males aged 10 and over were engaged in rural nonfarm occupations.[13] Since this figure is well above that for the United States, it seemed appropriate to calculate the ratio with Virginia excluded. I also converted the ratio to the appropriate population base of free white males aged 10 years and over. The resulting figure of 11.7% was rounded downward to compensate for the unknown upward bias arising from the inclusion of females and slaves in the 1840 worker count.

Two factors explain the 42,000-worker discrepancy in the free colored farm workforce. The major factor is that Lebergott's figure includes free colored females as well as males. The revised figure is restricted to males.[14] A second factor is that the 1800 urban share of the free colored population was 18%, a figure well above that derived from the 1790 census. The revision then places 82% in rural areas, and

thus in farming, as opposed to the 92.6% implicit in Lebergott's estimates.

12.5 Caveats

Obviously, it is possible to obtain different estimates of the workforce by varying the estimates of the components used in the calculation. And, there are clearly some further refinements that would improve the estimates, perhaps especially the agricultural series. I have not incorporated these here, because I wanted to produce a series that was faithful to the original procedures, and because some adjustments would be quite arbitrary and would offset each other to some extent, perhaps fully. Nonetheless, let me suggest some possible revisions.

First, the farm workforce estimates for 1850 and 1860 may be low because no account was taken of a general category of workers called "laborers, not otherwise specified." It is well known that estimation of the industrial distribution of the workforce in the years 1870 through 1900 must contend with the problem of allocating this group of general laborers to the various industries in which they worked. This is no inconsequential problem for these unspecified laborers made up between 8% and 10% of the labor force in each of the postbellum years, and Lebergott allocated an average of 56% of them to agriculture on the basis of their rural residency. For 1850 and 1860 the census reported nearly a million of these laborers, comprising 8.7% of the workforce in 1860 and 11% in 1850 (United States Census 1900, p. liv); none of which have been included in the farm workforce estimates. Surely some of them worked there, but any estimate would be crude. We cannot simply extrapolate the postbellum distributions, for they include all whites and blacks, whereas the antebellum census data refer predominantly to free whites. In order to apply the urban/rural approach used in the postbellum period, we would need information on the location of at least a sample of these workers. Improved estimates, then, await additional evidence.[15]

The 1820 agricultural share of the workforce appears somewhat high, being 2 percentage points above the 1800 figure. It is of course possible that the latter figure is too low, but the procedure for estimating the 1820 figure suggests a likely upward bias. That figure was derived by combining the census count with an estimate of farm workers omitted from that count. In so doing, the share of the omitted free workers allocated to farming was based on the share implicit in the census data (83%). Since those data include slaves, the share is likely higher than it would be for only free whites.

Female workers are treated inconsistently across census dates. In all years an explicit estimate of women in selected occupations was

included (see table 12.1). Additionally, there is an implicit count in several years, namely, 1820, 1840, and 1860. In 1860, the number implicit in the census count was made explicit by deducting free males from the census total. But some of these women must have been farmers and farm workers, and are thus included implicitly in the free farm workforce for that year. In 1820 and 1840, some women were probably included in the census count of farm workers, but their number is not specified in the present estimates, and moreover, they are not included in the total labor force figures for those years. By interpolation, then, some women are implicitly included in the farm workforce for 1810 and 1830, but again excluded from the total workforce. To be sure these numbers are small, but nonetheless they do cause the 1800 and 1850 figures to be somewhat different in scope.[16]

The possibility of offsetting adjustments can be seen in the 1800 estimation. One downward bias in the farm figure is that the nonfarm estimates of the free workforce double-count some workers, thus reducing the residual allocated to farming. Surely some of those engaged in navigation and rural nonfarm activities are also counted in the urban figure.[17] Then, too, the rural nonfarm figure may include some unspecified number of females and slaves, which again reduces the residual count of free males in farming. Working in the opposite direction is an upward bias in the number of slaves engaged in agriculture. The procedure used assumes that only 3% of the occupied slaves were engaged primarily in nonfarm activities. This seems low in light of other evidence (Weiss 1975; Crawford 1980; Higman 1984).

Whatever adjustments one might wish to make, a strength of Lebergott's procedure is its straightforwardness. The refinements are simply added to or subtracted from the prevailing level. From this perspective, the estimates are not unduly sensitive to changes in any of the components. In this regard the Lebergott procedure seems preferred over the balance equation approach devised by Paul David (1966). Estimation of the rural nonfarm and farm workforce by his method is quite sensitive to changes in some of the input data. For this reason, I have not used that approach to derive the farm workforce in the revised series.[18]

12.6   Conclusions and Implications

As already noted, this paper is but the first step in a longer-term effort to build up reliable estimates of the workforce at the state level. Given that those estimates will be derived using procedures set out by Lebergott, and that the sum of the state estimates should be consistent with the national figures, it seemed worthwhile to scrutinize and assess the original procedures and estimates. The exercise did indeed prove

valuable, suggesting, on the one hand, possible pitfalls in the estimation procedures, but on the other hand, indicating that the existing figures are reliable. In spite of the many places to go awry, Lebergott produced a carefully constructed set of figures. Even if no revisions were made in those estimates, they would depict well the nation's workforce, its trend over time, and could serve as a standard for assessing the summation of the state estimates.

The exercise did, however, suggest a few revisions. In some years, there were offsetting differences in the estimates for various population components which netted out to small discrepancies in the aggregate (see table 12.2). Since all the differences are explained in the text and appendixes, here let me just highlight the key discrepancies between my revised figures and Lebergott's original estimates.

The most substantial revision lies in the 1800 figures, and Lebergott now accepts that the original estimate of 10–15-year-old workers was too high (Lebergott 1984, p. 66). His revised figure, based on Paul David's work, still exceeds my estimate by 1.3%, a difference arising from our estimates of free colored workers. Lebergott included free colored females, while I confined my estimate to free colored males and assumed that free colored female workers were included in the independently derived estimate of female workers. At the aggregate workforce level, there is only one other year, 1810, in which I would revise Lebergott's figure by as much as 1%. This difference reflects primarily our treatments of 15-year-old workers. I included them with the older segment of the labor force which had a participation rate of 87.2%, while Lebergott included them with youths, with a 25% participation rate. At the sectoral level there are notable differences in the farm workforce estimates for 1800 and 1810, and smaller differences in 1840 through 1860 (see table 12.3). The 10.2% difference in 1800 reflects a number of factors, as explained in the text (see table 12.4), while the 1810 discrepancy of 7.8% results in part from the difference for 1800, since we both obtained the 1810 figure by interpolation between 1800 and 1820. The remaining difference is due to our methods of interpolation (see app. A, especially table 12.A.4).

Of course, these revisions of the workforce figures have implications for our understanding of historical trends and issues. In particular, the revisions in the farm workforce in the earlier years bear on our view of the pace and timing of economic growth in the antebellum years, and on the behavior of productivity change in farming over the course of the nineteenth century. A careful reinterpretation of these issues would involve lengthy discussion of some other unsettled matters and underlying assumptions, and would take us far astray of the purpose of this paper. Let me suggest, however, the consequences for our view of antebellum economic growth.

The use of these revised figures would lower Paul David's conjectural estimate of per capita growth for the period 1800–1860 from 1.27% to 1.09% per year.[19] Moreover, the impact on the subperiods is to make it even more clear that our record probably followed the British pattern in that there was no discontinuity in trend, but rather the shift to "a higher secular rate was a much more gradual affair" (David 1967, p. 195). Instead of a one-time leap, the revised figures would show some acceleration during the antebellum period, with the rate rising from 0.98% in the subperiod 1800–1835 to 1.3% in the years 1835–55, and additional acceleration after the Civil War.

My cursory examination of implications such as this suggests that the new workforce figures present a quite plausible picture, thereby lending credence to the suggested revisions. Much more careful assessment is of course called for, and will be an ongoing activity. Presumably other researchers as well will continually test the plausibility of the estimates as they are used. In my view, the revisions in the total labor force are quite small, serving primarily to improve the consistency and precision of an already solid set of figures and enhancing our confidence in these national benchmark figures. At the sectoral level, the changes are more substantial, being large enough to alter our perception and understanding of economic development in the antebellum period. Even these larger sectoral changes are not a wholesale revision of the original estimates, but rather a refinement and strengthening of them. For the most part, the changes are due to the use of improved underlying data and the removal of some inconsistencies in the execution of the estimation procedures. In consequence of the solidity of the aggregate figures and these sectoral refinements, this revised labor force series should provide a firm foundation for extending the estimation to the state and regional level.

Appendix A
Nineteenth-Century Labor Force Estimation

The estimation of the labor force for the nineteenth century was derived as the sum of estimates for several demographic groups: free males, free females, and slaves. These groups in turn were broken down by age and race. The estimates for each component were calculated as the product of the population base for that group times an appropriate participation rate. The estimation, then, required evidence on these rates as well as figures for the population base for each of the groups.

Population Figures

The population data used in the estimation are presented in table 12.A.1. Unless otherwise noted, the data are from *Historical Statistics* (1975) series A, pp. 119–34. While population counts for some groups were readily available, others had to be estimated, especially in the earlier years. Where possible, I followed the procedures laid out by Lebergott (1966). Since I have used a different age breakdown, it was necessary to estimate the number of 15-year-old free white males in the years 1800–1820.

Slaves

For 1800, the number of slaves aged 10 years and over was estimated as 65% of the reported total slave population. The percentage was that which prevailed in 1830, and which was used by Lebergott (p. 137, n. 44). For 1810, the slave figure was calculated as 69% of the total slave population, a percentage derived from the 1820 calculation explained below. This was the percentage used by Lebergott (pp. 138–39) and was adopted here. For 1820, I first estimated the number of slaves under the age of 10 as 70% of the reported number of those under 14 years of age. This estimate was then deducted from the reported total slave population to obtain the number of those aged 10 and over (Lebergott, p. 140, n. 55). The resulting figure is equal to 69% of the total slave population.

Free White Males

Free white males aged 10–14 years were reported for the years 1830–60. For 1800–1820 those aged 10–14 were estimated as equal to the reported number aged 10–15 years minus an estimated number of 15-year-olds. The resulting figure for 10–14-year-olds is equal to 86.2% of those aged 10–15 years. The number of 15-year-old free white males in the years 1800–1820 was estimated as 13.8% of those aged 10–15 years, the group for which data were reported. The percentage figure used is that which prevailed for whites in 1880, the first year for which such evidence could be found in the published census (United States Census 1880, 1:548). Free white males aged 15 and over is the sum of the reported number aged 16 years and over plus the estimated number of 15-year-olds.

Free Colored Males

The total number of free colored persons was reported in the early census volumes, but no sex or age breakdowns were shown for 1800 or 1810 (United States Census 1830, p. 26). The sexes were distinguished in later years, with the shares being very steady between 1820

Table 12.A.1   Population Data Underlying the Workforce Estimates (Thousands of People)

Year	Slaves 10 Years and Over	Free White Males by Age			Free Colored Males		Free Females 10 Years and Over
		10–14 Years	15 Years	15 Years and Over	10–14 Years	15 Years and Over	
1800	581	304	49	1,136	7	28	1,425
1810	822	403	65	1,549	13	48	1,962
1820	1,070	528	85	2,122	15	61	2,674
1830	1,308	670	—	2,936	19	85	3,617
1840	1,643	880	—	4,081	23	107	4,895
1850	2,185	1,226	—	5,956	26	124	6,937
1860	2,725	1,590	—	8,341	30	140	9,536

and 1860. The male share was 48% in each of those census years, and I have assumed that this figure applied in 1800 and 1810 as well. Those aged 10 years and over were then estimated to be 68% of the total number of free colored males, the share which prevailed in 1830, the first year in which the age breakdown was available. The share may actually be higher in the earlier years, as there does appear to be a trend in the data for the years 1830–60, but the numbers involved are so small that greater precision or more sophisticated estimation techniques do not seem necessary. The distribution between the age group 10–14 years and those 15 years and over was assumed to be the same as that derived for free white males in each year.

Free Females

The figures for free females were not used to estimate the female component of the workforce, but are included here for completeness. The figures are the sum of free white females and free colored females aged 10 and over. The number of free white females 10 and over was reported in each year, and that for free colored females was reported for 1830–60. For 1800 and 1810, free colored females were estimated as 52% of all free colored; and for these years, and for 1820, when females were reported separately, those aged 10 and over were estimated as 72% of all free colored females, the share which prevailed in 1830 and 1840 (*Historical Statistics* 1975, ser. A:119–34).

Labor Force Estimates

For all components of the workforce, except free females, the estimate is the product of each group's population base times a participation rate. The single exception is the figure for free males 15 years and over in 1850, which was obtained from the census of that year. The participation rates were taken from Lebergott, but adjusted to the revised age groupings. A few other changes were made in order to achieve consistency in the estimation procedures. The estimates are presented in table 12.A.2.

Slave Labor Force

The slave labor force includes males and females 10 years of age and above. For all years I used the 90% participation rate which Lebergott espoused. The description of his estimates suggests he used 90% in some years (1810, 1830, and 1850) but 87% in others. In fact, in his execution he used approximately 90% in all years except 1860. In that year he used the rates which prevailed for free whites in southern states in *1850*. Since he did not think these rates were appropriate for 1850, it seemed inconsistent to use them in 1860, so I opted for the 90% figure.

Table 12.A.2   Revised Estimates of the Labor Force (Thousands of Workers)

Year	Slaves 10 Years and Over	Free White Males		Free Colored Males		Free Females 10 Years and Over	Total Labor Force 10 Years and Over
		10–14 Years	15 Years and Over	10–14 Years	15 Years and Over		
1800	523	55	991	1	25	63	1,658
1810	740	73	1,351	2	42	150	2,358
1820	963	96	1,850	3	54	160	3,126
1830	1,177	122	2,560	4	74	235	4,172
1840	1,479	160	3,559	4	93	390	5,686
1850	1,966	223	5,222	5	108	675	8,199
1860	2,452	289	7,273	6	122	920	11,063

Free Males

The participation rate for free males aged 10–14 years was derived from the 1900 census data. For that year a rate of 21.4% was found for all males 10–14 years old. Following Lebergott's lead, it was assumed that a rate for native whites would be more representative of the antebellum group of free males than would the rate for all males. In 1900 the native white race was reported for those aged 10–15 years. That rate of 22.1% was equal to 85% of the reported rate for all males aged 10–15 (26.1%), and so it was assumed here that the native white rate for those aged 10–14 was equal to 85% of the rate for all males aged 10–14 years (United States Census 1900, pp. lxvii, cxviii). This same rate was used for free colored males aged 10–14 years.

For free males aged 15 and over I used the 1850 participation rate of 87.2% as derived by Lebergott (p. 140 and elsewhere). I used this rate in all years, whereas Lebergott used it in all years except 1860. For that year, he divided the 1860 census figure into males and females by applying the 1850 participation rate for males on a state-by-state basis. The summation of the state estimates yields a slightly higher participation rate (88.6%) for all free males. The 1850 figure for free white males is the reported census figure, excluding students, less the estimated number of free colored workers.

Free Females

The numbers for female workers were taken from Lebergott (1966). The ages were not always specified, so I have treated them as referring to those 10 years of age and over. For 1800, Lebergott (p. 136) indicated that in urban areas there were 40,000 female domestics "plus an arbitrary 10,000 addition for other females." There was no specific discussion of rural female workers, but an estimate of 13,000 free domestic servants was made, and Lebergott's worksheets indicate that these were female. Paul David (1966) treated these rural domestics as females. The addition of these 13,000 female domestics brings the total to 63,000 female workers. The 1810 figure (p. 139) had no age specification, but the 1820 estimates (p. 140, n. 55) were referred to as those 10 years of age and over. For 1830 (p. 141) he specified 75,000 in manufacturing, to which must be added his estimate of domestic servants. It appears that all servants were female (160,000), as was specified in 1810, 1820, and 1840. I assumed likewise for other years. I derived the 1840 figure as a residual of Lebergott's total free workforce less his estimates of free male workers (p. 142). Lebergott did specify that there were 240,000 domestics, which by subtraction from the 390,000 leaves 150,000 females in manufacturing. This figure is certainly consistent with the number he must have estimated in industrial pursuits. He did not cite

a specific figure, but noted that one was derived by interpolation be-
tween the 1830 figure of 75,000 and the 1850 one of 220,000. He did
specify clearly that the figures for 1840 pertained to females 16 and
over. His discussion of the 1840 estimate implies that the 1830 and 1850
figures should pertain to those 16 years and over, but it is not specified
in either of these years. For 1860, Lebergott explicitly included an
estimate of females aged 10–15 years (p. 146, n. 73). I have therefore
included an estimate for the 10–14-year age group. Lebergott used a
rate of 6.4% for those aged 10–15 years (the 1900 rate for native whites),
whereas I used a rate of 5.1% for those aged 10–14 years. This figure
was based on the 1900 data (United States Census 1900, pp. lxvii,
cxviii). The rate of 8.1% for all females aged 10–14 was converted to
a rate for native whites on the basis of the participation rates for those
aged 10–15. In 1900, the rates for 10–15-year-olds were 6.4% for native
whites and 10.2% for all females, giving a ratio of .627. In 1860 there
were 1,553,234 free females aged 10–14 years in the population (*His-
torical Statistics* 1975, ser. A:122), yielding 79,214 gainful workers in
that age group. The bulk of the 1860 female workforce, those aged 15
and over, was calculated by subtracting the revised estimate of free
male workers aged 15 and over (7,935,000) from the 1860 census count
of gainful workers (8,235,557); the latter figure excluding 51,486 stu-
dents, nuns, and sisters of charity (United States Census 1900, p. liii).
The result is 840,557.

Agricultural Workforce Estimates

Slaves

I followed the procedures outlined by Lebergott for estimating the
number of slaves in agriculture (see table 12.A.3). I obtained figures
on the number of slaves 10 years of age and over, allocated 95% of

**Table 12.A.3   Revised Estimates of the Agricultural Workforce United States,
1800–1860 (Thousands of Workers)**

Year	Slaves	Free Males in Agriculture			Total
		10–14 Years	15 Years and Over	10 Years and Over	
1800	480	—	—	785	1,265
1810	680	—	—	1,117	1,797
1820	885	—	—	1,577	2,462
1830	1,082	—	—	1,862	2,944
1840	1,360	—	—	2,160	3,520
1850	1,807	182	2,405	2,587	4,394
1860	2,252	234	3,336	3,570	5,822

these to the rural areas, and calculated the number in agriculture as 87% of this rural base. Lebergott, in fact, estimated the slave farm workforce as 90% of the rural figure (except in 1860), which implies that the entire rural slave workforce was in farming. The 87% approach allows for 3% to be engaged in nonfarm occupations, a figure which seems low in light of other evidence (see Weiss 1975; Crawford 1980).

The 1800 census data put the urban share of the slave population at 3%. In view of the fact that I have not adequately assessed this figure and have not revised the share in other years, I have adopted Lebergott's 5% figure for all years.

Free Males

For 1850 and 1860 Lebergott estimated the 10–15-year-old males in farming as equal to 17% of the population. Since I have used a much different participation rate for those aged 10–14 (namely, 18.2%), I could not assume the same agricultural participation rate of 17%. The share of 10–14-year-old gainful workers in agriculture might be higher than that for 10–15-year-olds, because the 15-year-olds would have had some greater freedom of job choice. Still it seems unlikely that the share would be as high as 93% (17 ÷ 18.2), when the 10–15-year-old share implicit in Lebergott's data was only 75% (17 ÷ 22.6). In 1900, the only year for which we have reliable data, the respective shares were 74% for 10–14-year-olds and 70% for 10–15-year-olds. By assuming that the same ratio of shares (74/70 = 1.06) prevailed in 1800, the 10–14-year-olds' share was placed at 80% (1.06 × 75%).

The 1850 and 1860 figures for males 15 and over are from the census (1900, *Occupations,* p. liii) and are the sum of farmers, planters, and overseers; agricultural laborers; dairymen; gardeners, etc.; and one-half the figure for stock raisers, etc. In 1850, laborers were *probably* included with farmers and planters, and some women were included in the 1860 census count.

The 1840 figure for males 10 and over was taken from Lebergott (p. 155) and is the 1840 census count of agricultural employment minus all rural slaves aged 10 and over. The 1820 figure for males 10 and over was derived by subtracting the slave farm workers from the total farm workforce. The latter was derived by following Lebergott's procedure (pp. 155, 156). The 1820 census figure of 2,491,000 workers was deducted from the revised labor force total of 3,126,000, obtaining 635,000. I then deducted the 160,000 females, allocated 83% of the balance to agriculture (393,000), and combined it with the 1820 census count for agriculture (2,069,000) (United States Census 1900, p. xxx).

For 1800, I produced two estimates of the free farm workforce, both of which are consistent with the revisions incorporated in the total

workforce figures. The variant which is shown in table 12.A.3 was derived following Lebergott's procedures; the alternative, discussed subsequently, was based on David's procedures. In the reported version, the free farm workforce is the sum of estimates for free white males and for free colored males. The free colored farm workforce was derived by allocating the revised estimate of free colored male workers between urban and rural areas; the former being counted as nonfarm workers, the latter as farm workers. This is the procedure used by Lebergott, but his figures and mine differ for two reasons. First, he apparently included free colored females, and my revision is confined to males. Second, his urban/rural breakdown was based on the 1790 data for five cities, while my breakdown is based on the census counts for 1800, which show that 18.0% of the free colored population lived in cities (see text). The rural count of free colored gainful workers, then, is 82% of 26,000. The free white male farm workforce was derived as a residual, again following Lebergott's method. The residual is simply the difference between the total number of white workers and those engaged in navigation, urban, rural nonfarm occupations. Each of these was estimated independently by Lebergott. I have accepted his estimate of navigation employment (50,000), and followed his procedures to derive the other two but obtained different figures.

The revised urban estimate differs from his because I have used different urban population estimates, and a different participation rate for males aged 10–14 years. I used the 1800 census data to construct the urban/rural distribution for each age and sex category of the white population, while Lebergott used the 1790 census evidence for five cities (p. 135). The disaggregated evidence of the 1800 census shows that only 7.3% of the free males aged 16 and over, and 5.5% of those aged 10–15 years lived in cities, figures noticeably below the 9.1% figure used by Lebergott. My urban workforce statistic is lower as well, because I used a participation rate of .182 for males aged 10–14, while Lebergott used the much higher rate (.872) more pertinent to those aged 15 and over.

The rural nonfarm figures differ because I revised the ratios used to derive the number of workers. It appears that Lebergott multiplied the male population 10 years and over by a ratio of rural nonfarm workers to males over 15. I have adjusted the ratio (derived from the 1840 census data) to relate to males 10 years of age and over. Additionally, I excluded Virginia from the calculation on the grounds that in 1840 it showed a substantially higher ratio (22.2%) for the numerically important category of manufactures and trades than that in any other southern state, or for the United States (16%). Thus I used a ratio of 11% instead of the 17.6% used by Lebergott. The exact calculation of the ratio was

11.7%, but I rounded down to allow for the fact that the 1840 census worker counts included some females and slaves (United States Census 1900, p. xxx; United States Census 1940, pp. 373–74).

Lebergott does make important distinctions between farmers and farm laborers, but these are for use in assessing the results, and are not necessary to derive the workforce itself.

An alternative estimate of 533,000 free male farm workers was derived using Paul David's approach. I used his balance equation, his two assumed ratios of family heads to rural nonfarm workforce (.56) and farm labor to farmers (.4), and the same figure for navigation employment used by David and Lebergott. I substituted my revised figures for white male workers, urban white male workers, and free colored in farming, and also adjusted the number of white family heads used in the balance equation. This last revision has a decided impact on the results. Since this estimate was not used the details are presented in another section of the appendix.

Finally, the free farm workforce in 1810 and 1830 was estimated. Lebergott calculated his figures for these years as 150% of the number of free farmers (p. 155–56). The number of free farmers was apparently estimated on the basis of the ratio of farmers to rural white families in other years. This required that he derive a breakdown of the free farm workforce between farmers and laborers in these other years. I have chosen a more direct approach, bypassing the derivation of the farmer-laborer breakdown. I simply calculated the ratio of the free farm workforce to rural white families for the years 1800, 1820, 1840, 1850, and 1860; and estimated the 1810 and 1830 ratios by interpolation. In fact I used the mean of the ratios for the immediately adjacent years. The data are summarized in table 12.A.4.

Alternative Estimates of the Farm Workforce, 1800

Paul David's revisions of Lebergott's figures included an alternative approach to estimating the industrial distribution of the workforce. His idea was to avoid making a direct estimate of the rural nonfarm workforce based on assumptions about the temporal stability of the relationship between nonfarm employment and population (1966, p. A-11). He preferred to use a balance equation, which enabled him to specify selected parameters about the workforce and its distribution, and then simultaneously solve for the number of rural nonfarm workers, white male farmers, and farm laborers.

In order to solve the equation, he had to have estimates of six items: the total white male workforce; the white male urban workforce; those engaged in navigation, fishing, and whaling; white male rural heads of families; free colored male farmers; and free colored male farm laborers; and he had to assume values for two ratios, the ratio of heads of

Table 12.A.4   **Estimating the Free Male Farm Workforce (Thousands) in 1810 and 1830**

Year	Rural White Families[a] (1)	Free Males in Farming[b] (2)	Ratio Col. 2 ÷ Col. 1 (3)
1800	700	783	1.119
1810	947	1,117 (est.)	(1.179)[c]
1820	1,274	1,577	1.238
1830	1,685	1,862 (est.)	(1.105)[c]
1840	2,223	2,160	.972
1850	2,945	2,587	.878
1860	3,978	3,570	.897

[a]Lebergott's worksheets. My 1800 figure differs from his (708,000) because I divided the total number of families between urban and rural on the basis of the distribution of free males 16 and over. The rural share is 92.7%.

[b]The figures for all years except 1810 and 1830 are discussed in the preceding notes and are presented in table 12.A.3. The figures for 1810 and 1830 were derived using the interpolated ratios contained in col. 3.

[c]These figures are the means of the values in the two adjacent years.

families to white males among the rural nonfarm workforce, and the ratio of free farm laborers to free farmers.

The balance equation can be expressed in reduced form to solve for the number of rural nonfarm workers, X. Once that value is known, one can subsequently derive the number of white farmers and the number of farm laborers. The current workforce revisions include changes in a number of the input values, so the equation must be recalculated. The equation, the variables, the input values, and the solutions are presented in table 12.A.5 for the original and revised versions.

While five of the estimated inputs take on different values in the revised version, the one of significance is that for white, male rural family heads (658,000 vs. 610,000). Both of these figures rest on Lebergott's estimate of 755,000 white families in 1800 (p. 135). Assuming that the 87.2% participation rate for free white males applies to this group gives a total of 658,000 white heads of families in the workforce. This would appear to be how Paul David obtained his figure. However, this figure includes those family heads engaged in navigation or urban occupations, and an estimate of their number must be deducted to obtain the number of rural heads of families. I have assumed that family heads were distributed between urban and rural areas in the same proportion as males 16 years and over (United States Census 1800). This gives a rural share of 92.7%, or 610,000 white, rural heads of families in the workforce. This leaves 48,000 nonrural heads, and for this group, an implicit .38 ratio of heads to workforce. Lebergott's

Table 12.A.5   **Balance Equation Estimates of the Farm and Rural Nonfarm Workforce United States, 1800 (Thousands of Workers)**

	David's Values	Revised Values
Estimated inputs		
T = white male workforce	1,033.8	1,047
U = white, urban male workers	91.3	75
N = navigation, fishing, whaling employment	50.0	50
H = white, male rural family heads	658.0	610
CF = free colored farmers	8.5	3
CL = free colored farm laborers	45.0	18
Assumed ratios		
hr = family heads/rural nonfarm workforce	.56	.56
fr = farm laborers/farmers	.40	.40
Solutions		
X = rural nonfarm workforce	60	387
F = white, male farmers	624.3	393
L = white, male farm laborers	208.2	140

Sources: David (1966), table A-2; tables 12.4, 12.A.2. The reduced form of the balance equation is

$$X = \frac{T - U - N - H - fr(H + CF) + CL}{1 - hr - fr \times hr}$$

White farmers $(F) = H - .56X$.
White farm laborers $(L) = .4 (F + CF) - CL$.

original figures implied a .34 ratio. Both of these ratios are below the .56 ratio David assumed for rural nonfarm families. An alternative approach would be to assume that the .56 ratio applied to this group, but this would reduce further the number of rural heads and the farm workforce.

The revised calculation showing 387,000 rural nonfarm workers, implies as well that the farm share of the workforce was only 62.4%, a figure which seems much too low. The result is of course influenced by the assumed ratios, and since the workforce figures have changed, these should probably change as well. Obviously one could alter these ratios to produce reasonable results, but I have not done so. Instead, I have explored the sensitivity of the estimates to changes in selected parameters. My judgment is that the results are very sensitive to changes in selected parameters, and therefore one must be very cautious about accepting figures obtained by this method. A summary of the sensitivity experiments is presented in table 12.A.6.

None of the input changes are extraordinary, all being based on some piece of evidence or imputing a tolerable error to the input variable. Consider just a few examples. An error of only 5% in the estimated number of rural family heads would lower David's figure from 658,000 to 625,000 and reduce the farm share of the workforce by 13 percentage

Table 12.A.6   Sensitivity of the Balance Equation Method of Estimation

	David's Figures		Revised Figures	
	Rural Nonfarm (Thousands)	Farm Share (%)	Rural Nonfarm (Thousands)	Farm Share (%)
Base values (table 12.A.5)	60	83	387	62
New values of selected parameters				
Rural heads				
658,000 (David's base)	60	83	76	81
610,000 (revised base)	371	64	387	62
634,000 (midpoint; 4% change)	215	74	232	72
Head/worker ratio				
.3 (Lebergott: rural nonfarm)	22	85	144	77
.71 (David: farm sector)	2,150	− 40	13,940	− 755
.73 (David: white male workforce)	− 586	121	− 3,803	315
Laborer/farmer ratio				
.3 (arbitrarily lower)	293	69	533	54
.52 (Lebergott)	− 451	113	67	82

points. At certain levels, changes in the ratios produce bizarre results. If the head/worker ratio is set at .71, the ratio implicit in David's farm figures, the rural nonfarm workforce exceeds the total labor force. A further rise to the .73 ratio implicit in his total workforce data gives a negative number (David 1966, p. A-14, A-19, and tables 12.A.2, 12.A.3). Likewise a positive to negative swing occurs when the laborer to farmer ratio changes within a narrow range between David's ratio (.4) and the .52 ratio noted by Lebergott. Indeed, the rural nonfarm workforce becomes negative when the ratio equals .42.

Appendix B
Census Evidence on Fifteen-Year-Old Workers

There has long been ambiguity surrounding the census age coverage of gainful workers reported in 1850 and 1860. The odds are that the uncertainty regarding the inclusion of 15-year-old workers originated at the time of the census surveys and has persisted to the present. The exact treatment of these 15-year-olds was not crucial to the present workforce estimation, but since I did treat this group as being included in the census count in those years, it seemed pertinent to present some evidence in support of that decision. Moreover, since such data were

not previously available, the evidence may be of interest in its own right to some other researchers.

There are two sets of data. The first (table 12.A.7) is a random sample of rural, northern households taken from the 1860 manuscript census (Bateman and Foust 1976). The sample is representative of the region, and not necessarily each state. I have reported the results on a state basis to suggest the possible variation that may have prevailed. The second body of evidence (table 12.A.8) is a less systematic collection of data from the censuses of 1850 and 1860. That evidence was taken from manuscript schedules that were readily at hand, and was not compiled as a representative sample of any state or region. Thus that evidence is presented by county, or counties in some cases, for which it represents a 100% sample. Its chief merit is that it contains data for 1850.

Both sets of data make clear that 15-year-olds were recorded as workers and that some of these youths were classified as farmers, not merely farm helpers. Moreover, it is also clear that females were included in the 1860 census count. Indeed, the search of the 1850 schedules also turned up four females, aged 15, who reported occupations.

Table 12.A.7   Random Sample Evidence on 15-Year-Old Workers, 1860

State	Sample Sizes		Percentage with Occupation		Distribution of Those with Occupations		
	Males	Females	Males	Females	Farmer	Laborer	Other
Connecticut	10	9	20%	11%	0	0	100
Illinois	96	91	16	21	3	44	53
Indiana	332	301	29	7	37	46	17
Iowa	47	53	45	25	12	29	59
Kansas	34	30	18	0	67	33	0
Maryland	41	30	15	3	0	57	43
Michigan	75	73	63	45	13	38	49
Minnesota	16	14	25	7	40	0	60
Missouri	68	68	40	9	27	52	21
New Hampshire	21	36	43	8	0	58	42
New Jersey	9	16	33	6	25	0	75
New York	192	194	60	46	0	55	45
Ohio	58	45	59	31	0	72	28
Pennsylvania	160	139	28	7	32	42	26
Vermont	9	8	22	25	0	75	25
Wisconsin	24	31	0	3	0	0	100
Totals	1,192	1,138	36	19	14	48	38

Source: Bateman and Foust (1976).

Table 12.A.8   Unsystematic Evidence on 15-Year-Old Males, 1850 and 1860

County, State	Sample Size	Percentage with Occupation	Distribution of Those with Occupations (%)		
			Farmer	Laborer	Other
1850					
Washington, White, and Yell, Arkansas	253	18	20	72	9
Frederick, Maryland	405	27	21	58	21
Rockingham and Rowan, North Carolinia	214	29	8	82	10
Venango and Warren Pennsylvania	336	33	65	15	19
Grant, Wisconsin	131	56	44	29	27
1860					
Frederick, Maryland	413	31	1	79	20
Warren, Pennsylvania	156	42	59	8	33
Grant, Wisconsin	289	66	—	51	49

Source: Manuscript census schedules.

Note: The 1850 results include 4 females, aged 15 years, who reported occupations. For 1860, when females were to be counted we found 104 females aged 15 years who reported occupations; 27% of all 15-year-old gainful workers.

The evidence also shows great variation across states. For males the rates range from zero in Wisconsin to 63% in Michigan, while for females the range is zero (Kansas) to 46% (New York). Such wide variation suggests that the inconsistencies of census enumerators might have been at work, as well as real economic behavior; although the 1900 evidence also indicates a wide range of rates, 20%–72% for males and 4%–47% for females (Miller and Brainerd 1957, table L-3).

Notes

1. For 1860 Lebergott estimated the slave workforce state by state, using the 1850 participation rates for free males. David assumed that the weighted average would approximate 87.2%, but in fact it equaled only 86%. The consequence is that David's revision for 1860, as well as Lebergott's original estimate, is still inconsistent with other years.

2. For example, Lebergott relied on the 1949 edition of *Historical Statistics,* a source that has been revised and expanded twice since then.

3. In several years, 1820, 1840, and esp. 1850 and 1860, the census provided data on the workforce, which enabled more direct estimation of free males aged 16 years and over.

4. The mean rate of 36% for males is above the 25% figure used by Lebergott. This surely reflects the fact that this sample evidence pertains to rural areas where the work-force participation of farm children would give an upward bias. On the other hand, the sample data exclude the South, where the participation rate for children was typically above that for the nation.

5. The 1900 data suggest that the inclusion of 15-year-olds lowers the participation rate by about 1.5 percentage points. The rate for those 16 and over was 90.7%. Using a participation rate of 43% for 15-year-olds (the rate which prevailed for 14- and 15-year-olds), the rate for those 15 years and over would have been 89.2% (Miller and Brainerd 1957, tables L-1 and L-2). If the 1850 census undercounted 15-year-old workers, the derived participation rate of 87.2% would further underestimate the number of workers 16 years of age and over.

6. I used a rate of 18.2% for those aged 10–14 years. In order to make the comparison for the 10–15-year group I used the 87.2% figure for 15-year-olds. The implied rate for the combined group aged 10–15 is 27.7, slightly above the figure of 25 used by David.

7. I have used an estimate of 63,000 females, the same figure used by David. There is some ambiguity surrounding this estimate as 13,000 domestic servants may be included with females or rural nonfarm male workers (Lebergott 1966, p. 136).

8. The revised slave figures, as well as the original ones, differ from Paul David's estimates of slave workers for 1820 and 1840. This is because he revised Lebergott's slave figures in light of text statements that the participation rate used was 87% in those years. However, the text was wrong, and the figures required no such upward revision.

9. The error raises serious doubts about this method and the estimate. The error arose because the method yields a negative number of female workers in several states (namely, Illinois).

10. In 1860, the estimate includes some unspecified number of females who were recorded in the census figures. The same is true for 1820 and 1840, and thus in 1810 and 1830 by interpolation.

11. Lebergott estimated the 10–15-year-olds in agriculture as 17% of the male population in that age group. Since 15-year-olds were counted in the census, this calculation resulted in an overcount of 44,000. For those 10–14 years of age, the revised calculation used a lower overall participation rate (18% vs. 25%) and thus a lower agricultural participation rate (14.4% vs. 17%). This resulted in 42,000 fewer farm workers aged 10–14 years.

12. The 1800 census also yields a lower urban share of the slave population (3.1 vs. 5.0). I have not used this revision as it would make the 1800 slave figures inconsistent with other years.

13. Paul David quite correctly asks whether the 1840 southern evidence is represen-tative of conditions in 1800 (1966, A-11).

14. It is certainly true that some free colored females were employed in farming, but conceptually the estimates were to exclude females (Lebergott 1966, p. 139). It would be easy enough to add an appropriate number of free colored females once one had a reasonable estimate of their participation rate. I have estimated that the free colored female population included 9,000 aged 10–15 and 31,000 aged 16 and over. Using the male participation rates yields 28,600 workers, with 5,100 in urban areas and 23,500 in farming.

15. Extrapolation of the post-1870 ratios of urban laborers, not otherwise specified, to urban population would yield 664,000 rural laborers, n.o.s. in 1860 and 718,000 in 1850 (Weiss 1975, p. 108). The addition of these workers to the farm workforce would raise the farm shares to 62.3% in 1850 and 58.6% in 1860. Since this would raise the 1850 share above the 1840, the adjustment appears excessive. Nonetheless, it does suggest that the farm figures for these years may be substantially underestimated.

16. According to Lebergott, "examination of the unpublished Census schedules for 1820 and 1840 indicates [females] were not included in those years," so the only problem may be the inclusion of free nonwhite females in 1860 (1966, p. 139).

17. Assuming that the estimate of 158,000 (table 12.4) includes urban as well as rural, and in the same proportion as males 16 years and over, then the figure should be reduced by 11,500 workers and the farm sector increased by that amount.

18. The sensitivity of that approach can be seen in the results derived by revising the number of rural family heads used in the calculation. David used a figure of 658,000 which is that for all gainfully occupied family heads (87.2% × 755,000 heads). This figure includes heads of families engaged in navigation and urban occupations. By adjusting the figure to include only rural heads of families (610,000) the resulting solution for the rural nonfarm workforce is 387,000 instead of 60,000; and the farm share falls from 82.7% to 62.0%. This is discussed in greater detail in the appendix.

19. The revised growth rates were derived using David's formula, the present workforce estimates and David's other input data, some of which (e.g., farm productivity index) had to be revalued in light of the workforce changes (David 1967, table 1). David has revised his conjectural estimates of growth to 1.1% per year (1977, p. 194), a figure identical to the present calculation. The change, however, reflects the use of a broader measure of GDP, and if that broader measure were used in the present calculation, presumably the result would be a rate below 1.1%. The comparison of the present calculation of 1.09% and the original value of 1.27% more accurately suggests the impact of the workforce revisions.

Comment   Stanley Lebergott

Weiss's paper divides into two parts, "revised estimates" and "implications."

Revised Estimates

His revisions in my published estimates are readily summarized:

Percentage Revisions in
Lebergott Estimates[1]

	By Thomas Weiss			By Paul David		
	Labor Force			Gainful		
Year	Total	Slaves	Agriculture	Workers	Slaves	Agriculture
1800	− 1%	− 1%	10%	*	+ 3%	*
1810	1	*	− 8	*	*	*
1820	*	1	*	1	3	*
1830	*	*	*	*	*	1
1840	*	*	*	1	3	1
1850	*	*	− 3	*	*	*
1860	*	5	− 2	1	3	1

*Under 1% (includes zero).

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1. Lebergott (1984, p. 66). An earlier version Lebergott (1964) and Volume 30 of the proceedings of this Conference had an arithmetic error for the 1800 labor force, noted in 1967 by Paul David. See Weiss, table 11.1, note a.

Surely this is very small beer indeed. (Weiss's few noticeable changes, for agriculture, far exceed the 1%—or smaller—revisions proposed by David.)

Implications

His numbers may carry "important implications for our understanding of long-term economic changes in productivity." But Lady Cotton's question does come to mind. (Her husband—a sixteenth-century luminary and amateur scientist—once inspected a dusty object; wondering whether "it was Moses shoe, or Noah's, wond'ring at the strange Shape and Fashion of it: But 'Mr. Cotton,' says she, 'are you sure it is a shoe?' ")

Weiss is sure that his "revisions in the farm workforce do imply notable differences in farm productivity." Indeed, they do differ from the estimates by Robert Gallman.[2]

Factor Productivity in Agriculture
Annual Rate of Change

Years	Gallman (1975)	Weiss (1984)
1800–1850	+.14	+.43
1850–1900	+.80	+.49

That Gallman increased my 1850 farm worker figure by 600,000, while Weiss reduced it, partly accounts for their differing productivity estimates.

How did Weiss arrive at a surgically precise (3%) revision in the 1850 number of persons in agriculture—more than a century and a quarter ago? He outlines no procedure, but does cite two sources. One proves to be a collection of narratives to WPA interviewers by ex-slaves, some 70 years after slavery ended. The other source appears to be what he terms his "unsystematic sample."

2. Since reference to Gallman's (1975) work has been struck from Weiss's revised draft, I may usefully cite it. Weiss has retained the workforce estimates he presented at the conference, and description of his productivity estimation appears to be the same. The estimates he presented there presumably serve as basis for his assertion that they "alter our perception of development in the antebellum period." Weiss originally emphasized the strength of his work by noting that these productivity rates were much the same 1800–1850 and 1850–1900 as Gallman's 1971 work suggested, but unlike David's 1967 study. We cite Gallman's later work.

Without commenting on Gallman's 1975 farm productivity study, he goes on to the broader topic of total productivity, as treated by Paul David (1967).[3] Since his changes in the farm totals may yield compensating changes in the nonfarm totals of a fixed population, Weiss's "implications" may prove premature.

Some recognition is due to the many words and numbers Weiss presents for 15-year-olds. They lead to an unwarranted adjustment in my estimates (and those by others).[4] The adjustment rests on his unsupported guess that the occupation tables in the 1850 census, and the 1860, were incorrectly labeled (and incorrectly labeled by Walter Wilcox, Wesley Mitchell, and Alba Edwards in 1900 when summarizing the historic occupation record).

That improbable assumption rests on his discovery that some enumerators reported occupations for 15-year-olds. But since Jefferson American censuses have had editing and transcription instructions, plus review procedures—all to select, adapt, and correctly summarize the original enumerator schedules. We need a stronger basis than guess to conclude that the reported census figures for those "over 15 years of age" incorrectly include those aged 15.

One awaits with interest further work by the National Bureau of Economic Research project of which this study is part.

Reply   Thomas Weiss

Lebergott makes three points about my paper, and I shall address each in turn.

His first point, that my effort produced few noticeable changes, simply underscores my main conclusion. My wording, that "Lebergott produced a carefully constructed set of figures," is not quite as eloquent as "this is very small beer indeed," but the point is the same. We can have some faith in our existing body of knowledge. It seems to me

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3. David has since superseded his 1967 estimates.

4. No economic historian, old or new, has devoted so much attention to their role in the nineteenth-century labor force. His original table 12.A.8, labeled "unsystematic evidence on 16-year-old workers in 1860," is now accompanied by a table termed "Random Sample Evidence. . . ." Is the "random sample" evidence preferable? One would think so. But his estimates have not changed from the earlier paper, which presented only the "unsystematic evidence." Moreover, his "random sample totals" for 15-year-old males imply that 28% of them lived in Indiana. (The census locates fewer than 5% of United States 10–15-year-olds there.)

helpful that these assurances come from someone other than the researcher who produced the original figures.

His second point is that my revised agricultural figures are questionable. He is particularly skeptical about the 1850 revision, suggesting that I did not outline my estimating procedures and based my revisions on two unworthy sources, ex-slave interviews and an unsystematic sample. Obviously, my presentation must be unclear.

I cited the WPA interviews of ex-slaves only to suggest that more slaves worked at nonfarm tasks than was implied by his estimation. I did not use this evidence to reduce the estimate of agricultural slaves. Nor is the 3% difference in our estimates due to the use of an unsystematic sample of 15-year-olds working on farms. That evidence, along with a random sample containing similar information, was presented only for the purpose of showing that 15-year-old workers were already included in the census counts of 1850 and 1860.

Our 1850 farm figures differ because we used different participation rates for rural slaves. In the former case, Lebergott used the participation rate for those aged 10–15 years, while I used the more appropriate rate for those aged 10–14 years. My rate was not taken from the sample data, but from the same source that Lebergott obtained his figure, namely, the census of 1900. In estimating the slave farm workforce I used a farm participation rate for rural slaves of .87 instead of the .90 he used. This lower rate was not taken from the slave reminiscences, it was taken from Lebergott! He argued in his original article that the .87 figure would allow for those rural slaves engaged in nonfarm tasks. Unfortunately, and unbeknown to Lebergott, his research assistant did not agree and used the higher figure. In my opinion, it is these sorts of changes that make the revised figures more consistent and precise.

Finally, Lebergott sees little value in the evidence on 15-year-old workers (contrary to what he says, there is no evidence on 16-year-olds). I am sure he is correct in claiming that no economic historian has devoted so much attention to this group of workers. My reason for devoting any attention to them is simply to straighten out the record. As far as I can tell, all previous researchers, including Lebergott, David, and myself, behaved as if 15-year-old workers were not included in the census counts of 1850 and 1860. The fact of the matter is that they were included, and I am willing to admit I was wrong. I presented the evidence not only because it shows that 15-year-old workers were included in the census count, but also because it contains other information that might be of use to other researchers. Lebergott has, however, simply misinterpreted the evidence and my use of it.

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