NBER WORKING PAPER SERIES
ON
HISTORICAL FACTORS IN LONG RUN GROWTH

ECONOMIC GROWTH BEFORE 1860: REVISED CONJECTURES

Thomas Weiss

Working Paper No. 7

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
October 1989

The research reported here is part of the NBER's research program in Development of the American Economy. Any opinions expressed are those of the author not those of the National Bureau of Economic Research.

NBER Working Paper #7
October 1989

ECONOMIC GROWTH BEFORE 1860: REVISED CONJECTURES

ABSTRACT

The current view of U.S. economic growth before 1860 is based on the conjectural estimates of output made by Paul David (1967). This paper sets forth new estimates of the farm labor force for the period 1800 to 1860 and uses them to revise those conjectures about growth of per capita output. An additional conjectural estimate is produced based on recent evidence about manufacturing productivity.

The new estimates lower the farm labor forces in the years before 1830 by 10 to 15 percent, while raising the figures for 1840, 1850, and 1860 by 5 to 9 percent. As a consequence the farm work force grew more rapidly than was previously believed, and farm productivity grew more slowly. The impact of the revisions varied by subperiod, and is concentrated almost entirely in the middle 20 years. Because the advance in farm productivity was the major determinant of change in the conjectural estimates of per capita output, that series shows a slower rate of growth as well, especially over the period 1820 to 1840. A refined estimate, which incorporates the recent evidence on manufacturing productivity, alters the picture somewhat, but still shows slower growth and more gradual acceleration of output per capita than is revealed in the David series.

Thomas Weiss
Department of Economics
University of Kansas
Lawrence, KS 66045

Economic historians have long been interested in determining when modern economic growth began in the United States, whether the shift to a high rate of growth was a sudden or gradual affair, and what caused growth to proceed at a faster pace. It is generally accepted that the transition occurred before the Civil War, but there is disagreement whether this took place before or after 1840.[1] The current view of this transition is based on the set of controlled conjectures of Paul David (1967). Those estimates of per capita output for the period 1800 to 1840 revealed an average annual growth rate of between 1 and 1.5 percent; an enviable performance, albeit not quite as good as the rates achieved after the Civil War.[2] For longer term changes, those of 20 years or more, he found that "no significant acceleration of the secular trend in real GDP per capita took place within the period of our national history that preceded the Civil War." (p.157).[3] Instead of a take-off, the "acceleration of per capita real income growth to a higher secular rate was a much more gradual affair." (1967, p.195)[4]

David acknowledged that the performance before 1840 was not steady, and that "Most of the net gain between 1800 and 1840 was thus a consequence of an impressively rapid rate of advance achieved after 1820." (p.155) This is quite evident in the figures reproduced in Table 1. The average annual rate of growth was only .25 percent per year in the opening twenty years of the century, and then rose to 1.96 percent in the next

two decades.[5]

Recent revisions of the U.S. labor force statistics and new estimates of manufacturing productivity advance require that the course of growth in the years before 1860 be reexamined. In what follows, I first consider the consequences of the alterations to the labor force figures, and then present a further refinement based on the new productivity evidence for manufacturing. The figures on the levels and changes in per capita output produced by the new labor force series are presented in Table 1, along with David's original estimates for comparison. At this point let me just note the key differences in the results and return to these substantive issues below, after the more refined series is described.

First, the levels of per capita product implicit in the revised conjectures are above David's in each year, except the base year of 1840. The new figures are roughly 25 percent above David's in the years 1800 through 1820. The new output estimates seem far more reasonable than the previous ones in light of the higher levels and slower changes in the nonperishable residuals shown in the Table.[6]

Second, the two series offer different perspectives on the course of growth in the antebellum period. In the new series growth was slower overall and exhibited more gradual acceleration from the slow pace of the colonial era to a more modern rate of advance. David's figures indicate that for much of the period before the Civil War, U.S. per capita output grew

nearly as fast as after. Over the entire antebellum period the David series yields a cumulative increase of 113 percent (1.29 percent per year), well above the 71 percent rise (.90 percent per year) in the Weiss figures. According to David's estimates the nation had reached its modern rate of growth long before the Civil War; from 1820 onward the antebellum record was nearly identical to the postbellum, doubling every 40 years. In the new series there is a greater distinction between the ante and postbellum records, and in that former era the rate in each twenty year period exceeded that of the preceding two decades, suggesting quite clearly that the United States experienced a gradual acceleration in the growth of per capita income during the antebellum period, rather than a sharp, sudden increase.

Third, while the two series imply dissimilar stories about the entire antebellum period, the difference rests entirely on the subperiod 1820 to 1840. There is no difference between the two series regarding the growth of per capita output between 1840 and 1860, because both series are based on Gallman's direct measures of output, and we show very similar results for the earliest 20 year period, 1800 to 1820. The levels of output per capita differ, but the rates of growth are equal and low.

Accounting for the Differences

The sources of the different behavior of the economy described by the two series can be traced in one way or another

to the revisions made to the labor force estimates, especially the farm figures.[7] The importance of the labor force figures can be seen in Paul David's conjectural estimating equation for that early period.[8]

$$O/P = LF/P * [S_a*(O/LF)_a + S_n*k(O/LF)_a]$$

According to this, output per capita (O/P) in any year is equal to the product on the right hand side of the equation, the participation rate (LF/P) times the weighted average output per worker. Given the specification, only three factors bring about changes in output per capita; changes in the participation rate, changes in agricultural output per worker $(O/LF)_a$, and shifts in the distribution of the labor force between agriculture (S_a) and nonagriculture (S_n). The labor force estimates affect each of these factors. The total labor force determines the participation rate, while the size of the farm labor force has an obvious and direct effect on measured farm labor productivity.[9] At the same time, estimates of the changes in the industrial allocation of the labor force have an effect on the overall level of productivity because of the differences in the levels of output per worker in the farm and nonfarm sectors.[10]

Methods of Estimation

For the most part, my estimation of the labor force

follows the procedures laid out by Stanley Lebergott, but is executed at the state and regional level.[11] In concept and coverage, the new total and farm labor force series are similar to Lebergott's and David's. Indeed, as will be seen, the levels and changes in the total labor force are nearly identical in the two series.[12] The farm figures differ more, but share in common that they are based largely on the existing census statistics. While imperfect, these census counts were collected at specific dates during the antebellum period so represent the actual state of affairs, capturing the economic realities of the time.[13]

Both Lebergott and I assessed and revised the census data for 1820, 1840, 1850, and 1860.[14] While he focused primarily on the national totals, I examined each state, and was concerned as well with the accuracy of the major demographic components of each state's labor force. My work has produced a clearer picture of the age-sex coverage of each of those censuses, which in turn has permitted a more reliable revision of the labor force data.[15] In addition, for 1820 and 1840, it was possible to use the revised census data to estimate the number of slaves engaged in farming, and to derive the urban and rural labor forces in several industries.[16] All these improvements in accuracy and detail provided a better statistical base with which to estimate the farm labor force in 1800, 1810, and 1830. There are three aspects of my estimation which differ substantially from the earlier work of

Lebergott, Easterlin, and David. In all years the new estimates incorporate a smaller number of slaves in farming, roughly 75 percent of the rural slave population of working age as opposed to the previous estimate of nearly 90 percent (Weiss, 1987b). In 1850 and 1860 this downward bias is more than offset by the addition to farming of workers who had reported their occupation as "laborer, not otherwise specified." Previous estimates had placed all these workers in nonfarm industries, but careful examination of the state data, and the location of many of these workers in rural areas, argues for the assignment of many of them to farming (Weiss, 1987c). In 1820 and 1840 the new estimates differ from the older ones because of varying judgments about how to correct the census deficiencies. In 1840, I raised the census count of farm workers by about 5 percent, while Lebergott reduced it by about the same margin. For 1820, we both increased the census count of the total labor force by approximately the same amount, but Lebergott allocated nearly twice as many of these added workers to agriculture. Since the original census count was low primarily because of the exclusion of workers in the service industries, a large allocation to farming seems inappropriate.

While the new estimates of the farm labor force were constructed at the state and regional level, a by-product of the careful estimation of the state labor force figures has been an alteration, and I believe an improvement, in the accuracy, of the national totals. The new estimates are

presented in Table 2, along with the Lebergott-David series for comparison.[17] As can be seen readily, the total labor force figures differ very little, the Lebergott-David series being below the present one by 1 to 2 percent in most years. The farm figures differ much more, and the variations are not all in the same direction.

The new farm figures are higher than the previous ones in 1840, 1850, and 1860, by a fairly uniform percentage; 7 percent in 1840, 9 in 1850, and 5 in 1860. While the levels of the two series differ, they show roughly the same growth over the period, as well as over each of the two decades. This is true for both the absolute increases in numbers of workers and the percentage changes. In sharp contrast, the new national totals for 1800 through 1820 are below the previous figures by approximately 10 percent in 1800 and 1820, and by 15 percent in 1810. In spite of these disparities, the two series show very similar changes over the earliest 20 year period; an increase of 76 percent in the new and 78 percent in the Lebergott-David figures.[18] The most notable consequence of these revisions shows up in the years 1820 to 1840, over which time the new series shows an increase of 72 percent (2.77 percent per year), in contrast to a rise of only 45 percent (1.86 per cent per year) in the old series.

An overall assessment of the two alternative series can be accomplished by comparing the rate of decline of the farm labor force share to that of the rural population share.[19] As can be

seen in Table 2, the farm share declined at about the same rate in both series over two of the twenty year subperiods, 1800 to 1820 and 1840 to 1860. During those intervals the rural share of the population declined at annual rates of .06 and .57 respectively. In both periods the farm share decline slightly faster than the population share. In the period 1820 to 1840, however, the series diverge noticeably. While the rural population share declined by .20 percent per year in that period, the Weiss series declined slightly faster at .32 percent year, but the Lebergott-David farm share declined by 1.09 percent per year. The greater conformity between changes in the rural population and the farm labor force in the Weiss series provides some confidence in the new figures.[20]

Productivity and Sources of Growth

A summary of the course of labor productivity over the antebellum period, as revealed by the two different labor force series, is presented in Table 3. Two measures of productivity are shown. One describes the path of agricultural productivity advance, and by assumption reflects the rate of nonfarm productivity growth; the other, total output per worker, measures the combined effect of intrasectoral advance, and the intersectoral shift of workers toward the more productive nonfarm sector. The most obvious consequences of the new labor force estimates are to raise the levels of output per worker in farming in the opening decades of the century, and lower them

in the late antebellum period.

At the national level, the growth in output per worker is similar in the two series in two of the twenty year subperiods, 1800 to 1820 and 1840 to 1860. In the remaining subperiod, however, productivity growth is much more rapid in the Lebergott-David series than in the Weiss estimates. As a consequence, over longer time spans that encompass this subperiod, the older labor force series produces a noticeably faster rate of productivity growth than does the new one; for example, .78 versus .52 percent average annual increases between 1800 and 1860. The higher rate means a cumulative rise of 59 percent, in contrast to an increase of only 36 percent in the Weiss series.

The sources of growth in per capita output are now slightly different than those that generated David's figures (See Table 4). In both series, the rise in the participation rate is the least important source, except for the earliest twenty years when little growth took place. For the entire period this factor is relatively more important in the new series, reflecting that the rise in the participation rate is nearly the same in both series, and that the new series shows a smaller increase in output per capita. The effect of the labor force redistribution is roughly the same in the two series, a consequence of two offsetting forces. A major alteration of the present series is to lower the farm share of the labor force in the earliest years, raise the share slightly after

1840, and in consequence show a smaller shift of the workforce out of farming (19 percentage points versus 29 in the Lebergott-David series). The impact of the redistribution of the work force is about the same in the two series because the weight given to the redistribution is larger in the present case.[21]

The result of most consequence is that the growth of labor productivity was more important in David's series than in the present one. Even in this regard, there is little disparity between the two series regarding the performance over the years 1800 to 1820 or 1840 to 1860. In the latter period the levels of output per worker are different, by approximately 7 percent, but their growth is identical (.99 versus 1.02 percent per year). Likewise, we show very similar results for the earliest 20 year period, 1800 to 1820. Again the levels of farm output per worker differ, but the rates of growth of productivity are equally low.

In the middle 20 years, however, the differences are glaring, and give rise to dissimilar results for the longer period of 1800 to 1840. In this critical 20 year period, the new series shows much slower growth of output per worker (.48 vs 1.34 percent per year), stemming from the faster growth of the farm labor force evident in the new series (2.74 vs 1.86 percent per year), and the corollary phenomenon of a smaller decline in the importance of the farm labor force (See Table 2).[22] The latter is no minor matter because in the David

series, the workforce shift over this period generated more growth of per capita product than occurred in total in the present series. Still, the key issue has to do with the behavior of farm labor productivity.

It is not just that the David series shows a much more rapid growth in productivity over this period than does the new evidence, but its performance relative to the subsequent 20 years is at issue as well.[23] Given the time pattern of advance in the two series, at issue is whether agricultural productivity grew faster in the 20 years before 1840, as in the David series, or in the 20 years after, as implied in the new estimates.

The absence of data on productivity requires that we form an opinion on less direct evidence. Paul David turned to wage data to assess his estimated index of farm productivity, and found "a fair resemblance..between the magnitude and timing of the changes" in the two series. That evidence showed average annual wage rate increases between 1818/20 and 1840 that corresponded roughly to the change in his growth index (1.84 vs 1.35 percent per year). That same evidence, however, revealed an acceleration in real wage increases to 2.01 percent per year over the next two decades, implying that labor productivity increased more rapidly in those years as well.

This shred of quantitative evidence is fortunately consistent with what Gallman termed "the burden of the narrative histories of the period," and with other scraps of

descriptive information. Perhaps most importantly, that more tangible evidence suggests that there was far greater mechanization after 1840. According to Towne and Rasmussen "The rate of real investment in implements and farm machinery increased markedly in 1845-55 from an average of $11 million a year (in 1910-14 dollars) to $23 million.." (1960, p.261). Their figures for real farm improvements show a 61 percent increase between 1840 and 1860, compared with only 42 percent in the preceding 20 years (Table 1, p.265). Even Cooper, Barton, and Brodell, who paint a favorable view of the period before 1840 contended that "the year 1840 marks the beginning of worth-while results by inventors and experimenters who had been making persistent trials and studies throughout 50 years." (1947, p.6) Leo Rogin's narration of the development of farm machinery makes the same point in exquisite detail.

Institutional developments, as well, argue for more rapid advance in the later decades. There were more agricultural periodicals after 1840, and increased readership; while state agricultural societies, whose purposes were to improve technology and diffuse knowledge, "did not attain widespread importance until the 1840's." (Danhof, 1972, p.60) Moreover, there were no commercial sales of fertilizer until 1843.

Finally, and perhaps most pertinent, is that the different picture of agricultural productivity growth rests entirely on the labor force estimates, and in particular on the different adjustments that Lebergott and I made to the census counts of

farm workers in 1820 and 1840. In 1840, I raised the census count of farm workers by about 5 percent, while Lebergott reduced it by about the same margin.[24] For 1820 we both increased the census count of the total labor force by approximately the same amount, but Lebergott allocated nearly twice as many of these added workers to agriculture. Since the original census count was low primarily because of the exclusion of workers in the service industries, a large allocation to farming seems inappropriate.

Variations on a Theme

The preceding comparison between the different conjectural estimates of per capita output was intended to show the impact of the labor force revisions, and so retained the estimating procedure and equation as laid out by Paul David. Both variants made use of the assumption that productivity in the nonfarm sector grew at the same rate as that in farming. David made the assumption in an effort to bias the growth rate downward before 1840 and thus provide a stronger test of the hypothesis that there was a take-off after that date. The intuition that the bias ran this way, that nonfarm productivity must have grown faster than that in farming, seemed plausible, particularly if nonfarm output was taken to be largely manufacturing, an industrial sector that featured the growth industries of the time. That intuition, however, could be misleading for other nonfarm industries. While technological

progress and other favorable conditions in these growth industries served to push up the rates of growth of worker productivity in manufacturing, the same forces were not at work in some service industries important at the time.

Engerman and Gallman have stressed this very point, that productivity for the entire nonfarm sector probably did not exceed that of farming (Engerman, 1967; Gallman, 1971; Engerman and Gallman, 1981). In fact, such was not the case in the period 1840 to 1860 when we have some direct estimates by which to judge the two sectors' performances. The figures in Table 5 show the percentage increases in output per worker over the period for the two broad sectors. It does not matter which labor force series is used, output per worker in farming increased faster, the difference being greater using the Weiss labor force statistics. Part of the reason for this relative performance is that the nonfarm output includes the value of shelter, a product which cannot easily be ascribed to either sectors' labor force, and which increased only about as fast as population after 1840. Whichever sector incorporates this product in its output total will have its growth biased downward.[25] The Table shows the consequence of removing this output from the calculation. Growth of nonfarm-nonshelter output per worker increased faster than the broader nonfarm measure, by about 9 percentage points.

Beyond the bias introduced by the inclusion of the output of shelter, it is debatable whether output per worker in the

remainder of the nonfarm sector could have consistently increased faster than output per worker in farming. The calculations just made shed some light on this but are far from conclusive. With the value of shelter removed, output per worker in the more narrowly defined nonfarm sector grew slightly faster than output per worker in agriculture using the David labor force series, but still somewhat slower using the Weiss figures. Even for this later part of the antebellum period when technological progress in manufacturing and transportation must have had a stronger impact than in earlier years, the verdict is not so clear. Before 1840 the behavior of productivity in the other service industries would have had a greater influence, and could have slowed down the growth of output per worker for the entire nonfarm sector so that it lagged behind that in agriculture.

My refined conjecture, presented in Table 6, drops the assumption of equal rates of productivity growth, an exercise made possible for the years after 1820 by the recent availability of evidence regarding productivity growth in manufacturing.[26] In this version, the nonfarm sector is composed of two parts, manufacturing and all other industries, with different rates of productivity advance in each. Furthermore, I have treated the value of shelter output separately from the product of either industrial sector, and added estimates of its value to the output of those two sectors.

For the earliest 20 years, 1800 to 1820, I retained the assumption that productivity of the nonfarm workers, including those in manufacturing, increased at the same rate as that of farm workers. For the period 1820 to 1840 I assumed that manufacturing productivity grew at 2.3 percent per year, as estimated by Sokoloff.[27] For all other nonfarm industries (except shelter) I retained the original assumption that output per worker grew at the same rate as that in farming. The weighted average rate of nonfarm productivity growth works out to 1.25 percent per year.[28]

This nonfarm figure may still be biased upward slightly. The rate of growth in the manufacturing portion is biased upward because the Sokoloff evidence applies strictly to just northeastern manufacturing, and it is unlikely that productivity in southern and midwestern manufacturing was advancing as rapidly. If it were assumed that manufacturing productivity in those other regions grew only as rapidly as U.S. farm productivity, then the weighted nonfarm rate of productivity advance would be only .99 percent per year. For the all other part of the nonfarm sector, the assumption that productivity advance was equal to that in farming may bias upward the rate of growth before 1840 because service productivity, other than in transportation and perhaps distribution, probably did not advance much.[29]

The results of the refined conjecture depict a standard of living and a pattern of growth that lie between the David and

Weiss versions discussed earlier. (They are shown in Table 6 as the Base Cases). The refined per capita figures are 12 to 21 percent above David's in the years 1800 through 1820, and while they are approximately 10 percent below the Weiss Base estimates they seem high enough to pass Gallman's test of the reasonableness of the implicit flow of non-perishable consumption and investment spending (1971).[30]

The changes in the new residuals imply an income elasticity of demand for non-perishables that is consistent with other evidence for the 19th century. For the period 1840 to 1860, the direct income figures imply an income elasticity of 1.61.[31] For later years, family income studies show cross-sectional elasticities ranging from 1.33 to 1.83.[32] The new non-perishable figures yield an elasticity of 2.1 for the periods 1800 to 1820, 1820 to 1840, and 1800 to 1840. These are somewhat higher than that for 1840 to 1860, and fall slightly out of the upper range of those for the late 19th century. While they do not fare as well as the elasticities implied by the Weiss Base Case they are not unreasonably wide of the mark.

The chief alterations resulting from the relaxation of the assumption of equal productivity advance are, by construction, concentrated in the middle 20 years. The David series showed an annual growth of per capita income of only .25 percent between 1800 and 1820, then a more substantial increase of 1.96 percent over the subsequent 20 year period, followed by a

slightly slower rise of 1.60 percent over the years 1840 to 1860. In the Weiss Base Case, which shows just the effect of using the new labor force estimates, the conjectural growth was also very small in the opening twenty years and then picked up in each of the subsequent twenty year periods. In the refined series the pattern of acceleration still prevails, but there is a noticeable quickening of the rate after 1820. Even still the revised pace of 1.3 percent per year is well below David's figure, and the rate in each twenty year period exceeds that of the preceding two decades.

Over the entire antebellum period the refined series yields a cumulative increase of 92 percent, just about the average of the increases in the two base cases (70 percent in the Weiss series, 113 in David's). There is still a greater distinction between the ante and postbellum records than was revealed in David's series. With an overall rate of growth of 1.1 percent per year the antebellum economy's record falls comfortably between the likely colonial growth rate (.4 percent per year) and the postbellum rate of 1.7 percent.[33]. For the subperiod 1800 to 1840, the growth of .84 percent per year presents a picture resembling the colonial economy even more closely.[34]

The refined estimates reflect a pattern of labor productivity growth different from either of the Base Cases. The growth of total output per worker is now much faster between 1820 and 1840 compared to the Weiss figures (1.07

versus .68), but still slower than David's (1.90). While this pattern of acceleration seems more like David's the source of it is fundamentally different. In David's series the acceleration of total output per worker required a sharp rise in agricultural productivity growth, from virtually 0 percent per year to 1.34 percent, and a substantial effect from the shift of labor toward the more productive nonfarm industries (See Tables 3 and 4). Now the overall acceleration is accomplished with only a mild increase in the rate of agricultural productivity advance from .07 to .45 percent per year, and rests more on the speeding up of productivity advance in manufacturing.

Conclusions

This paper has set forth new estimates of the farm labor force covering the period 1800 to 1860 for the United States. The original intent of the estimation was to produce state and regional series that were consistent with the existing national series. Revisions to the individual state data, however, yielded national figures noticeably different from the previous estimates. In particular, the new estimates lower the farm labor forces in the years before 1830 by 10 to 15 percent, while raising the figures for 1840, 1850, and 1860 by 5 to 9 percent.

These differences in the sizes of the farm workforce are due largely to three factors. First, I increased the farm

labor force in 1850 and 1860, and thus indirectly in other antebellum years as well, by including an estimate of some number of "laborers, not otherwise specified." Second, I produced a different set of estimates of the numbers of slaves engaged in farming, which is based more heavily on the available statistics. Third, I reached different judgments about the deficiencies of each census, and so made corrections that differed in size from those made by previous writers.

As a consequence of these changes, the farm work force grew more rapidly than was previously believed, which implies that farm productivity grew more slowly. The impact of the revisions varied by subperiod, and is concentrated almost entirely in the middle 20 years. Because the advance in farm productivity was the major determinant of change in per capita income in the Base Case, that series shows a slower rate of growth as well.

A refined conjectural estimate alters the picture somewhat, but still shows slower growth and more gradual acceleration of output per capita. Agricultural productivity advance underlying the refined series is the slower one contained in the Weiss Base Case, but the growth of national output per worker is quicker due to the acceleration in manufacturing productivity.

The striking differences between the David series and the new ones presented here raise some questions and force reconsideration of the path of American economic development.

In particular, the differences in the timing of productivity advance in agriculture are quite sharp, and focus attention on the period 1820 to 1840. While it seems more reasonable to believe that farm productivity advanced more rapidly in the twenty years after 1840 than in the twenty before, the evidence to support that view is scanty. A key piece of evidence is that the revised series shows changes in the farm share of the labor force that are far more consistent with those of the rural population. Moreover, the resulting income figures in both of the new series appear more consistent with evidence on the levels and changes in the consumption of nonperishable products. This gives a measure of credence to the new series, and to the altered picture of growth presented here.

This paper has benefitted from discussions with the participants of the National Bureau of Economic Research's Summer Institute on the Development of the American Economy. Earlier versions were presented at the economic history workshops at the Universities of Chicago, Indiana, Illinois, Northwestern, Stanford, and at Lake Forest College and the Second World Congress of the Cliometrics Society. I would also like to thank Jeremy Atack, Lou Cain, Gregory Clark, John Clark, Stan Engerman, Betsy Field, Claudia Goldin, Joshua Rosenbloom, and John Wallis for helpful comments. The work has been funded by the University of Kansas and the National Science Foundation (Grant No. SES8308569).

FOOTNOTES

1. The chief proponent that modern growth began in the last two decades of the antebellum period is W. W. Rostow, whose "take-off" stage of development was one of the broader and bolder attempts to date and explain the start of growth. In that scheme, the transition to modern growth was abrupt, a substantial increase in per capita output being achieved over a fairly short period of time, roughly 20 years. Rostow did not specify exactly how large an increase in per capita output was necessary, only that it be substantial. (1960, esp. chap.5). A larger number of people have argued that modern growth began before 1840, and while the exact dating is not known it is typically placed sometime after 1820. A minority opinion is

that modern growth was ushered in by the Civil War, or at least during the decade of that war.

There is a long history of debate on the topic, beginning with Robert Martin (1939), and including Simon Kuznets (1952), William Parker and Franklee Whartenby (1960), Douglass North (1961), and George Rogers Taylor (1964). Summaries of the discussions can be found in Stuart Bruchey (1965), Stanley Engerman and Robert Gallman (1981), and Diane Lindstrom (1983).

2. In a more recent work David has revised his estimate of growth downward ever so slightly, from 1.22 to 1.17 percent per year for the period 1800 to 1835. The reduction arises from a broadening of the measure of Gross Domestic Product (1977, p.186).

3. This result rests on a comparison of the economy's performance in two subperiods, 1800 to 1835 and 1835 to 1855, marked off because the beginning and ending years of each lay in approximately the same position of the business cycle. According to David, around 1800, the mid-1830's, and mid-1850's "the U.S. economy experienced strong pressure on existing capacity, and rising prices, generated by high levels of demand" The earlier period's growth of 1.22 percent per year was virtually equal to the 1.3 percent measured for the latter (David, 1967, p.156).

4. This general conclusion can be seen in David's figures reproduced in Table 1. Those figures reflect a slightly different dating of subperiods, 1800 to 1840 and 1840 to 1860,

and show more divergent performances with rates of 1.13 versus 1.56 percent per year respectively. Still, each subperiod is quite close to the 1.27 percent figure achieved for the period as a whole.

5. While earlier acceleration may have been the nail in the coffin of Rostow's take-off in the 1840's, the specter of a take-off was still alive, and had simply been shifted to the 1820's.

6. The higher levels pass Gallman's test of the reasonableness of the implicit flow of non-perishable consumption and investment spending (1971, Table 4). (See the discussion below for greater detail). And, the changes in the new residuals imply an income elasticity of demand for non-perishables that is more consistent with other evidence for the 19th century (summarized below). The new non-perishable figures yield elasticities of 1.7 for the period 1800 to 1820, and 1.8 for the years 1820 to 1840. David's figures give elasticities of 2.4 and 2.5 for those same periods. The new figures are somewhat higher than that implied by the direct income figures for 1840 to 1860 (1.31), and fall in the upper range of those for the late 19th century, but they are nonetheless much closer than the alternative.

7. Over the past decade and a half, Robert Gallman has raised doubts about the extant estimates of the antebellum farm labor force figures, questioning in particular the estimates for 1800 and 1850 (1971, p.81, and 1975,pp.36-38). As will be seen,

Gallman was not precisely correct in identifying the years in which the labor force figures might have been flawed, or the exact extent of the error, but his questions about the accuracy of the farm workforce series were well placed.

The measurement of growth before 1840 also rests on the estimating assumptions underlying the Towne and Rasmussen figures on farm gross product, in particular that per capita consumption of most farm products was constant during the period (Towne and Rasmussen, 1964). Since both the David and Weiss series on farm productivity rest on these same farm output estimates, this is not a source of the different results.

8. This equation is derived from the identity that output per capita (O/P) is equal to output per worker (O/LF) times the fraction of the population engaged as workers (LF/P). In turn, O/LF for the nation is equal to the weighted average of O/LF in the two sectors, agriculture and nonagriculture, where the weights are the shares of the labor force engaged in agriculture (S_a) and nonagriculture (S_n). It was also assumed that output per worker in nonagriculture remained equal to a constant multiple of that in agriculture $(O/LF)_n = k*(O/LF)_a$.

9. This in turn has an indirect impact on the rate of advance in nonfarm industries by virtue of the assumption that productivity change in that sector equaled that in farming. Given the absence of evidence on the growth of nonfarm output or productivity, some assumption about their behavior was

required, but not necessarily this particular one. David argued that nonfarm productivity likely increased faster than farm, and made the assumption of equal rates of advance in order to bias downward the estimated rate of growth in the years before the alleged take-off might have occurred. It is not certain that the bias works in the direction David thought, and in the refined estimates presented below I alter this assumption.

10. There is also an indirect effect through the estimate of k which is determined in part by the labor force estimates in the base year of 1840.

11. The total labor force is the sum of the workers in five population components; free males aged 16 and over, free females aged 16 and over, free males aged 10 to 15, free females aged 10 to 15, and slaves aged 10 and over. The estimate of the number of workers in each group is the product of the population in the group times the group-specific participation rate.

The estimates are based on the concepts and coverage used by the decennial censuses of the 19th century. They are more precisely termed "gainful worker" counts, and are known to exclude workers engaged in certain types of activities, especially married women working as boardinghouse keepers or unpaid family farm workers. Recent work has tried to estimate the importance of these omissions, but those efforts have been

confined to the period after 1880 (Abel and Folbre, 1988; Bose, 1987; Ciancanelli, 1983; and Goldin, 1986;). As yet, there are no such estimates for earlier years which would permit an adjustment of the census data to a comparable coverage over time, so I have not corrected in any year for these sorts of omissions

12. The national totals produced from the state estimates differ only slightly from Lebergott's figures, or from my earlier estimates of the national totals (Lebergott, 1966, Table 1; Weiss, 1986, Table 1). The state-based estimates are within two percent of the national estimates in all years except 1800. In that year, the state-based figure of 1,712,000 is virtually identical to David's estimate (David, 1967, Table A-1).

13. In all this work I am proceeding on the assumption that the census counts of population are accurate, or at least equally reliable at the various census dates. Several researchers have concluded that the census undercounted population in the particular years and localities they studied. Since my labor force estimates are derived as the product of age-sex-state specific participation rates times the population component, it would be straightforward to adjust my labor force estimates to conform to any revised population levels, should reliable estimates of these undercounts be produced.

Coale and Zelnick (1963) argued that the population enumerations in the postbellum period (actually since 1855) were low, but so far, the evidence of underenumeration in the

antebellum censuses pertains to specific places, and it is not known whether the entire census in any year, much less all years, was subject to the same degree of error. (See Steckel, 1987, for a summary of the case studies pertaining to the antebellum years.)

More troublesome, is the possibility that the undercount fell more heavily on certain population groups which held a disproportionate share of selected occupations, thus giving a relatively larger undercount of the number of workers in those occupations in the census figures (Sharpless and Shortridge, 1975).

14. This work is described in several working papers titled "The Assessment and Revision of the Antebellum Census Labor Force Statistics: Part I (1850 and 1860), Part II (1840), and Part III (1820)." The 1850 and 1860 census counts of workers appear quite accurate for the nation and most states, but the figures for several states were extremely flawed. For the United States, the 1850 count of free male workers aged 16 and over was revised upward by less than one percent, while the 1860 count of free workers, males and females aged 16 and over, was increased by 3.4 percent. I revised each occupation by the same percentage as the total in each state.

15. I assessed the 1820 and 1840 censuses in order to determine which industries were covered, which age and sex portions of the population were included in the counts of workers, and which state counts were in need of revision

(Weiss, 1987b and 1987d). For the industries covered, both censuses tried to count all workers aged 10 and over, including slaves, although the accuracy and completeness varied by county and state. While the industrial coverage of the two censuses differed, in principle we have a count of the entire farm work force in both years.

16. The revisions were carried out by examining the county and subdivision data in much the same manner as had been done before by Richard Easterlin (1960) and Stanley Lebergott (1966). The census counts included many slave workers, but not all, so the farm worker totals in most slave states had to be revised. Fortunately, the reported figures in a large number of counties in the southern states were accurate and could be used to correct those in other counties (Weiss, 1987b). The corrections and additions to the census counts of farm workers amounted to 233,000 in 1820 and 164,000 in 1840; increases of 11.3 percent and 4.5 percent respectively. By comparison, in his assessment and revision of the 1840 census comparison, Easterlin increased the farm count by 104,000 workers (1966, p.127). Lebergott reduced the 1840 count by 148,000 workers, and increased the 1820 figure by 401,000.

17. Lebergott (1966) developed the estimation procedures and produced the initial estimates, while David (1967) revised some of the figures, especially that for 1800. Where they differed, I used David's figures because they are the more pertinent to

the subsequent discussion of conjectural growth. The use of Lebergott's figures instead would make little difference in these comparisons. Lebergott's figures are presented in the Table notes so that the two totals can be compared.

18. The absolute increase is slightly smaller in the new series than in the old, 977,000 workers versus 1,094,000. Lebergott's estimates show an increase of 1,070,000 workers, or 76 percent.

19. Gallman was suspicious about the Lebergott-David series because it showed changes in the farm labor force that seemed inconsistent with the changes in the rural population. The inconsistency seemed greater in the antebellum period when the farm share of the labor force declined by substantially more percentage points than the rural population share. Gallman focused on the changes between 1800 and 1850, noting that "the agricultural share of the work force fell by 28 percentage points between 1800 and 1850, at a time when the share of the rural population in total population was declining by only 9 points." (1975, p.38).

20. The new series shows a much higher correlation between the change in the farm share and that in the rural population on a decade to decade basis. The correlation coefficient using the new series is .909, while with the Lebergott-David figures the coefficient is only .239.

21. The weight is the relative sectoral output per worker figure for 1840. For that year, output per farm worker is slightly lower and output per nonfarm worker slightly higher using the present labor force estimates as compared to the David figures.

22. The growth of per capita output in the present series is aided by a more rapid rise in the participation rate, but the difference is quite small.

23. This was David's concern as well. After constructing his farm labor productivity series and pointing out that virtually all of the advance took place during the 1820' and 1830's, he asked "How reasonable a set of conjectures does this particular farm labor productivity index constitute?" (p.177)

24. On the basis of a sample of counties Lebergott judged that the census had overenumerated farm workers, and so reduced the count. My procedures did not rely on sampling, but rather examined virtually every county, finding some with high counts and others with low ones. My upward revision reflects the net outcome of these adjustments.

25. Of course, at the same time the level of ouput per worker in that sector is biased upward, and so influences as well the intersectoral shift effect on output growth.

26. Specifically, Kenneth Sokoloff has made estimates of productivity growth in manufacturing for the period 1820 through 1860, that can be used to guage productivity growth outside of farming. These estimates confirm David's suspicion that

productivity in the nonfarm sector grew more rapidly than in farming. Of course, these more rapid rates apply only to manufacturing, and more specifically to that in the Northeast, so may not reflect the performance of the entire nonfarm sector.

27. His series show a range of rates of productivity advance, with particularly high rates prevailing over the period 1820 to 1832. Those high rates may have been due in part to the 1820 business cycle position, and so I have used his longer term average rate for the period 1820 to 1850. Moreover, the longer term figures encompass 13 industries, while the figures for the subperiod 1820 to 1832 cover only eight, omitting in particular boots and shoes and flourmilling (Sokoloff, 1986, Table 13.6).

The 2.3 percent rate is based on his value added output series, calculated with aggregated data. This gives a slightly slower rate of growth than the 2.7 percent figure evident in his gross product series, but makes little difference in the weighted nonfarm rate of advance. Rates of growth calculated from his firm level data are lower, 1.8 percent in the value added series and 2.5 percent using gross product (Sokoloff, 1986, p. 698, Table 13.6).

28. I have used weights of 42 percent for manufacturing and 58 percent for all other nonfarm industries. According to my revised labor force figures, manufacturing employed 11.6 percent of the labor force in 1820 and 14.2 perecent in 1840, or 40.6 and 43.3 percent of the nonfarm labor force in the respective years.

29. In 1840 these two industries employed only 28 percent of the service sector labor force. Personal services, in which there was probably no productivity change, employed 49 percent (Weiss, 1975, Table 17, p.49).

30. Gallman has estimated that the flow of perishable consumption per capita was quite steady over the course of the nineteenth century, changing primarily because of changes in the composition of the population (1971, pp. 71-79 and 1972, p.197) His estimates showed a very mild rise from $42 in 1800 to $45 in 1840. When these perishable consumption estimates were subtracted from the per capita income figures implied by David's conjectural growth rates, the residuals were quite small, implausibly so in Gallman's view (1971, p.81)
The levels of the residuals implied by the refined output figures are not as high as in the Weiss Base Case, but are well above David's (See Table 1, bearing in mind that the residuals reported there include an unspecified amount for the rental value of shelter).

31. This figure differs from the 1.31 reported earlier because of the different treatment of shelter output.

32. These studies pertain to urban families, grouped by income class. The average family income per class ranged from $156 to $1,450 for the U.S. in 1888-91, and from $395 to $1,383 in Massachusetts in 1874-75. (Historical Statistics, 1960, Series G:313-330). Given the average family sizes, the implicit per capita incomes ranged from $46 to $337 in 1888-91, and $79 to

$200 in 1874-75.

Jeff Williamson used the 1875 Massachusetts sample to estimate expenditure elasticities, which for aggregated groups of nonfood items ranged as follows: Apparel-1.3 to 1.7; Dry Goods-1.2 to 1.6; and Sundries-1.7 to 2.0 (1967, Tables 4 and 5, pp.116-117). More recently, Michael Haines has estimated expenditure elasticities for various ethnic and occupational groups in 1889/1890. The national figures are elasticities of 1.11 for clothing, .62 for fuel and light, 1.21 for liquor and tobacco, and 1.77 for other products (1988, Table 7).

33. McCusker and Menard put the colonial rate between .3 and .6 percent per year between 1710 and 1770 (1985, p.55-56 and 267). More recently, Morris Altman has argued that the more likely rate falls near the lower end of the range (1987).

34. This pattern is influenced slightly by the assumption regarding shelter. If I retained shelter as part of nonfarm output, the per capita output levels would be 4 percent lower in 1800 through 1820, and 2 percent lower in 1830. In consequence, the rates of growth are raised slightly.

Table 1

Comparison of Conjectural Estimates
of Per Capita Product
(1840 dollars)

Year	Growth Index (1840=100)		Per Capita Product		Non-Perishable Residual	
	David	Weiss	David	Weiss	David	Weiss
1800	0.644	.801	$ 58	$ 73	$ 16	$ 31
1810	0.617	.826	56	75	13	32
1820	0.676	.846	61	77	18	34
1830	0.840	.913	76	83	32	39
1840	1.000	1.000	91	91	46	46
1850	1.099	1.099	100	100	53	53
1860	1.374	1.374	125	125	69	69
Average Annualized Rate of Change						
1800-1820			.25	.27	.59	.46
1820-1840			1.96	.84	4.80	1.52
1840-1860			1.60	1.60	2.05	2.05
1800-1840			1.13	.55	2.68	.99
1800-1860			1.29	.90	2.47	1.34

Sources: David, 1967, Table 8; and Gallman, 1971, Table 1

The Growth Index is the product of an index value for three variables, the participation rate, farm output per worker, and the effect of the shift to nonfarm employment. These indexes are presented in Table 4.

The 1840, 1850, and 1860 per capita product figures are based on Gallman's direct estimates of output for those years. The conjectural figures are $103 and $126 in the David series, and $100 and $131 in the Present. The earlier year figures were obtained by extrapolating the 1840 base year value on the growth index. The product figures are intended to represent gross domestic product, exclusive of the value of home manufacturing and farm improvements.

The value of perishable consumption (food and firewood) deducted in order to derive the non-perishable residual was $42 in 1800, $43 in 1810 and 1820, $44 in 1830, $45 in 1840, $47 in 1850 and $55 in 1860. (Gallman, 1966, Tables A-1 and A-2).

Table 2

Estimates of the Total and Farm Labor Force
United States, 1800 to 1860
(Thousands)

Year	Total Labor Force		Farm Labor Force		Farm Shares	
	Lebergott-David	Weiss	Lebergott-David	Weiss	Lebergott-David	Weiss
1800	1,700	1,712	1,406	1,274	82.6%	74.4%
1810	2,330	2,337	1,950	1,690	83.7	72.3
1820	3,165	3,152	2,500	2,249	78.9	71.4
1830	4,200	4,272	2,965	2,982	70.6	69.8
1840	5,707	5,778	3,617	3,882	63.4	67.2
1850	8,250	8,192	4,520	4,975	54.8	60.7
1860	11,180	11,290	5,950	6,292	53.2	55.7
Average Annualized Rates of Change						
1800-1820	3.16	3.10	2.92	2.88	-0.23	-0.19
1820-1840	2.99	3.08	1.86	2.77	-1.09	-0.32
1840-1860	3.42	3.41	2.52	2.44	-0.87	-0.93
1800-1840	3.07	3.09	2.39	2.82	-0.66	-0.25
1800-1860	3.19	3.19	2.43	2.70	-0.73	-0.48

Sources: David, 1967, Appendix Table I. The construction of the Weiss estimates is described briefly in the text. More detailed descriptions of the procedures may be obtained from the author.

David's estimates are identical with Lebergott's in the years 1810, 1830, and 1850. For 1800, Lebergott's original estimates were 1,900 workers in total, and 1,400 in farming. Lebergott now accepts an 1800 estimate of 1,680 total workers, and an unchanged farm figure (1984, p.66). In other years, the differences between David and Lebergott are quite small. Lebergott's total labor force estimates are 3,135 in 1820, 5,660 in 1840, and 11,110 in 1860; the farm figures in those respective years are 2,470, 3,570, and 5,880 (Lebergott, 1966, Table 1).

Table 3
Participation Rates and Estimates of Output per Worker

	Participation Rates		Output per Worker (1839 prices) Agriculture		Total	
	David	Weiss	David	Weiss	David	Weiss
1800	.322	.323	$ 134	$ 147	$ 180	$ 226
1810	.323	.324	129	148	173	232
1820	.329	.328	134	149	185	235
1830	.325	.331	158	156	234	251
1840	.333	.338	175	163	273	269
1850	.355	.352	174	162	282	284
1860	.355	.358	213	201	352	349
	Average Annualized Rates of Change					
1800-1820	.11	.06	.02	.04	.14	.20
1820-1840	.06	.13	1.34	.48	1.94	.68
1840-1860	.32	.30	.99	1.02	1.28	1.30
1800-1840	.08	.10	.68	.26	1.04	.44
1800-1860	.16	.18	.78	.52	1.12	.73

Notes: Agricultural Output per worker is Gross Farm Product divided by the number of workers in farming. The Farm Gross Product figures were constructed from farm output and output indexes presented in David (1967, Tables 2, 5, and 6). The original output figures, from Towne and Rasmussen, exclude the value of home manufacturing and farm improvements, and were revised slightly by David. The labor force figures are presented in Table 2 above.

The Total Output per Worker is the value implicit in the growth index calculations presented in Table 1. It is derived for each year by dividing the estimated output per capita by the participation rate.

Sources: David (1967, Tables 2 through 8); Weiss, 1989.

Table 4
Comparison of Input Indexes
(1840 = 1.0)

YEAR	Output/Labor		Participation Rate		Intersectoral Shift Effect	
	David	Weiss	David	Weiss	David	Weiss
1800	.762	.899	.967	.956	.864	.931
1810	.736	.907	.970	.959	.856	.953
1820	.765	.910	.988	.970	.890	.961
1830	.901	.958	.976	.979	.948	.976
1840	1.000	1.000	1.000	1.000	1.000	1.000
1850	.999	.971	1.066	1.041	1.032	1.087
1860	1.213	1.232	1.066	1.059	1.062	1.053
	Average Annualized Rates of Change					
1800-1820	.02	.04	.11	.06	.15	.16
1820-1840	1.34	.48	.06	.13	.58	.20
1840-1860	.99	1.02	.32	.30	.30	.26
1800-1840	.68	.26	.08	.10	.36	.18
1800-1860	.78	.52	.16	.18	.34	.21
	Relative Contribution to Per Capita Growth					
1800-1820	6%	20%	42%	25%	52%	55%
1820-1840	66	56	3	19	31	25
1840-1860	63	67	19	17	18	15
1800-1840	58	47	8	21	34	32
1800-1860	60	60	13	18	26	22

Sources: The indexes for the participation rate and output per worker can be calculated from the data in Table 3.

The intersectoral shift effect equals $S_a + kS_n$, where S_a and S_n are the labor force shares in farm and nonfarm industries, and k is the 1840 ratio of nonfarm to farm productivity. The 1840 base year values for the intersectoral shift effects are 1.35 and 1.43 for the David and Weiss series respectively. The values of k are 1.97 for David and 2.31 for Weiss. The shift effect for 1850 and 1860 is based on the actual values, not the hypothetical results derived holding k constant.

The relative contribution to growth is measured here as that variable's share of the sum of the changes in all the indexes over the given time period.

Table 5
Comparison of Farm and NonFarm Productivity, 1840 to 1860

Variable	1840	1860	Percent Increase
Gross Domestic Product ($000s)	1,553	3,930	
Farm Sector			
Gross Product ($000s)	634	1,266	
Output per Worker			
Weiss	163	201	23.3%
David	175	213	21.7
NonFarm Sector			
Product ($000s)	919	2,664	
Output per Worker			
Weiss	485	534	10.1
David	440	509	15.7
NonFarm-NonShelter			
Product ($000s)	753	2,352	
Output per Worker			
Weiss	397	471	18.6
David	360	450	25.0

Notes to Table 5

The Gross Domestic and Farm Gross Product figures are valued in 1840 prices,and exclude farm improvements and the value of home manufacturing.

The Gross Domestic Product and Farm Gross Product figures for 1840 come from David, 1967, Table 5. The 1860 GDP figure was obtained by multiplying the 1840 figure by the index of real GNP in 1860 prices (Gallman, 1966, p.26). The Farm Gross Product for 1860 was obtained by extrapolating the 1840 figure on an index of real farm output in 1879 prices, estimated following the procedures outlined by David (1967, Table 2).

The labor force figures used in the calculations come from Table 2 above.

The value of shelter was deducted from the NonFarm Product to obtain the NonFarm-NonShelter Product. The value of shelter (in 1840 prices) was $166 million in 1840, and $312 million in 1860 (Gallman and Weiss, 1969, pp. 292 and 330).

Table 6

Output per Capita, 1800 to 1860
A Refined Conjecture

Year	Base Cases David	Base Cases Weiss	Refined Estimate	Composition of Refined Estimate: Value of Shelter	Composition of Refined Estimate: Perishables	Composition of Refined Estimate: Non Perishable Residual
1800	$ 58	$ 73	$ 65	$ 4	$ 42	$ 18
1810	56	75	68	6	43	19
1820	61	77	70	6	43	21
1830	76	83	79	8	44	27
1840	91	91	91	10	45	36
1850	100	100	99	9	47	44
1860	125	125	125	10	55	60
			Average Annualized Rates of Change			
1800-20	.25	.27	.37	2.03	.12	.77
1820-40	1.96	.84	1.32	2.21	.23	2.73
1840-60	1.60	1.60	1.60	.10	1.01	2.59
1800-40	1.13	.55	.84	2.12	.17	1.75
1800-60	1.29	.90	1.10	1.44	.45	2.03

Notes: The Base Cases are those reported in Table 1 above.

The Refined Conjecture is explained in the text, and involves the separate treatment of the annual value of shelter and the relaxation of the assumption that nonfarm productivity advanced at the same rate as that in farming.

The per capita value of shelter for 1840 through 1860 comes from Gallman and Weiss (1969). Those figures yield a ratio of the annual flow of shelter to the stock of dwellings of roughly 20 percent. For earlier years the shelter figures have been estimated as the product of that ratio times Gallman's estimates of the stock of residential dwellings (for 1800, 1805, and 1815) and by interpolation (for 1810, 1820, and 1830).

The assumed rate of nonfarm productivity advance is 1.25 percent per year between 1820 and 1840, which is a weighted average of 2.3 percent for manufacturing and .48 percent in the other nonfarm industries. For 1800 to 1820 the rate is assumed to be the same as in agriculture, and for 1840 to 1860 the figures are from the direct estimates of output. See the text and Tables 1 and 3 for a fuller discussion.

SELECTED BIBLIOGRAPHY

Abel, Marjorie and Folbre, Nancy. 1988. "Never Done and Under-Counted," mimeo.

Altman, Morris. 1987. "The Economy of colonial America: A Critical Note on the Real per Capita Income Estimates," Social History, XX, No. 40, pp. 337-342.

Atack, Jeremy and Bateman, Fred. 1986. To Their Own Soil. Ames: Iowa State University Press.

Bateman, Fred and Foust, James. 1973. "Agricultural and Demographic Records of 21,118 Rural Households" Data Tape, Indiana University.

Bidwell, P.W. and Falconer, J.I. 1925. History of Agriculture in the Northern United States, 1620-1860. Washington: Carnegie Institute.

Bose, Christine. 1987. "Devaluing women's Work: The Undercount of Women's Employment in 1900 and 1980," in Hidden Aspects of Women's Work, eds. Christine Bose, Roslyn Feldberg, and Natalie Sokoloff. New York: Praeger Publishers.

Bruchey, Stuart. 1965. The Roots of American Economic Growth. New York:

Ciancanelli, Penny. 1983. "Women' Transition to Wage Labor: A Critique of Labor Force Statistics and Reestimation of the Labor Force Participation of Married Women in the United States 1900-1930," Doctoral Dissertation, New School for Social Research.

Coale, Ansley and Zelnick, Melvin. 1963. New Estimates of Fertility and Population in the United States. Princeton: Princeton University Press.

Cochran, Thomas. 1981. Frontiers of Change. New York: Oxford University Press.

Danhof, Clarence. 1969. Change in Agriculture. Cambridge: Harvard University Press.

David, Paul. 1967. "The Growth of Real Product in the United States Before 1840: New Evidence, Controlled Conjectures," Journal of Economic History, vol.27, No.2, 151-197.

David, Paul. 1974. "Invention and Accumulation in America's Economic Growth: A Nineteenth Century Parable," in K. Brunner and A Meltzer, eds. Carnegie-Rochester Conference Series on Public Policy, vol.6, pp.179-228.

Easterlin, Richard. 1960. "Interregional Differences in Per Capita Income, Population, and Total Income, 1840-1950," in Studies in Income and Wealth, vol.24. Princeton: Princeton University Press.

_____. 1975. "Farm Production and Income in Old and New Areas at Mid-Century," in Klingaman and Vedder, 1975.

Edwards, Alba. 1940. Comparative Occupation Statistics for the United States, 1870-1940. 16th Census Report.

Engerman, Stanley. 1967. "Discussion of the Conjectural Estimates" American Economic Review, LVII, May, pp.307-310.

Engerman, Stanley and Gallman, Robert. 1981. "Economic Growth, 1783 to 1860," Research in Economic History.

Fabricant, Solomon. 1949. "The Changing Industrial Distribution of Gainful Workers: Comments on the Decennial Statistics, 1820-1940," in Studies in Income and Wealth, 11, pp 1-49. New York: National Bureau of Economic Research.

Gallman, Robert. 1966. "Gross National Product in the United States, 1834-1909," in Studies in Income and Wealth, vol.30. New York: National Bureau of Economic Research.

Gallman, Robert. 1971. "The Statistical Approach: Fundamental Concepts Applied to History," in G.R.Taylor and L.F.Ellsworth, eds. Approaches to American Economic History. Charlottesville: The University Press of Virginia.

_____. 1972. "Changes in Total U.S. Agricultural Factor Productivity in the Nineteenth Century," in D. Kelsey, ed. Farming in the New Nation. Washington, D.C.: Agricultural History Society.

_____. 1975. "The Agricultural Sector and the Pace of Economic Growth: U.S. Experience in the Nineteenth Century," in Klingaman and Vedder, 1975.

Goldin, Claudia. 1986. "The Female Labor Force and American Economic Growth, 1890-1980," in Studies in Income and Wealth, vol. 51. Chicago: University of Chicago Press.

Haines, Michael. 1988. "Consumer Behavior and Immigrant Assimilation: A Comparison of the United States, Britain, and Germany, 1889/1890. mimeo.

Klingaman, David and Vedder, Richard. 1975. Essays in Nineteenth Century Economic History. Athens: Ohio University Press.

Lebergott, Stanley. 1964 Manpower in Economic Growth. New York: McGraw-Hill

_____. 1966. "Labor Force and Employment, 1800-1960" in Studies in Income and Wealth, vol. 34, 117-204. New York: McGraw-Hill.

Lindstrom, Diane. 1979. "American Economic Growth before 1840: New Evidence and New Directions," Journal of Economic History, vol.39, No. 1, pp.289-301.

_____. 1983. "Macroeconomic Growth: The United States in the Nineteenth Century," Journal of Interdisciplinary History, XII, No.4, pp.679-705.

McCusker, John, and Menard, Russell. 1985. The Economy of British America,1607-1789. Chapel Hill: University of North Carolina Press.

Miller, A. and Brainerd, C. 1957. "Labor Force Estimates," in Everett Lee, et.al., Population Redistribution and Economic Growth. Philadelphia: The American Philosophical Society.

Rostow, W. W. 1960. The Stages of Economic Growth. Cambridge: Cambridge University Press.

Sharpless, John and Shortridge, Ray. 1975. Biased Underenumeration in Census Manuscripts," Journal of Urban History, Vol.1, pp.409-437.

Steckel, Richard. 1988. "Census Matching and Migration: A Research Strategy." Historical Methods. 21, No.2, pp.52-60.

U.S. Bureau of the Census. Population. 1800 through 1910.

_____. 1840. Compendium of Enumeration. Washington, D.C.: Thomas Allen

_____. 1840. Enumeration of Inhabitants. Washington, D.C.: Blair and Rives.

_____. 1900. Occupations.

_____. 1910. Vol. IV, Occupations.

_____. 1940. Population, II.

_____. 1975. Historical Statistics of the United States. Washington D.C.

Weiss, Thomas. 1975. The Service Sector in the United States, 1839 to 1899. New York: Arno Press.

_____. 1985. "Adjustments to the Census Counts of Population and Labor Force, 1870, 1890 and 1910" (mimeo) University of Kansas.

_____. 1986. "Revised Estimates of the United States Workforce, 1800 to 1860" Studies in Income and Wealth, vol.51. Chicago: University of Chicago Press.

_____. 1986b. "Assessment and Revision of the Antebellum Census Labor Force Statistics: 1850 and 1860" (mimeo) University of Kansas.

_____. 1987. "Demographic Aspects of the Urban Population, 1800 to 1840" in Quantity and Quidity: Essays in Honor of Stanley Lebergott. Middletown, Conn.: Wesleyan University Press.

_____. 1987b. "Assessment and Revision of the Antebellum Census Labor Force Statistics: 1840" (mimeo) University of Kansas.

_____. 1987c. "Estimation of the Farm/Nonfarm Distribution of Laborers, not otherwise specified; by State, 1850 to 1900" (mimeo) University of Kansas.

_____. 1987e. "The Farm Labor Force by Region, 1820-1860: Revised Estimates and Implications for Growth" NBER Working Paper No. 2438.

_____. 1988. "Assessment and Revision of the Antebellum Census Labor Force Statistics: 1820" (mimeo) University of Kansas.

_____. 1989. "Estimation of the Antebellum Labor Force Figures" (mimeo) University of Kansas

Whelpton, P.K. 1926. "Occupational Groups in the United States, 1820-1920," Journal of the American Statistical Association.

Williamson, Jeffrey. 1967. "Consumer Behavior in the Nineteenth Century: Carroll D. Wright's Massachusetts Workers in 1875," Explorations in Economic History, Vol.4, No.2, pp.98-135.

Wright, Carroll. 1900. The History and Growth of the United States Census. Washington, D.C.: Government Printing Office.