TABLE Ca-G An illustration of rebasing estimates of real gross domestic product and its components

	Year	Gross domestic product	Personal consumption expenditures	Gross private domestic investment	Exports of goods and services	Imports of goods and services	Government consumption expenditures and gross investment	Residual
Chain-type quantity indexes (1996 = 100)	1948	19.97	19.06	17.33	6.84	5.65	23.13	—
	1949	19.85	19.58	13.22	6.78	5.45	25.83	—
	1950	21.59	20.83	18.71	5.93	6.44	25.84	—
	1951	23.23	21.14	18.77	7.27	6.69	35.16	—
	1952	24.16	21.81	16.99	6.93	7.28	42.56	—
	1953	25.26	22.86	17.78	6.47	7.97	45.54	—
	1954	25.09	23.33	16.96	6.78	7.57	42.40	—
	1955	26.87	25.02	21.09	7.50	8.49	40.82	—
	1956	27.40	25.75	20.81	8.75	9.17	40.85	—
GDP in chained 1952 dollars	1948	296.4	192.0	55.1	16.1	11.9	45.6	−0.5
	1949	294.6	197.2	42.0	15.9	11.5	50.9	0.0
	1950	320.5	209.8	59.5	13.9	13.5	50.9	−0.2
	1951	344.8	213.0	59.7	17.1	14.1	69.3	−0.2
	1952	358.6	219.7	54.0	16.3	15.3	83.9	0.0
	1953	374.9	230.3	56.5	15.2	16.8	89.8	−0.1
	1954	372.4	235.0	53.9	15.9	15.9	83.6	−0.1
	1955	398.8	252.0	67.0	17.6	17.8	80.5	−0.5
	1956	406.7	259.4	66.1	20.6	19.3	80.5	−0.7

Sources

Chain-type quantity indexes: Table Ca159–168. Gross domestic product (GDP) and its major components for 1952: Table Ca74–90.

Documentation

The chain-type quantity indexes in the top panel are used to extrapolate the 1952 data forward and backward. For example, GDP in chained 1952 dollars can be computed as follows:

For years before the base year: $GDP_t = GDP_{t+1} * (I_t/I_{t+1})$

$GDP_{1951} = GDP_{1952} * (I_{1951}/I_{1952})$

$344.8 = 358.6 * (23.23/24.16)$

For years after the base year: $GDP_t = GDP_{t-1} * (I_t/I_{t-1})$

$GDP_{1953} = GDP_{1952} * (I_{1953}/I_{1952})$

$374.9 = 358.6 * (25.26/24.16)$

1929–1947 uses 1937 dollars; for 1942–1962 the base is 1952 dollars, and so on.

References

See the references at the conclusion of the essay on estimates of national product before 1929, in this chapter.

Estimates of National Product before 1929

Paul W. Rhode and Richard Sutch

The official estimates of national income and product provided by the Bureau of Economic Analysis (BEA) begin in 1929. The broad interest in long-term trends has generated a number of attempts to estimate national product for the earlier period. We briefly summarize this work, concentrating on annual estimates of real national output suitable for estimating economic and productivity growth. One product of this effort is a new annual series on real per capita gross product for 1790–2000 (Table Ca9–19).

Although estimates of aggregate output for the nineteenth and early twentieth centuries are undoubtedly valuable for the study of economic growth, the increase in the average standard of living, and other long-run trends, a concern arises because aggregate measures of output presented as annual time series are also used to study fluctuations in economic activity. However, the standards of precision in the estimates of national output required for examination of short-run changes, study of business cycles, or analysis of macroeconomic dynamics are much higher than those required to assess the pace and pattern of long-term economic growth. In Chapter Cb, data on economic fluctuations are described in detail. This chapter deals with estimates of national product that are intended primarily to focus on trends rather than fluctuations.

It is important to note that all pre-1929 estimates are based on fragmentary data that were not originally collected for the purpose of making national product estimates. This means that the series are less precise than the official estimates. Moreover, the further back in time these estimating methods are pushed, the more degraded the quality of existing data and the more scarce reliable detailed series become. These problems force the investigator to fill the gaps with interpolated data, rough estimates, and conjectured relationships between available and missing data. Finally, most experts in the field regard all of the available annual estimates of gross product before 1909 as unfinished "work in progress." Simon Kuznets, John Kendrick, and Robert Gallman, whose work on pre-1929 gross national product (GNP) is the foundation for all existing estimates, did not publish their annual series for the early period (Kuznets 1946, 1961; Kendrick 1961; Gallman 1966). They were interested in long-run trends and the factors underlying economic growth, not in annual economic fluctuations. Their annual estimates were not intended to accurately measure the timing and magnitude of recessions and depressions. At the time of his death in 1998, Gallman still regarded his annual series as subject to revision (Rhode 2002).

Attempts to estimate aggregate national output actually predate the work of Kuznets initiated in the 1930s by the Department of Commerce. Writing in 1806, Samuel Blodget was the pioneer of this field. He produced an estimate of national income in 1805 by classifying all employed persons into seven different categories, ranging from slaves to professionals. He then estimated the number of workers and dependents in each class and the average income for members of the seven classes. Totaling the products for each class, Blodget produced the aggregate for the country (Blodget 1806, p. 89). In 1843, George Tucker, a former member of Congress, based an estimate of the national product on the returns of the Census of 1840, and in 1855 he produced a second edition of his book with estimates of both national income and national product for 1850 (Tucker 1843–1855). Ezra Seaman also produced estimates of national product based on the 1840 and 1850 Censuses (Seaman 1846, 1852). In the 1890s, Charles Spahr produced estimates of national income for 1880 and 1890 based on the censuses of those years (Spahr 1896). Willford I. King extended this work to 1910 and back to 1850 (King 1915).

Kuznets–Kendrick Series

Modern estimates of long-term change in national product are based on the pioneering work of Simon Kuznets. In 1941, Kuznets extended his annual estimates of GNP, which originally spanned 1929–1932, back to 1919 (Kuznets 1941). He later published estimates for overlapping decades for 1869–1878 through 1914–1923 (Kuznets 1946). In 1961, he revised and finalized his annual estimates for 1869–1918. However, he published the annual estimates only for 1889–1918. He presented the earlier data only as overlapping decadal averages for 1869–1878 to 1884–1893, explaining that they "did not seem sufficiently reliable as *annual* measures to warrant presentation" (Kuznets 1961, p. 534). The underlying annual data, however, were widely circulated in mimeographed form by the National Bureau of Economic Research and have been widely used by subsequent researchers (Kuznets circa 1961).

Kuznets produced four variants of his estimates for GNP. These he labeled "Component Series, Variants I and III" and "Regression Series, Variants I and III." Variants I and III differ in the way that services were estimated. Variant I estimates services as a residual by subtracting all of the other components of GNP from an independently measured estimate of national income. Variant III estimates services directly (Kuznets 1961, p. 472). Variant II was not estimated as an annual series for the years before 1919.

The Component Series estimated each of ten components of GNP separately and then summed the components to arrive at the comprehensive total. Kuznets expressed the view that these estimates were excessively volatile and would exaggerate the amplitude of the business cycle (Kuznets 1961, p. 546). He made and published alternative estimates of GNP, which he labeled the Regression Series. This series extrapolates real GNP for the period 1889–1908 on an index of finished commodity output, derived from the work of William Shaw, using a nonlinear regression of GNP on commodity output estimated with data from the period spanning 1909–1938 (Shaw 1947; Kuznets 1961, pp. 536–8, series R-21(6)). Shaw's aggregates are reproduced in Table Ca169–183. Shaw's finished commodity output, which was adjusted and used by Kuznets, is series Ca183. As intended, the effect of Kuznets's regression method was to damp the fluctuations in estimated GNP below those of commodity output.

The long-run trend of all of the Kuznets variants relies on a single set of benchmarks calculated largely with data drawn from the federal Censuses of Agriculture and Manufacturing. From 1840 through 1930 these censuses were conducted at the same time as the population census (in years ending in zero), but the outputs that were collected from each farm and firm were those of the previous calendar year (years ending in nine). Because the Censuses of Agriculture and Manufacturing were quite comprehensive, they provide strong statistical bases for estimating national product for 1839, 1849, 1859, 1869, 1879, 1889, 1899, 1909, and 1919. In addition, supplementary manufacturing censuses allowed for the creation of benchmarks for 1904, 1914, and 1924.

The Component Series bridged the gap between benchmarks by interpolating with available annual series for each of the ten components. Generally speaking, there exist fewer – and less reliable – data for the intercensal years, so a variety of interpolation techniques were used. For physical goods Kuznets relied heavily on the commodity flow statistics compiled by Shaw. Kuznets's Regression Series interpolated between the benchmarks for aggregate GNP and is thus available only for the aggregate and not for its component parts. Both Variants I and III of Kuznets's component GNP estimates are presented in Table Ca184–191. Despite Kuznets's preference for the less volatile regression estimates, most subsequent work has employed his directly estimated Component Series because only they provide component detail.

The definition that Kuznets adopted for GNP differed from the concept of gross domestic product (GDP) used by the Department of Commerce today. At the time he was writing, the Department of Commerce also preferred the GNP concept. It was not until 1991 that the official series was shifted from GNP to GDP. The difference between GDP and GNP is net receipts of income from the rest of the world (U.S. Bureau of Economic Analysis 1991, p. 8). For the years before 1929, the distinction between GNP and GDP is small.

Kuznets's definition of GNP also differed in concept from the Department of Commerce's definition of GNP. Kuznets treated government purchases quite differently and excluded the unpaid services of financial intermediaries. He regarded much of government output as an intermediate rather than a final product, basing his argument on the idea that GNP should be a measure of the satisfaction of final wants. Many government services, such as those that contribute to business productivity or maintain social stability (including nondurable national security outlays), he argued, were a means to better satisfy end wants rather than services directly desired for their own utility.

Shortly after the appearance of Kuznets's estimates, his former student John Kendrick undertook adjustments to Kuznets's Component Series, Variant III, to bring Kuznets's series into conceptual and statistical alignment with the official estimates of GNP published by the U.S. Department of Commerce (Kendrick 1961). These involved adopting the official treatment of government expenditure and adding an imputed series on the unpaid services provided by financial intermediaries (Kendrick 1961, pp. 238–46, and Table A-IIb, pp. 296–7). The resulting adjustment raised Kuznets's estimates by a fairly stable, slightly contracyclical, 3 to 4 percent throughout the entire period 1869–1908. Kendrick's estimates of GNP are presented as series Ca188–189. Series Ca191

gives Kendrick's estimates of GDP. Kendrick's series has an advantage over Kuznets's insofar as consistency with the official estimates after 1929 is desirable. However, Kendrick's estimates of government purchases of goods and services are somewhat rough, and users who do not care about this consistency or who are persuaded by Kuznets's argument for his treatment of government may prefer the original.

Gallman Series

Robert Gallman, another of Kuznets's students, undertook the task of revising Kuznets's GNP series and extending it back to 1839. The Gallman estimates were originally published in 1966 as overlapping decade averages. Gallman never published the annual data, in part because he worried that they would be used to analyze business cycle movements, a purpose for which they were not designed. In the best scholarly tradition, he did make his numbers available through the avenue of personal correspondence, with the appropriate caveats, to other economists and economic historians "for testing purposes." They are published here for the first time, with the warning that they are not appropriate for studies of economic fluctuations or dynamics.

Gallman produced estimates for the periods 1834–1859 and 1869–1909, using the same basic methodological framework, but those for the earlier period required substantially more original work (Tables Ca192–207 and Ca219–232). Construction of the series generally involved establishing solid benchmarks every five or ten years and then using a less comprehensive set of annual time series to interpolate values for the intervening years. Gallman did not make annual estimates for 1861–1869 because he did not believe he had reliable interpolating series for the decade that witnessed the American Civil War. Gallman's pre–Civil War estimates will be discussed after the description of the post–Civil War period.

For the post–Civil War period, Gallman largely adjusted estimates made by Kuznets, working with Kuznets's Variant I Component Series. Gallman made a number of adjustments to Kuznets's series that increased his benchmark estimates for the early years and reduced the trend rate of growth before 1889 but left the year-to-year movements proportionally unaffected. Gallman's principal adjustments to the Kuznets series are (1) substitution of new estimates for firewood, animal products, and federal excise taxes for the Shaw series used by Kuznets; (2) incorporation of new estimates of distribution costs, based on Harold Barger's work (Barger 1955); (3) separation of railroad construction from other building activity, based on series taken from Melville Ulmer (Ulmer 1960); and (4) deflation of the current-value GNP series by Dorothy Brady's detailed final price indexes, using an 1860 base (Brady 1966). By construction, the large upward revisions for the early years gradually taper to a "smooth link at 1909 with the Kuznets series" (Gallman 1966, p. 31).

Two points deserve attention. The first is that the Gallman estimates incorporated the most up-to-date data available in the early 1960s. To the extent that researchers over the past four decades have generated new statistics on the production or prices of individual goods and services, it should be possible for today's scholars to produce improved national product figures. Second, the annual national product series between the benchmark years is interpolated or extrapolated using a less comprehensive set of products than is used in the benchmark years. The main issue is how representative the movements in this data series are. For the post–Civil War period, many scholars believe that the Gallman–Kuznets series is reasonably reliable for studying long-run trends (see our comments on the excess volatility debate and the Balke–Gordon series in the following sections).

As we have emphasized, the interpolation and extrapolation procedures were designed to determine long-run trends, but as Gallman noted, they are problematic for analyzing business cycle fluctuations. This is especially true for investigations of the changing volatility of the macroeconomy or for comparison of one specific cycle with another. This message carries double weight for analyses contrasting the behavior of the antebellum and postbellum series, which are constructed in significantly different ways.

At the time of his death in 1998, Gallman had made several revisions to his post–Civil War series. Two seem particularly important to the overall research agenda designed to produce meaningful estimates of both long-term growth and cyclical changes. Gallman had prepared a revised version of railroad construction, based on data from Albert Fishlow, that corrected serious deficiencies in his earlier railroad construction estimates, and he had calculated estimates of the change in business inventories that, when added to his original GNP estimates, would bring his aggregate closer to the conventional definition of GNP, which includes this form of investment (and which is of importance to any study of business fluctuations). The series we present in Table Ca192–207 include these revisions. While preparing the Gallman series for publication, Paul Rhode also corrected several errors and made other minor revisions to the original Gallman numbers. See the documentation for Table Ca192–207 and Rhode (2002) for details. For this reason, the totals for GNP (series Ca192) and for GNP excluding inventory change differ from those that underlay the overlapping decade averages published by Gallman.

Standard Series

With two different revisions proposed to the Kuznets series for 1869–1909 – one by Kendrick to bring it into conceptual alignment with the Department of Commerce estimates and another set of improvements by Gallman – economists have tended to accept both revisions. This has produced a series known as the "Standard Series" (Balke and Gordon 1989, p. 49). Table Ca208–212 presents this series and documents the methods used in its computation. Because the version of Gallman's series that is reported here differs somewhat from the original Gallman data, this version of the Standard Series also incorporates the improvements introduced by Rhode.

Although there is room for dispute and much scope for improvement, most experts are now inclined to accept the Standard Series estimates for the period 1869–1909 as the best currently available. They especially depend on the Gallman series, and, as Rhode has concluded, Gallman's estimates "remain among the best numbers we have for this period." Gallman's data set also provides details on the components of GNP that no subsequent research has replaced.

Excess Volatility Debate

Neither Kuznets nor Gallman approved of the use of their annual series for the study of short-term economic fluctuations. Yet

the temptation for others to use them for this purpose was strong. Economists have used annual data for 1869–1908 as evidence about the degree of price, output, and employment flexibility in the American economy (Gordon 1981, 1982; Friedman and Schwartz 1982; DeLong and Summers 1986; Allen 1992). In particular, comparison of the volatility of the Standard Series with the fluctuation of the official post–World War II data has led many to the conclusion that economic fluctuations have moderated since World War II (Bailey 1978; Gordon 1986; Zarnowitz 1992). In 1999, the Secretary of Commerce, when naming national income accounting as the department's "achievement of the century," attributed the reduced harshness of the business cycle to the development of reliable national accounts data, which led to better macroeconomic policy. To bolster this claim, he presented a chart that joined data from Kendrick with the official series beginning in 1929 (Daley 2000).

Yet in an influential series of articles, Christina Romer has argued forcefully that this conclusion is inappropriate (Romer 1986a, 1986b, 1988, 1989; Miron and Romer 1990). In particular, she claims that the Standard Series on GNP exaggerates the fluctuations in economic activity in the period before World War I (Romer 1989). She explains that Kuznets's component estimates implicitly assume that output valued in market prices moves proportionately with commodity output measured in producer prices. She claims that this "might not be true." Moreover, she suggests that both "economic theory and modern experience suggest that GNP actually moves much less over the cycle than commodity output" because the service components are less affected by "aggregate shocks" (Romer 1989, p. 2). Because she believed that the Standard Series exhibited excess volatility, Romer undertook to revise that series by adopting Kuznets's regression method to damp the fluctuations in GNP. By design, Romer's regression estimates are less volatile than the Standard Series. They are reproduced in Table Ca213–218.

Critics of Romer's work have joined, but not resolved, the ensuing debate (Lebergott 1986; Balke and Gordon 1989; Zarnowitz 1992, pp. 77–9; Weir 1992). There are three basic issues.

(1) Although it is granted that much of the direct evidence used by Kuznets and Gallman consisted of cyclically volatile series, this was well known to them, and they took care to avoid introducing spurious volatility in the broad aggregates. Moreover, excess volatility in some components was offset, at least partially, by inadequately measured volatility in other components. A number of the series were converted from fiscal year observations to calendar years by averaging, thus reducing the volatility of the series. When there was inadequate interpolating data, smooth interpolations were used for some of the components. Ultimately, the volatility displayed by the annual series is the product of explicit, conscious data collection and assembly choices. The possibility of a bias, as Zarnowitz notes, results "from the lack of data and so has no real solution short of introducing new pertinent historical information" (Zarnowitz 1992, p. 78).

(2) Kuznets's and Romer's regression procedures are intended to reduce the volatility of the component estimates, and, by design, they do. However, we have no direct way of determining whether a reduction in volatility is in fact warranted and, if so, whether either of these damping procedures gets it right. Romer makes six changes to Kuznets's procedures, yet there are neither theoretical nor historical reasons to prefer her choices to those of Kuznets.

(3) The regression procedures impose recent relationships between commodity output and GNP on the more distant past. In Romer's case, data as recent as 1985 are employed to estimate those relationships, which are then applied to years as far back as 1869. This ignores the structural changes that have occurred in the economy during this period of more than a century. These structural changes include the growth of government, with its stable spending patterns; the secular decline in agriculture, which was a majority activity in 1869; the growth of services; and the revolutions in manufacturing technology, business organization, and distribution. More fundamentally, the presumed stability in the structure of the economy precludes any possibility that macroeconomic policy guided by national income statistics *could have* moderated the business cycle. The method rules out the possibility that the application of Keynesian stabilization policy and the establishment of the independent Federal Reserve System to manage credit and monetary policy worked to prevent financial crises.

Balke–Gordon Series

Alone among Romer's critics, Nathan S. Balke and Robert J. Gordon not only rejected Romer's procedures but also undertook the estimation of a new annual series for real GNP for 1869–1908 (Balke and Gordon 1989). Their innovation was to introduce a multivariate regression procedure to estimate GNP. The three independent variables were Kuznets's estimates of real commodity output (based on Shaw) and two indexes, one that directly measured real output in trade and transportation and one that directly measured the real value of nonfarm buildings. Romer's method used only the commodity output series. All variables were measured as a percentage deviation from trend. The sample period was 1909–1938. The estimated regression parameters were then used to backcast GNP to 1869, using the data on all three independent variables.

The Balke–Gordon estimates "are as volatile on average over the business cycle as the . . . [Standard S]eries" and are more volatile than Romer's series (Balke and Gordon 1989, p. 38). Although they "judge the components method [used to calculate the Standard Series] to be superior in theory, in practice the two methods yield almost identical conclusions regarding prewar GNP volatility" (Balke and Gordon 1989, p. 85). Balke and Gordon also constructed new annual deflators based primarily on the consumer price indexes prepared by Ethel Hoover and Albert Rees (Hoover 1960; Rees 1961), in contrast to Kuznets's deflator, which was based on wholesale price indexes (Balke and Gordon 1989, pp. 71–5). These estimates are distinctly less volatile than the traditional series. Their new deflator allowed them to calculate a current-dollar series (see Table Ca213–218). Because the new deflator is probably superior to the deflators implicit in the Standard Series, one might use the Balke–Gordon deflator to convert the real Standard Series in Table Ca208–212 into a current-dollar series (note that the base of the Balke–Gordon deflator would have to be shifted to 1929 dollars).

Pre–Civil War Estimates

Gallman constructed his pre–Civil War national product series by (1) taking his benchmark figures for commodity production (agriculture, mining, and manufacturing) for the years 1834, 1836,

1839, 1844, 1849, 1854, and 1859 (Gallman 1960); (2) adding estimates for the value of services based largely on capital stock series; and (3) interpolating the series in the intervening years using scattered annual data on numerous economic activities. The "major" benchmarks (1839, 1849, and 1859) were primarily based on materials from the U.S. Census, whereas the "minor" benchmarks (1834, 1836, 1844, and 1854) used several state censuses. Gallman believed that the use of more frequent benchmarks for the pre–Civil War series reduced some of the problems of interpolation that plagued the post–Civil War estimates. Gallman's estimates are presented in Table Ca219–232.

There remains the question of how reliable the interbenchmark estimates for the pre–Civil War period are. This comes down to a question of the adequacy of the series used to interpolate between the benchmarks. Gallman noted that the statistics on net imports "receive relatively too much weight," industrial equipment is "inadequately represented," many of the major groups rely on one or a few underlying series, and the flow of materials into production (such as wheat, corn, raw cotton and wool, and lumber) tended to dominate the series. He adds, lest these warnings "raise too many doubts, bear in mind that the interpolations and extrapolations generally carry over only four years, and frequently fewer years than this" (Gallman 1966, pp. 64–71).

As with the post–Civil War series, Gallman did not publish his annual numbers, and he was generally opposed to work using his annual national product series to compare the volatility of pre- and postwar business cycles. However, he also took strong issue with claims that his procedures to estimate noncommodity production over the 1839–1859 period generated excessively volatile series. In his view, any bias in volatility due to his construction procedure was likely to be weak or to work in the opposite direction from what is usually suggested. The pre–Civil War series was not constructed using Kuznets's ratio method to estimate service flows, but rather using the growth of housing stocks, which was far smoother. Services, which accounted for about 24 percent of Gallman's real value estimate of national product over the 1834–1859 period, were estimated as a smooth series between the benchmarks. In addition, the estimates for firewood production, which accounted for about 6 percent of national product, relied on straight-line interpolation. One offsetting force was the interpolation using net imports, which tended to "oscillate fairly widely" over the 1834–1842 period, but Gallman "attempted to dilute the effect of these oscillations by bringing the leather series into the interpolator" (Gallman 1966, pp. 64 and 71).

Gallman's definition of GDP for the pre–Civil War era was the same as that used by Kuznets (1961) for the years following the Civil War; thus, it is not consistent with the Standard Series, which has been adjusted to the Department of Commerce definitions. However, because the government was relatively small before the Civil War, Kendrick-like adjustments would increase Gallman's figures by only a small and stable percentage.

Slave Economy Concept of GDP

A more fundamental, perhaps even philosophical, issue arises concerning the proper definition of GNP for a slave economy. Simon Kuznets hinted that the consumption of slaves should not be viewed as final goods, because slaves were like "tools" and hence their consumption would be intermediate inputs into production (Kuznets 1961, p. 466). This approach would treat slaves as work animals or machines rather than as human beings. At first blush, such a view will undoubtedly offend modern sensibilities, but from a strictly economic point of view, slaves were assets rather than citizens. They were not free agents allowed to earn a living and make consumption choices as they pleased. It comes down to what purpose the aggregate statistics will be used for. For those interested in GNP as an index of the well-being of all residents of the country, slaves included, the Gallman definition is appropriate. However, if one is interested in capital formation, saving, and the mechanisms of economic growth, then a modified definition of GNP might be seen as more appropriate (Ransom and Sutch 1988).

To adjust the Gallman estimates in Table Ca219–232 to a slave economy definition of GNP, we must subtract the value of slave consumption and add the value of the increase in the slave stock. The latter can be thought of as a form of capital formation. Table Ca233–240 makes a rough adjustment along these lines. The net effects are to lower GNP and raise the rate of capital formation. To calculate real GNP *per capita* using the Gallman concept, one simply divides his estimates by the total population. However, when using the slave economy concept, only the *free* population is included in the denominator (series Ca238). The slave economy estimate of material well-being is larger than the Gallman estimate because only the welfare of the free population is measured. The standard of living was higher for the free population (an average of $146 in 1859, when measured in 1860 prices) than for the slave population (only $29.45).

Statistical Dark Age: 1790–1840

The long-run trends in real national product are defined by the decennial benchmarks based on the U.S. Censuses of Population, Agriculture, and Manufacturing. Because the first census that comprehensively surveyed manufacturing and agriculture was the Census of 1840 (with economic data for 1839), direct estimates of gross product are not possible before that date. This led Paul David to label the pre-1839 period the "statistical dark age" (David 1967b). The absence of direct data, however, has not prevented scholars from making conjectures about the likely trend of output per capita going back to the beginning of the nineteenth century. Several estimates are presented in Table Ca9–19. Users must be cautioned about the fragility of these estimates. The paragraphs that follow describe the procedures used to make output estimates for the period 1790–1840.

Dividing the standard Kuznets–Gallman series for real GNP (series Ca212) by the population (series Aa9) allows us to estimate the rate of economic growth for the period 1869–1929. This statistic is remarkably stable at about 1.7 percent per annum. Interestingly, the annual estimates of the rate of growth of per capita GNP based on the work of Robert Gallman also grow at approximately 1.7 percent, whether one uses Gallman's GNP concept or the slave economy concept (series Ca239–240). Raymond Goldsmith first called attention to this remarkable stability in the rate of growth over the century from 1840 to 1940 (Goldsmith 1959). Given that stability, we may be tempted to extrapolate these growth rates backward into the statistical dark age. However, if we succumb to that temptation, we soon observe improbably low figures (North 1966, p. 16). Thus, Goldsmith postulated that there must have been an acceleration in growth sometime "not very long before 1839" (Goldsmith 1959, pp. 277–8). W. W. Rostow argued (on the basis of little evidence) that the acceleration or "take-off,"

as he called it, was an abrupt shift from little or no growth to sustained economic growth. He placed the break around the 1840s and argued that the development of the railroad network in the 1838–1845 period was the proximate cause of the change (Rostow 1960).

It had seemed impossible to Goldsmith, Rostow, and North to get solid numbers on which to estimate national output for the period before 1839. The underlying data on production, particularly on the crucial manufacturing sector, simply did not exist. Yet this did not quell a lively debate about Rostow's take-off hypothesis, his dating of the take-off, and its connection to railroad construction (Fogel 1964; Fishlow 1965; North 1966).

Paul David introduced an ingenious method for extending the numbers back before 1840 (David 1967a). GNP per capita can be decomposed into the product of worker productivity (i.e., average output per worker) and the rate of labor force participation (workers per capita). Stanley Lebergott made a major contribution by estimating the size of the labor force at each census date from the first Census in 1790 (Lebergott 1964). He also estimated the proportion of the total labor force that worked in agriculture (Table Ba814–830). Average productivity for the economy could be calculated, David observed, as a weighted average of agricultural productivity and nonagricultural productivity, with the weights determined by the relative proportion of the labor force in the two sectors. A fundamental ingredient for the application of David's methodology was a decennial series on crop output estimated by Marvin Towne and Wayne Rasmussen (Table Da1277–1287) (Towne and Rasmussen 1960). By deflating the Towne–Rasmussen output series by Lebergott's series on agricultural labor force, David was able to compute an index of agricultural labor productivity for 1800–1840. This series showed little (or no) growth between 1800 and 1820 and then rose rapidly between 1820 and 1840, spurred on by the opening of the highly fertile new lands in the Ohio valley and the Alabama–Mississippi cotton belt.

Next turning to Gallman's estimates of GDP for 1839–1840, David was able to obtain an estimate of agricultural productivity based on Gallman's agricultural output and Lebergott's agricultural labor force in that year. This established a point on which he could peg the Towne–Rasmussen index (see point A in Figure Ca-H). At the time David was writing, virtually nothing was known about the level of nonagricultural productivity in the antebellum period. However, David could calculate the level of nonagricultural productivity in 1840 implied by Gallman's work. Lebergott's estimates gave him the respective proportions of the total labor force in agriculture and nonagriculture; he had calculated the level of agricultural productivity from the Towne and Rasmussen data (point A); and Gallman's work, of course, gave him the level of output per capita (point B). Thus, David could establish that nonagricultural productivity was at the (relative) level of point C.

If we take time to think about it, this is an astonishing result. Because agricultural productivity was so far below overall productivity, a worker off the farm produced twice as much output as a farmer, and this in a country that had a level of agricultural productivity higher than had been seen in world history. Indeed, if such an enormous gap in productivity were a feature of the half-century between 1790 and 1840, it would have been an enormous engine of growth. Workers willing to take the risk and leave the security and independence of agriculture for a job in manufacturing could double their incomes. No wonder the proportion of the labor force in agriculture fell dramatically over the fifty-year period. As more and more workers poured into nonagricultural jobs, the overall productivity of the economy rose.

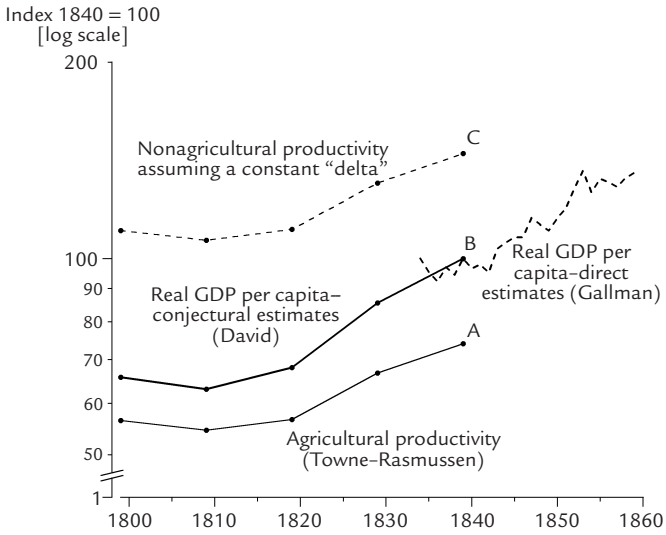

FIGURE Ca-H Paul David's method of extrapolating real GDP per capita back to 1799

Source

See discussion in the text.

Having no information on the trend of nonagricultural productivity between 1800 and 1840, David adopted the expedient of assuming that the ratio of nonagricultural productivity to agricultural productivity remained a constant over the forty-year period. This constant he called "delta." Although obviously arbitrary, the assumption of a constant productivity advantage was not entirely indefensible. There would have been two offsetting forces operating on this productivity gap. Working to close the gap would be the rising fraction of the labor force working in the nonagricultural sector. The higher wages possible in the manufacturing sector would attract some workers away from agriculture. The flood of workers into manufacturing and other nonagricultural pursuits should have slowed the productivity advance of that sector, whereas the slower growth of the agricultural labor force would (other things being equal) encourage productivity growth in that sector. On the other hand, the appearance and rapid expansion of manufacturing could be supposed to be accompanied by very rapid productivity gains as new methods of production were devised, learning by doing took place, and technological obstacles were overcome. David's assumption of a constant delta amounts to assuming that the classical equilibrating mechanism just offset the forces that might have otherwise exaggerated the gap between nonagricultural and agricultural productivity. The projection of nonagricultural productivity back to 1799–1800 from point C in the diagram reflects this guess.

Average economy-wide productivity is a weighted average of the productivities in the two sectors. The weights are the proportions of the labor force in agriculture and elsewhere. In 1800 and 1810, most Americans worked in agriculture, so David's conjectural estimates of GDP per capita are close to the level established by agricultural productivity. After 1810, the changing weights pull the average up and closer to the productivity line reflecting off-farm productivity. By 1840, economy-wide productivity is at point B.

David's conjectural estimates were a blow to Rostow's take-off thesis. They show no sharp acceleration in the rate of growth before 1820. The impact of the railroad age initiated in the late 1830s is not evident in the aggregate figures (although the railroads were undoubtedly part of the process that kept the rate of growth sustained at 1.7 percent for the next seven decades). David's work has stood as a foundation for the picture of American economic growth in the period before 1840. However, work by Thomas Weiss, Nancy Folbre, and Barnet Wagman suggests that revisions in David's estimates are warranted. These scholars accept the basic methodology but challenge the underlying data.

Weiss proposed three refinements to David's data inputs. First, and central to Weiss's research agenda, he proposed revisions in Lebergott's labor force data (Table Ba814–830) (Weiss 1992). The revisions change both the overall labor force participation rate of the population and its division into farm and nonfarm occupations. Second, Weiss revised the Towne–Rasmussen agricultural output series by expanding the definition of agricultural productivity to include the rental value of farm structures and the production of firewood for home use and sale, and he revised the Towne–Rasmussen estimates of home manufactures and the value created by land clearing and other farm "improvement" activities (Weiss 1993). Third, Weiss used estimates made by Kenneth Sokoloff of manufacturing productivity growth between 1820 and 1840 to challenge David's assumption of a constant productivity gap (delta) (Sokoloff 1986). However, Weiss adopted – consistent with David – a constant delta gap for the period 1800–1820.

The effect of the agricultural productivity revisions is to slow the rate of growth in that sector, because Weiss's estimates of imputed rents, firewood, and land improvements all grow more slowly than crop output. Weiss also reduces the rate at which the labor force moves from agricultural to nonagricultural pursuits, further slowing the rate of overall growth. Working against these revisions, which slowed the conjectural rate of growth over the 1820–1840 period, was Weiss's relaxation of David's constant advantage of nonagriculture over the farm sector. Making use of Kenneth Sokoloff's analysis of the McLane report on manufacturing (McLane 1833), Weiss argued that manufacturing productivity grew much faster than agricultural productivity between 1820 and 1840. Of course, not all nonagriculture is manufacturing. So Weiss assumed that manufacturing grew at Sokoloff's 2.3 percent per annum between 1820 and 1840, but that nonmanufacturing, nonagricultural productivity grew at the same rate as agricultural productivity. He assumed that nonagricultural production grew at the same rate as agricultural output before 1820. Because Weiss's revised estimates of agricultural productivity do not show growth prior to 1820, the end result he proposes is a flattening of the growth rate before 1820 compared to David's original estimate.

Nancy Folbre and Barnet Wagman were unhappy with the treatment of women in the David–Weiss framework (Folbre and Wagman 1993). They made three points: (1) Kuznets-defined GNP excludes housework, child care, and all other contributions to output made by women outside of the system of production for the market; (2) Weiss's labor force estimates – and Lebergott's as well – undercount females' contribution to market production; and (3) the true labor force participation of women and children differed markedly depending on which sector the husband/father labored in; however, Weiss's numbers (by assumption) do not allow for those differences.

The most vexing of the Folbre–Wagman objections is the second one, because Folbre and Wagman had no solid data source on which to make a better estimate of adult female labor force participation. However, expanding the standard definition of economic activity to explicitly include the production of services and goods produced by women for their families and outside of the market sector – thus addressing the first of Folbre and Wagman's complaints – obviated the need to estimate accurately the fraction of women's labor time devoted to the two activities. Folbre and Wagman increased female labor force participation rates to equal those of males and also imputed a value to the housework, child care, and other nonmarketed production of women. They did not, however, attempt to adjust for the third problem.

For the purposes of Table Ca9–19, we take a different approach to these problems. To retain comparability with the estimates of national output prepared by Gallman, Kuznets, and the BEA, we accept Kuznets's approach to housework and other nonmarketed production of women; we do not count it. Comparability, of course, would be of no value if the results were grossly misleading. In this case, they are not. In fact, the Folbre–Wagman approach does not have a noticeable impact on the *trends* in per capita income growth. The reason for this is that the Folbre–Wagman method imputes productivity in the nonmarket sector that increases at the same rate as productivity in the market sector.

In Table Ca9–19 we finesse the need to improve the estimate of the labor force participation of women and children by a different trick. We calculate productivity on a per-adult-male basis. Because we are interested only in the growth rate of a productivity index, the distortion of the level of productivity does not matter. The underlying assumption is that the man's wife and unmarried children live and work in the same sector he does. This is reasonably plausible. The major departure would be the practice of some young New England farm women of leaving home before marriage to work in the textile mills. This they did in sizable numbers beginning in the 1820s. However, if roughly the same number of young single men also left farming for urban pursuits, the assumption underlying the method adopted here would remain intact.

This approach will also automatically measure the output changes that were caused by evolving changes in the labor force participation rate of women and children in market activity. As men moved from agricultural work to nonagricultural work, some of the change in (per-male) productivity came directly from the elevated productivity in the nonagricultural sector, and some of it came from the different rates of labor force participation by his family. We do not have to measure that second component directly, nor even know the direction of the change, to incorporate it into the productivity index. The figures given for the benchmark years 1800, 1810, 1820, 1830, and 1840 for series Ca9 represent the conjectural estimates of GDP per capita estimated in this way. These estimates adopt Weiss's estimates of the adult male labor force participation and his division between the agricultural and nonagricultural sectors. They accept Weiss's revision of the Towne–Rasmussen index of agricultural output. They also accept Sokoloff's estimate of the rate of growth of manufacturing between 1820 and 1840. The result of these revisions is to flatten growth from 1800 to 1820 to a virtual standstill. A sharp take-off is located sometime between 1810 and 1830.

Just how reliable are these conjectural estimates? The answer is that they are quite fragile. Zero growth from 1800 to 1820 and

the appearance of sustained growth after 1820 is the consequence of three pieces of evidence, each of which is open to criticism:

1. The adult male labor force estimates suggest that labor does not begin to shift out of agricultural occupations before 1820. However, after 1820 the proportional rise in the nonagricultural sector is rapid.
2. Agricultural output is estimated to have grown only slightly faster than the adult male labor force engaged in agriculture between 1800 and 1820. Indeed, agricultural productivity (per adult male) does not grow much even after 1820.
3. Nonagricultural productivity is assumed to grow at the same rate as agricultural productivity (that is, not at all) before 1820, but rises rapidly after 1820, on the authority of Sokoloff's study.

Although this may leave us quite uncertain about the validity of the conjectural estimates, one should not conclude that nothing has been gained by the extensive examination of David's methodology and the available evidence. We can be quite confident that the changes inspired by the work of Weiss, Sokoloff, and Folbre and Wagman are all in the right direction and all of those changes work to flatten the growth rate between 1800 and 1820 relative to that between 1820 and 1840. Even David now agrees. In a still unpublished paper, Paul David revised his earlier estimates, replacing the assumption of a constant delta with a model in which the gap between manufacturing productivity and agricultural productivity widened particularly rapidly after 1820 (David 1996). David's revised estimates are much closer to our own than to his original estimates. However, we hope that it is clear that our knowledge about the rate of economic growth (however measured) before 1840 remains uncertain. This remains a subject of active research, and refinements and revisions of the estimates are a likely future result.

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