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### **ABSTRACT**

This paper presents Robert Gallman's classic, but heretofore unpublished annual series for US national product over the 1834-59 and 1869-1909 periods. The "Volume 30" series, reported as decadal averages, underlie much of what we know about American income growth and capital formation before 1909. This paper briefly documents Gallman's construction and use of the annual series, offers corrections for minor errors found in the previously circulated versions, compares the series with alternative national product estimates, and explores promising avenues for further research. Most importantly, this paper lays out why Gallman considered his annual "Volume 30" series unsuitable for business-cycle analysis.

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## **GALLMAN'S ANNUAL OUTPUT SERIES FOR THE UNITED STATES, 1834-1909**

Robert Gallman's annual series on the US Gross National Product over the 1834-1909 period represents one of the underground classics of American economic history.<sup>1</sup> Building on over a decade of hard labor, Gallman assembled his national product estimates in the mid-1960s to provide a clearer picture of long-run performance of the US economy. The data were originally published as overlapping decade averages in his 1966 article in Volume 30 of the *Studies in Income and Wealth* series.<sup>2</sup> Over the next three decades, Gallman continued to refine and elaborate his value added and final flow estimates as part of a long-term project on capital formation and national product. Gallman never published his 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." Since the mid-1960s, these series have passed from hand-to-hand in mimeo, Xerox, and worksheet form.

This paper takes Gallman's series out of the underground.<sup>3</sup> It presents his two major annual series for US GNP calculated on the final flow (i.e. spending) side for the

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<sup>1</sup> I have benefited from the comments and advice of Peter Coclanis, Joseph Davis, Lance Davis, Michael Edelstein, Stanley Engerman, Matthew Gallman, Claudia Goldin, Tom Mroz, and Thomas Weiss as well as the suggestions of the participants of the NBER Development of the American Economy, 2000 Summer Institute.

<sup>2</sup> Robert E. Gallman, "Gross National Product in the United States, 1834-1909," in Dorothy S. Brady [ed.] *Output, Employment, and Productivity in the United States after 1800*, *Studies in Income and Wealth* Vol. 30 (New York: Columbia Univ. Press, 1966). This work was completed well before 1966; the volume collected the papers given at the Chapel Hill, NC conference in Sept. 1963.

This work relied extensively on Robert E. Gallman, "Commodity Output, 1839-1899," in William N. Parker [ed.] *Trends in the American Economy in the Nineteenth Century*, *Studies in Income and Wealth*, Volume 24 (Princeton: Princeton University Press, 1960). This volume collected the papers from the 1957 Williamstown, NY conference.

<sup>3</sup> There is ample evidence that Gallman intended eventually (perhaps after further modifications and testing) to publish the Volume 30 series. For example, his 1981 proposal to the National Science Foundation (which received funding) listed among the tasks "to prepare the annual GNP series for

long nineteenth century: (1) US national product (excluding inventory changes) and the main sub-components in 1860 prices over the 1834-59 and 1869-1909 periods; and (2) national product in current prices over the 1869-1909 period. It goes beyond the spreadsheets that have circulated since the mid-1960s by incorporating Gallman's more recent work on inventory changes and discussing whether their inclusion is justified. It also uncovers and corrects a small number of errors appearing in the circulated spreadsheets. The paper briefly documents the methods employed in making the estimates, with special emphasis on the reasons why Gallman thought the resulting annual series were unsuitable for business cycle analysis. Finally, this paper discusses Gallman's later efforts to improve the Volume 30 series and explores promising avenues for further revisions.

Gallman's numbers are among the best we have for the nineteenth century and provide important material for any attempt to create better national product estimates. In his modest way, Gallman gave a sense of their value in his 1996/97 "Notes for the File on National Accounts":

The annual series underlying Volume 30 have several virtues... It has been extended into the ante-bellum years—on an annual basis, to 1834, and on an intermittent basis, to 1800—and it links with twentieth century series, rendering a quantitative account of virtually the entire national history of the United States; in most of the period with which we are principally concerned, it is available in considerable detail, distinguishing the various forms of consumption and of capital formation; (and) it lies within a consistent scheme of national accounting, which includes both the sectoral values added series... and the capital stock estimates...<sup>4</sup>

The Volume 30 series represent the product of decades of painstaking labor and careful judgment by one of the best economic historians. One motivation behind this paper is the belief that the best way to prevent the abuse of these series is greater openness, publicizing their limitations as indicators of the business cycle while highlighting their

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publication." His 1983 NSF proposal (again funded) was to compose a monograph on "Capital and American Economic Growth" in which the "Annual G.N.P. and N.N.P. figures, not presently in print, will be published" in Appendix A. "Proposal to the National Science Foundation: U.S. Capital Stock and National Income in the Nineteenth Century," August 19, 1981, p. 14 and "Proposal to the National Science Foundation: Capital and American Economic Growth in the 19<sup>th</sup> Century," August 4, 1983, p. 24, Gallman papers. His passing in November 1998 prevented this intention from being realized.

<sup>4</sup> "Notes for the File on National Accounts," p. 5, Gallman papers. This note was not dated, but internal evidence suggests Gallman composed it in 1996/97 while working on Lance E. Davis and Robert E.

value for other scholarly endeavors. To prevent their misuse, I ask that those using the series presented in this paper include the following statement in their citation: “*These data were not constructed for analysis as annual series.*”

This paper has the following form. The first section introduces Gallman’s annual series and documents why these figures, among those in Gallman’s files, are his most “finished” product. It also notes and provides corrections for several minor errors in the circulated series. The second and third sections discuss Gallman’s efforts to construct and further develop the Volume 30 series. The fourth sector lays out the limitations on their usefulness for business-cycle analysis while the fifth section compares the Volume 30 estimates to other available pre-1909 series for GNP and the implicit price deflator. Gallman’s work on extensions and promising areas for future research are explored in the sixth section. The seventh section concludes.

## **I. The Annual Series**

Contrary to conventional practice, this paper offers the soup before the sermon. Table 1 and 2 show Gallman’s annual series in constant 1860 prices for national product and its major spending sub-components over the 1834-1859 and 1869-1909 periods, respectively. The 1834-59 series are for census years – that is, 1839 refers to 1 June 1839 to 31 May 1840 – and those for 1869-1909 are for calendar years.<sup>5</sup> Table 2 also includes Gallman’s newer (1990s) estimates of annual changes in inventories for the 1870-1909 period and reports on various corrections to the post-bellum real product series. Table 3 displays Gallman’s series on annual national product and its major spending sub-components over the 1869-1909 period in current prices. Gallman did not develop annual current-value national product series for the ante-bellum period in Volume 30 because the relevant price deflators were available only intermittently.<sup>6</sup> Because Gallman made a

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Gallman, *Evolving Financial Markets and International Capital Flows: Britain, the Americas, and Australia, 1865-1914* (Cambridge: Cambridge Univ. Press, 2001).

<sup>5</sup> Gallman generally believed that as decadal averages the “estimates for the latter years are more reliable than those for the earlier years.” Notes for Table 3 of Robert E. Gallman, “Economic Growth and Structural Change in the Long Nineteenth Century,” in Stanley Engerman and Robert E. Gallman, [eds.] *Cambridge Economic History of the United States*, Vol II, (Cambridge: Cambridge Univ. Press, 2000).

<sup>6</sup> Tables A-2 and A-3 of his Volume 30 article provide current-value estimates, broken down by major spending category, for the years 1839, 1844, 1849, 1854, and 1859.

number of revisions over time, the series reported in this paper differ somewhat from those underlying the published decadal averages. Nonetheless, I will follow Gallman's practice of referring to these numbers as the "Volume 30 series."<sup>7</sup>

The data in Table 1 are, with Gallman's minor revisions, fundamentally the same as those underlying the overlapping decennial series published in his 1966 article in Volume 30 of *Studies of Income and Wealth*. The differences resulted from (1) small discrepancies in rounding and (2) small revisions to the estimates for manufactured producer durables in the post-bellum period, especially for 1884-1903 period.<sup>8</sup>

Apart from the inventory investment estimates, the figures using the 1860 prices are from a typeset mimeograph found in Gallman's files dated June 1965 with "Master-Final Version" penciled in his hand.<sup>9</sup> We have several solid pieces of evidence that Gallman considered these series his most "finished." First, he was using these spreadsheets as the basis for his work on national product and capital formation in the

In 1985, Gallman had his research assistant, Mike Butler, create annual current-value product estimates for the ante-bellum period using the current-price benchmarks, the constant-value product interpolators, and relevant series from the Warren-Pearson wholesale price indices. Gallman apparently intended to use these data in his work estimating the capital stock using the perpetual inventory approach. When the trend in the Warren-Pearson prices differed in sign for that of the price benchmarks (e.g. for several categories of commodities during the 1849-54 period) they used straight-line interpolation. I do not judge these series to represent Gallman's "finished product" and do not report them.

<sup>7</sup> There is another set of series in Gallman's notes including constant 1929-price values for the 1869-1909 period. These series appear to represent Gallman's revisions of Kuznets' series, which he used for interpolation among other purposes. Because Gallman does not treat this series as his own creation, I have chosen not to include them.

<sup>8</sup> Gallman revised his post-bellum manufactured producer durable series between the preparation of the Volume 30 paper for publication and June 1965. The June 1967 spreadsheets note that manufactured producer durables "may be slightly different from the series underlying Vol. 30." During the 1990s, Gallman was apparently unable to locate the exact spreadsheets used in the Volume 30 tables. In a 21 Jan. 1994 letter to Richard Sutch, Gallman recounted having "a dim recollection of making minor changes of this cost (of manufacturing durables) after the Vol. 30 paper was in press." Similarly on 15 Aug. 1995, Gallman wrote to Benjamin Friedman that "The series I am sending you differ slightly, but only slightly--from those that figure in the Volume 30 paper."

As Gallman's notes for 13 March 1985 indicate, manufactured producers' durables series from the June 1965 worksheet "misses consistently—clearly modestly different series.

|         | Vol. 30 Work Sheet |      |         | Vol. 30 Work Sheet |       |
|---------|--------------------|------|---------|--------------------|-------|
| 1869-78 | .389               | .391 | 1889-98 | .637               | .639  |
| 1874-83 | .490               | .497 | 1894-03 | .860               | .858  |
| 1979-88 | .591               | .590 | 1899-08 | 1.30               | 1.30" |
| 1884-93 | .616               | .614 |         |                    |       |

While spreadsheets exist that perform some of the interpolations used in the new series, I have not found anything fully documenting the changes. It is likely that they were the result of Gallman's creation of new benchmarks using better price series. One extant set of spreadsheets in the manufacturers producer durable files contains the notes "price data... found after conf(erence) paper series completed." Gallman papers.

1980s and 1990s. One copy has a pencil note “Checked—May 24, 1993.”<sup>10</sup> Second, he apparently sent the 1860-price national product series for 1834-59 from the June 1965 sheets to Robert Margo as late as 7 February 1996.<sup>11</sup> Third, Gallman sent the 1834-1909 national product series to Benjamin Friedman as late as 15 August 1995.<sup>12</sup>

There seems little doubt that Gallman intended to revise the annual series underlying Vol. 30 to include the newer inventory investment estimates. In the document “Notes for the File on National Accounts,” he states “the annual series underlying Volume 30 ... has an important, but easily eliminated, shortcoming: it does not include changes in the value of inventories. New estimates have now been made, however, removing this shortcoming.”<sup>13</sup> Indeed, Gallman incorporated the inventory change figures in the national product series that he reported in his 1997 “Economic Growth and Structural Change” paper.<sup>14</sup> Moreover, he included his later estimates of annual inventory changes in the series sent to B. Friedman.

The current price series for the 1869-1909 period are from handwritten spreadsheets dated June 1967 found in Gallman’s files.<sup>15</sup> Again, there is evidence he used these sheets as the basis for his subsequent work.

Gallman’s efforts to construct and improve his national product estimates spanned more than five decades, his entire professional life. The paper trail he left, while not complete, is amazingly thick. There are feet after feet of files, containing drafts of articles and huge paper accounting spreadsheets filled with hard-written entries, calculations, and source notes. Many of the exercises are repeated ad infinitum, with

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<sup>9</sup> Mimeo June 1965, Gallman papers.

<sup>10</sup> I have contacted several of the research assistants involved in these efforts (including Colleen Callahan, Michael Butler, and Debin Ma). Specifically in a 29 Feb. 2000 conversation, Butler indicated that to his knowledge, Gallman produced no series in the 1980s to replace the Volume 30 series.

<sup>11</sup> Material sent to Robert Margo, 7 Feb. 1996, Gallman Papers.

<sup>12</sup> Letter from Robert E. Gallman to Benjamin Friedman, 15 Aug. 1995, Gallman papers.

<sup>13</sup> “Notes for the File on National Accounts” p. 5. The 1860-value inventory change estimates are from a spreadsheet labeled D-1 in the inventory estimation files; the current-value estimates from sheets labeled B-1. Gallman papers.

<sup>14</sup> The GNP figures presented in Table 3 of the paper “were based on the numbers from Vol. 30, p. 26, ‘adjusted to incorporate inventory changes...computed from Robert E. Gallman, “The United States Capital Stock in the Nineteenth Century” in Stanley L. Engerman and Robert E. Gallman, (eds.) *Long-Term Factors in American Economic Growth*, Studies in Income and Wealth, Vol. 51 (Chicago: University of Chicago Press, 1986), p. 204 and Robert E. Gallman, “American Economic Growth before the Civil War: The Testimony of the Capital Stock Estimates” in Robert E. Gallman and John Joseph Wallis, (eds.) *American Economic Growth and Standards of Living before the Civil War* (Chicago: University of Chicago Press, 1992), p. 94.’ ”

numbers transferred by hand from one sheet to the next. Gallman and his research assistants were usually very thorough in outlining the steps used to produce a given number on a given sheet, but less helpful in bridging between the sheets or in dating the calculations. And because the numbers created or used in one branch of his work built on and required modifications to numbers created or used in other branches, the records are not always in chronological order. There are several instances where gaps appear in the paper trail.<sup>16</sup> Research leaves, changes in research assistants, and movements between offices no doubt explain some of these gaps. Though one cannot exactly replicate the series from the background material available (or, at least, my efforts have not completely succeeded), one can usually come quite close and the published documentation of the sources and procedures employed is remarkably good.

As noted above, I have discovered a handful of errors in Gallman's original data underlying Tables 2 and 3. The most notable errors occur in the data on gross investment in new railroad construction in 1860 prices for the 1875-77 period. The supporting documents suggest that the problem arose because a research assistant misplaced the decimal point when deflating the current dollar investment series by the construction cost index.<sup>17</sup> I also found several typos and inconsistencies in the Gallman's inventory investment series.<sup>18</sup> Given that the original data are used in much of Gallman's later work, it seems desirable to present them without revision and include my suggested corrections separately (in the bottom rows and far right columns of the Tables). The corrections, while important for the component series, have a negligible effect on the national product estimates; the differences in the resulting GNP estimates are always less than 3.5 percent. All of the subsequent discussion in this paper will be based on Gallman's original series.

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<sup>15</sup> Hand-written spreadsheet, June 1967, Gallman papers.

<sup>16</sup> See above. Also "Notes on Mat'ls taken to England" Gallman Papers.

<sup>17</sup> The errors were not offset by corresponding errors in the series on "all other construction" and, as a result, carry through to Gallman's total construction, capital formation, and GNP estimates for these years. There is some evidence that Gallman found the movements of the railroad series suspicious because there is a check next to the numbers. As noted below, Gallman produced in 1994 a new set of railroad construction estimates that avoid these problems entirely.

<sup>18</sup> In addition to minor typos, I found an inconsistency in the current-price inventory estimates for livestock over the 1869-79 period. Gallman and his research assistants employed the Historical Statistics values for farm animals, K 564-573. These series use gold rather the greenback values (although this is not explicitly noted in the source). For consistency, I converted the livestock values into greenbacks using prices from the Annual Reports of the US Commissioner of Agriculture, 1869-78.



## II. Construction of the Series

Gallman produced his estimates for the 1834-59 and 1869-1909 periods using the same basic methodological framework, but those for the ante-bellum period required substantially more original work. 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.

For the post-bellum period, Gallman largely adjusted estimates made by his teacher, Simon Kuznets, who in turn had built up his estimates from the work of William H. Shaw.<sup>19</sup> Gallman made the following adjustments to the Kuznets series: (1) substituting new estimates for firewood, animal products, and federal excise taxes for Shaw's series (thereby, substantially raising estimated national product in 1869 and lowering growth rates over the 1870s and 1880s relative to Kuznets series); (2) incorporating new estimates of distribution costs based on Harold Barger's 1955 NBER publication;<sup>20</sup> (3) splitting off railroad construction from other building activity and creating a more appropriate markup series; and (4) deflating the current-value GNP series by Dorothy Brady's detailed final price indices (using an 1860 base).<sup>21</sup>

Gallman constructed his ante-bellum national product series by (1) taking his benchmark figures for commodity (agriculture, mining, and manufacturing) production

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<sup>19</sup> Simon Kuznets, *National Product Since 1869*, (New York: National Bureau of Economic Research, 1946); William H. Shaw, *Value of Commodity Output Since 1869*, (New York: National Bureau of Economic Research, 1947). Shaw provided annual estimates of commodity production after 1889 and single-year estimates for 1869 and 1879. Kuznets then interpolated between the 1869, 1879, and 1889 benchmarks using annual series for available components; see his *National Product*, pp. 90-117 for details. See also Simon Kuznets, "Annual Estimates, 1869-1953, T-Tables 1-15 (Technical tables underlying series in Supplement to Summary Volume of Capital and Financing)" New York, NBER, c. 1961.

<sup>20</sup> Harold Barger, *Distribution's Place in the American Economy Since 1869* (Princeton: Princeton Univ. Press, 1955).

<sup>21</sup> Dorothy Brady, "Price Deflators for Final Product Estimates" in Dorothy S. Brady [ed.] *Output, Employment, and Productivity in the United States after 1800*, Studies in Income and Wealth Vol. 30 (New York: Columbia Univ. Press, 1966).

To deflate the value of production of perishables, semi-perishables, consumer durables, and manufactured producers' durables, Gallman used detailed information on commodity flows from Shaw and his own Volume 24 piece and on prices from Brady to create benchmark estimates for 1869, 1879, 1889, and 1899 using 1860 prices. He then employed the yearly variations in the corresponding Kuznets constant 1929-price annual series to interpolate between the benchmarks. The 1900-09 figures were simply extrapolated based on the Kuznets series. Simon Kuznets published his series on national product and its sub-components only as 5-year moving averages.

for the years 1834, 1836, 1839, 1844, 1849, 1854, and 1859; (2) adding estimates for the value of services based largely on capital stock series;<sup>22</sup> and (3) interpolating the series in the intervening years using scattered annual data on numerous economic activities. The appendix of Volume 30 extensively documents the procedures employed. The “major” benchmarks (1839, 1849, and 1859) were primarily based on materials from the US census whereas the “minor” benchmarks (1834, 1836, 1844, and 1854) used several state censuses. The benchmarks for commodity production relied primarily on the sectoral value added data described in Gallman’s Volume 24 Studies in Income and Wealth article.<sup>23</sup> There were only small adjustments and shifts of commodity production between categories.

Two points deserve our attention here. The first is that these series incorporated the most up-to-date data available in the early 1960s. In his acknowledgements for the Volume 30 article, Gallman thanked Albert Fishlow who generously provided his unpublished statistics on the annual production of locomotives and estimates of investments in railroad construction, Paul David for his unpublished series on agricultural implement production, Robert Fogel for his iron output series, Maurice Gottlieb for figures on residential construction, and Dorothy Brady for her final price series. 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, especially for the ante-bellum period. Robert Gallman would have heartily applauded any serious new research based on the collection and analysis of real economic data.

Second, the annual national product series between the benchmark years are interpolated or extrapolated using a less comprehensive set of products. The main issue is not the number of series used— for his ante-bellum estimates, Gallman employed data on over thirty commodities drawn from an amazing array of primary and secondary

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<sup>22</sup> Gallman’s method of estimating service flows in the ante-bellum period differed substantially from that used in the post-bellum period. For the 1869-1909 period, he followed the procedure of Kuznets who used budget studies to derive the ratio of consumer expenditures on services relative to commodities and then multiplying the commodity flow series by this ratio. Volume 30, p. 37. For the ante-bellum period, Gallman built up service flows primarily from capital stock estimates, particularly on the value of housing.

<sup>23</sup> “Commodity Output, 1839-1899.”

sources—but how representative their movements are.<sup>24</sup> Regarding his use of interpolators and extrapolators, Gallman noted in Volume 30 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 that the flow of materials into production (e.g. 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. The estimates produced are only used in decade averages... to reduce our dependence on benchmark year estimates to establish prewar levels of performance.”<sup>25</sup>

The main point is that these interpolation/extrapolation procedures are useful for determining long-run trends, but as Gallman noted, problematic for analyzing business-cycle fluctuations.<sup>26</sup> This is especially true for investigations of the changing volatility of the macro-economy or for comparison of one specific cycle with another. And this message carries double weight for analyses contrasting the behavior of the ante-bellum and post-bellum series, which at the detailed level are constructed in meaningfully different ways. One key difference is how non-commodity production is estimated. As Gallman was keenly aware, the results of business-cycle analysis on the annual Volume 30 data would depend more on artifact as fact.<sup>27</sup>

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<sup>24</sup> In particular, see the long Table A-10 in “Gross National Product.”

<sup>25</sup> “Gross National Product,” pp. 64-71.

<sup>26</sup> In a world with high compound growth rates, the use of straight-line interpolation also introduces biases in the timing of the expansion. The direction of the bias depends on whether the interpolator series grows faster or slower than the benchmark series.

<sup>27</sup> For these reasons, Gallman was generally opposed to work using his annual national product series to compare the volatility of nineteenth and twentieth century business cycles. But he also took strong issue with claims that his procedures to estimate non-commodity production over the 1839-59 period were “flawed” and generated excessively volatile series. In his view, any bias in volatility due to his construction procedure was likely to be weak or work in opposite direction from what is usually suggested. The ante-bellum series were not constructed using the Kuznets’ ratio-method to estimate service flows, but rather using the growth of housing stocks, which was far smoother. Note services accounted for about 24 percent of Gallman’s real value estimate of national product (excluding changes in inventories) over the 1834-59 period. 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 1834-42 period (p.64). But as p. 71 notes, he “attempted to dilute the effect of these oscillations by bringing the leather series into the interpolator.” Clearly, the volatility displayed in the annual series was the product of explicit, conscious data collection and assembly choices.

### III. Gallman's Subsequent Use of the Volume 30 Series

From the mid-1960s on, Robert Gallman produced a long stream of articles--often in collaboration with Lance Davis, Edward Howle, or Thomas Weiss-- that further developed and analyzed the Volume 30 national product estimates (see Table 4). For example, in "The Social Distribution of Wealth in the United States of America," Gallman added estimates of annual changes in inventories (based on decadal averages of differences in the capital stocks as estimated in his work with Howle.)<sup>28</sup> The paper "Trends in the Structure of the American Economy Since 1840," written with Howe for Robert Fogel and Stanley Engerman's *Reinterpretations*, explored the sectoral distribution of income in greater detail.<sup>29</sup>

One of Gallman's early collaborative efforts with Lance Davis, "The Share of Saving," reported new estimates of capital consumption and net investment flows, although this seems hidden by the article's other important contributions.<sup>30</sup> Calculating these figures involved depreciating the annual investment flows of equipment and structures estimated in the Volume 30 series. Chapter 2 of L. Davis, et al., *American Economic Growth* entitled "Pace and Pattern of American Economic Growth" took the next logical step by generating estimates of net national product for every decade from 1840 on.<sup>31</sup> And in their masterful "Capital Formation in the United States during the Nineteenth Century" published in the *Cambridge Economic History of Europe*, Davis and Gallman used the net investment and the net national product statistics to provide evidence on the timing and extent of the rise of capital formation.<sup>32</sup> In each case, the

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<sup>28</sup> Robert E. Gallman, "The Social Distribution of Wealth in the United States of America," *Third International Conference of Economic History*, (Mouton, 1965); Robert E. Gallman and Edward S. Howe, "Fixed Reproducible Capital in the United States, 1840-1900," mimeographed.

<sup>29</sup> Robert E. Gallman and Edward S. Howle, "Trends in the Structure of the American Economy Since 1840, in Robert W. Fogel and Stanley L. Engerman, (eds.) *The Reinterpretation of American Economic History* (New York: Harper & Row, 1971) pp. 25-37

<sup>30</sup> Lance Davis and Robert E. Gallman, "The Share of Saving and Investment in Gross National Product During the 19<sup>th</sup> Century, United States of America," in F.C. Lane (ed.) *Fourth International Conference of Economic History, Bloomington, 1968* (Mouton, 1973), especially Table 8, pp. 456-57. This is based in part on a 1966 paper by Robert E. Gallman and Edward S. Howle, "The Structure of U.S. Wealth in the 19<sup>th</sup> Century" in Gallman papers.

<sup>31</sup> "The Pace and Pattern of American Economic Growth" in Lance E. Davis et al., *American Economic Growth: An Economist's History of the United States* (New York: Harper and Row, 1972), pp. 15-60.

<sup>32</sup> Lance E. Davis and Robert E. Gallman, "Capital Formation in the United States during the Nineteenth Century" in Peter Mathias and M. M. Postan, (eds.) *Cambridge Economic History of Europe Vol. VII The*

article fundamentally was a work of economic analysis and interpretation, but there was usually some “value added” to the income or investment concept under examination.

The original Davis-Gallman “Share of Saving” piece is also noteworthy for beginning to incorporate the research of Gallman and Weiss on the service sector. In his summary appraisal of the ante-bellum series in Volume 30 (p. 62), Gallman had observed:

Of all the estimates, the poorest are those of the value of services flowing to consumers. We do not know what margin for error to assign to these figures. If they are in error, the chances are that they are too high. Services account for roughly one-quarter of GNP in the prewar years. Consequently, an error as large as 20 per cent in the service component would throw GNP off by only 5 per cent.

Around 1966, Gallman began working with Thomas Weiss to create new estimates on non-commodity production. These efforts led to the estimates of the value added of the service sector measured at the census years from 1839 to 1899 reported in Volume 34 of the *Studies in Income and Wealth*.<sup>33</sup> Given that the new series used data from a far more comprehensive collection of service activities, Gallman and Weiss regarded the Volume 34 estimates as “stronger” (p. 290) than those derived from the Volume 30 statistics. As Gallman had anticipated, the new series was 5-18 percent lower than the Volume 30 current-price series for the “service” sector over the 1839-79 period and about 10 percent higher over the 1889-1899 period. Consequently, the growth rate of service output as revealed by the new series was faster than shown in the old, especially over the late nineteenth century.<sup>34</sup>

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*Industrial Economies, Capital, Labour, and Enterprise, Part 2, The United States, Japan, and Russia* (Cambridge: Cambridge Univ. Press, 1978), pp. 1-69, see especially (Table 1, p. 2; Table 9, p. 26; Table 13, p. 31). Independently, Gallman worked to improve his estimates of agricultural inventories. See Robert E. Gallman, “Changes in Total Agricultural Factor Productivity in the Nineteenth Century,” *Agricultural History*, XLVI: 1 (Jan. 1972).

<sup>33</sup>Robert E. Gallman and Thomas Weiss, “The Service Industries in the Nineteenth Century,” in Victor R. Fuchs [ed.] *Production and Productivity in the Service Industries*, *Studies in Income and Wealth*, Volume 34 (New York: Columbia University Press, 1969). Volume 34 collects papers from a conference held in Ottawa, Ont. in 1967. Together with the commodity production estimates in Volume 24, this paper provides the basis for estimate GNP on a decadal basis over the nineteenth century on the sectoral income or value-added side.

<sup>34</sup>The Volume 30 series as reported in Volume 34 actually was calculated as a residual of national product minus net income originating from agriculture (including firewood production), manufacturing, mining, and construction. In addition to services, it included fishing and forestry exclusive of firewood production. Vol 34. pp. 288-89.

Although the subsequent articles built on the Volume 30 product series, the revisions were generally not incorporated in the annual estimates. That is, the changes were made as adjustments to the decadal averages rather than as revisions to the underlying series. But I hope this discussion also makes it plain that the Volume 30 series form the core part of our best estimates of US GNP, NNP, and capital formation before 1909. Thus they underlie much of what we “know” about nineteenth-century American growth.

#### **IV. Limitations on the Uses of the Estimates**

During his long career, Gallman circulated his unpublished Volume 30 series to other scholars, but they always came with a warning. As a 1963 mimeo put it, "NOTE: These figures should not be regarded as reliable, annual estimates. They were derived for the purpose of computing decade averages and are supplied to interested technicians for testing, not for analysis as annual series."<sup>35</sup> While this warning was not included the June 1965 mimeo that is the source for the data presented here, there is little doubt that his feelings had not changed substantially. When he provided his annual series for the 1834-59 and 1869-1909 periods to Benjamin Friedman on 15 August 1995, Gallman wrote:

the bases for these annual series are by no means strong, which is why the series have never been published. I needed series that would give me some way of placing the benchmark estimates—which are pretty strong—in the context of cycles and long swings. I thought (and think) that the annual interpolations are good enough for that, but not close analysis of the cycles, themselves. (Emphasis in the original).<sup>36</sup>

Gallman’s background materials underlying the “Chapter 3: Appendix US Estimates of National Product” in Davis and Gallman, *Evolving Financial Markets* re-iterated these concerns. These drafts noted that neither Simon Kuznets nor John Kendrick published their annual GNP series. “Kuznets thought the series would be useful in the study of trends and long swings, but he had doubts with respect to their ability to properly describe business cycles. For this reason, he never published annual series for the years before 1889. These annual series were available in mimeographed form, however, and

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<sup>35</sup> Mimeo with pen note “Corrected Copy, Oct. 28, 1963,” Gallman papers

<sup>36</sup> Letter from Robert E. Gallman to Benjamin Friedman, 15 August 1995, Gallman papers.

have been used by other scholars in their work on national product.” Gallman further wrote that the explanation for publishing the Volume 30 series “only in the form of decade average...was the same as Kuznets had used earlier.”<sup>37</sup>

Because the research community abhors a vacuum as much as nature does, analyses of the annual Volume 30 series did appear in print. Where Robert Gallman refused to go, others would.<sup>38</sup> And eventually Gallman did allow Milton Friedman and Anna Schwartz to publish a “somewhat revised” version of his series over the 1869-1909 period in their *Monetary Trends in the United States and the United Kingdom*.<sup>39</sup> Essentially, they created a net product series from Gallman’s Volume 30 series by adding inventory changes back in, estimating and deducting depreciation, and shifting the price base to 1929. But as Gallman noted on occasion, his 1834-59 national product series were never published in annual form.

In an important sense, Gallman’s objective in creating his annual series was exactly the opposite of business-cycle analysis. He wanted to control for short-run fluctuations so they would not cloud our assessment of longer-run economic performance. Simple comparisons of the benchmark estimates, available only on a five or ten-year basis, risked comparing peaks with troughs. Table 5 provides a better sense of differences resulting from using the benchmark estimates and the decadal averages. As it shows, especially in the ante-bellum period, the growth rates calculated over the

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<sup>37</sup>“Chapter 3: Appendix U.S. Estimates of National Product” in *Evolving Financial Markets* pp. 342-344. Also see “Notes for the File on National Accounts,” Gallman papers. Gallman is presumably referring to Kuznets’ T-tables.

Kuznets observed that “the series available as annual interpolators were most frequently the more sensitive indexes and would yield annual series exaggerating the short-term changes.” His annual gross product estimates “would not be acceptable measures of the amplitude of short-term changes” and, therefore, “are not shown.” Simon Kuznets, *Capital in the American Economy, Its Formation and Financing* (Princeton: Princeton Univ. Press, 1961) p. 546

<sup>38</sup> For example, Peter Temin, *The Jacksonian Economy* (New York: W. W. Norton, 1969) pp. 156-58; John A. James, “The Stability of the 19th-Century Phillips Curve Relationship,” *Explorations in Economic History*, 26(2), April 1989: 117-34 and “Changes in Economic Instability in 19<sup>th</sup> Century America,” *American Economic Review*, 83(4), Sept. 1993, pp. 710-31 used Gallman’s unpublished series to analyze business cycles.

<sup>39</sup> Milton Friedman and Anna J. Schwartz, *Monetary Trends in the United States and the United Kingdom: Their Relation to Income, Prices, and Interest Rates, 1867-1975* (Chicago: University of Chicago Press, 1982) pp. 99-101, 122-26.

decadal averages are less volatile than those based on comparisons of the single-year benchmarks.<sup>40</sup>

## V. Comparisons with Other Estimates

To assess the Volume 30 series more fully, it is useful to compare them with the other available annual series. This is rather easily done for the ante-bellum period because the only other annual series in general circulation are Thomas Berry's. (Actually, Berry authored several series; I focus on his 1978 and 1988 versions.)<sup>41</sup> He constructed income estimates for the 1789-1889 period using regression analysis and back-projection. Basically, he found a number of long time-series of economic variables extending from the time when reliable national product estimate exist back into the earlier "statistical dark age." Berry empirically estimated the relationship between these variables and the national product series during the period of overlap and then used these coefficients to back-cast the product series for the earlier period. This procedure is problematic if these relationships shift over time, that is, if as almost every observer attests, the US economy experienced significant structural change over this period. Given that Gallman's national product estimates over the 1834-59 period are based on a firmer empirical foundation than Berry's numbers, this comparison is best viewed as a test of Berry.

Figure 1 and 2 compares the annual constant-dollar product 1978 and 1988 estimates of Thomas Berry with those of Robert Gallman over the 1889-1834 and 1834-59 periods, respectively. For the early period, Figure 1 includes Gallman's GNP estimates for 1793, 1800, 1807, 1810, 1820, and 1830 from Table 3 from the "Economic Growth and Structural Change in the Long Nineteenth Century" (which added estimates for inventory changes). For the later period, Figure 2 compares the Gallman and Berry

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<sup>40</sup> The contrast between the ante-bellum and post-bellum periods is largely the result of using benchmarks every five years in the early period and every ten years in the later period. It also helps that few of post-bellum benchmark years coincided with peaks or troughs of the business cycle.

<sup>41</sup> Thomas Senior Berry, *Revised Annual Estimates of American Gross National Product, Preliminary Annual Estimates of Four Major Components of Demands, 1789-1889*, Bostwick Paper No. 3 (Richmond, VA: Bostwick Press, 1978); and *Production and Population Since 1789, Revised GNP Series in Constant Dollars*, Bostwick Paper No. 6 (Richmond, VA: Bostwick Press, 1988).



series directly.<sup>42</sup> For the 1834-59 period, Gallman's series starts lower than either of the Berry's series and it displays considerably more variability than the Berry 1978 series but less than the Berry 1988 series. Also note that for the earlier 1789-1834 period, Berry's figures are initially lower than Gallman's, implying higher rates of growth.

Making comparisons for the post-bellum period is more difficult because there now exists a plethora of alternative series. Among the series pre-dating the Volume 30 series are those of Kuznets and Kendrick. Kendrick's main contribution was to adjust the concepts underlying Kuznets's series to make the national product estimates more comparable to the official Department of Commerce series. Specifically, Kendrick treated the government sector differently. This adjustment resulted in unimportant changes over late nineteenth century because government spending was small. Figure 3 compares the real Kuznets Variant 1 annual GNP series with Gallman's counterpart over the 1869-1909 period using 1909 as the base date. (Note Kuznets aggregated using 1929 prices whereas Gallman employed 1860 prices.) As the discussion in Volume 30 indicated, the rate of growth implicit in the Kuznets series well exceeded that in the Gallman series during the period after the Civil War.

Post-dating the Volume 30 series are those of Christina D. Romer and of Nathan S. Balke and Robert J. Gordon.<sup>43</sup> Both series accepted the revisions that Gallman made to Kuznets' series and made further changes which affected the cyclical movements of the series rather than its general trend. Romer used regression analysis to replace Kuznets's less formal procedure for establishing the relationship between commodity production and the output of the service sector. Balke-Gordon also used regression analysis, in a different form, to estimate non-commodity production. In addition, they developed new interpolators for the construction, transportation, and communications sectors and constructed new annual deflators, based on movements in consumer prices.

Comparing his series with the newcomers, Gallman concluded that the three series "differ chiefly in the methods used to estimate non-commodity production, and the

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<sup>42</sup> There is internal evidence in Gallman's files that he and his research assistants made such comparisons themselves. "Gallman vs. Berry" file, Gallman paper.

<sup>43</sup> Christina D. Romer, "The Prewar Business Cycle Reconsidered: New Estimates of Gross National Product, 1869-1908," *Journal of Political Economy* 97:1 (1989) 1-37; and Nathan S. Balke and Robert J. Gordon, "The Estimation of Prewar Gross National Product: Methodology and New Evidence," *Journal of Political Economy* 97:1 (1989) 38-92.

differences in methods chiefly affect undulations in the series, not trends.” Figure 3 introduced above also includes Romer and Balke-Gordon constant-value GNP series. As Gallman observed, there were important differences in the annual movements of the series around 1894 and again in 1903/04, but that over the long run the series can be regarded as telling roughly similar stories. He further argued that because only the Volume 30 style series offered details regarding the composition of GNP, it retained substantial value in any putative competition with the newcomers.<sup>44</sup> Elsewhere Gallman concluded the three series exhibited “quite similar” decennial rates of change. The most visible discrepancies occurred in the 1870s when the Balke-Gordon series displays a markedly different pattern from the Romer, Gallman, or Kuznets series. But note correcting the typos appearing in Gallman’s railroad construction series in the 1875-77 period creates a series closer to Balke-Gordon during the second half of the 1870s.

Another important point of comparison between the various national product estimates for the nineteenth century is their implicit price deflators relating current-dollar to constant-dollar GNP. Figure 4 graphs the deflators (set at 100 in 1909) implicit in the Gallman, Kuznets Variant I, Balke-Gordon, and Romer product estimates for the post-bellum period.<sup>45</sup> The Gallman and Romer series follow roughly similar patterns. The Balke-Gordon series, which is based primarily on the consumer price indices of Hoover and Rees, displays a consistently different picture as the authors note.<sup>46</sup> The Kuznets series initially tracks the Balke-Gordon series, but shifts to the Gallman-Romer pattern from the 1880s on. The year-to-year movements of all four series largely coincide.

## **VI. Extensions and Promising Areas for Future Research**

Gallman considered the annual estimates of nineteenth century US national product, which he made in the 1960s, “incomplete” and he worked over the subsequent decades to make improvements. A memo from 20 May 1985 highlighted the following limitations with the Volume 30 national product series:

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<sup>44</sup> “Notes for the File on National Accounts” pp. 7-8, Gallman papers.

<sup>45</sup> Gallman did not create any current-value estimates for the 1834-59 period that should be considered “finished work,” so no implicit price deflators exist for the ante-bellum period.

<sup>46</sup> Balke and Gordon, “Estimation,” pp. 71-75.

- “(a) They are missing one element of investment—changes in inventories.
- (b) There is a gap in the series from 1859 to 1869.
- (c) The current price components of the series are intermittent before the Civil War.
- (d) The series do not extend back of 1834.
- (e) There are no net national product estimates.
- (f) Also, it would be helpful to complete estimates expressed in, say, 1929 prices to facilitate long-term analysis.”<sup>47</sup>

Gallman and his research assistants engaged in a project in the summer of 1985 to address several of these issues, specifically (a), (b) and (c). With the exception of the estimation of inventory changes, these initiatives apparently did not reach such a finished stage as to merit incorporation in the annual series Gallman sent to scholars in the 1990s.

Most of this work in the mid-1980s focused on adjustments relevant to Gallman’s capital stock project. For example, to create estimates comparable to those of Raymond Goldsmith and to check his own census-based capital stock estimates, Gallman pursued the perpetual inventory approach of accumulating and depreciating annual investment flows.<sup>48</sup> As part of this research, he produced and published a variety of new annual series on investment in manufactured producers’ durables and construction. This endeavor required filling the gap in his annual product series during the Civil War decade and projecting the series back from 1834 to 1790 (addressing points (b) and (d) above). For this purpose, Gallman relied on Berry’s 1978 national product series, which explains in part his thoroughgoing analysis of this work. Gallman concluded that the Berry series suffered from two weaknesses: (1) investment was derived as residual of product minus consumption; and (2) “the empirical bases for the Berry estimates become ever more fragile as the series extends into the early nineteenth century and the late eighteenth.”<sup>49</sup> This project produced several new investment series, but there is little or no evidence Gallman believed that these should replace the figures in his Volume 30 series. Indeed regarding the perpetual inventory estimates, he wrote: “I publish the annual data with some misgiving – in view of the weaknesses of the evidence on which they are based—and refuse to warrant them for any particular purpose. Future users are on their own and

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<sup>47</sup> Memo to Mike Butler, 20 May 1985, Gallman papers.

<sup>48</sup> Robert E. Gallman, “Investment Flows and Capital Stocks: U. S. Experience in the Nineteenth Century,” in Peter Kilby [ed.] *Quantity and Quiddity: Essays in U.S. Economic History* (Middleton, CN: Wesleyan Univ. Press, 1987) pp. 214-54.

<sup>49</sup> “Investment Flows,” p. 217.

are asked not to blame me if the series do not perform up to expectations. On the other hand, I am willing to accept the credit if they do.”<sup>50</sup>

Gallman also actively but intermittently worked to revise his transportation investment series. The original Volume 30 estimates of the value of railroad construction relied on the work of Melville Ulmer, which never truly satisfied Gallman. He reported using Ulmer’s cost index with “some hesitancy.”<sup>51</sup> In the mid-1980s he set his research assistants on the task of re-calculating ante-bellum canal and railroad investment. Part of the goal was to incorporate Fishlow’s superior construction cost estimates. Part was to correct problems in Cranmer’s canal investment series, which as Segal noted included some of the Pennsylvania Mainline System’s early investments in railroads. More generally, Gallman wanted to derive series on railroad construction consistent with his decadal railroad capital stock estimates. A notebook from the mid-1980s entitled “Measurement of U.S. Nineteenth Century National Product” concluded that these adjustments were “not of great quantitative significance.”<sup>52</sup>

Spurred on by communications with Richard Sutch in 1993/94, Gallman re-visited his attempts to revise capital formation estimates in American railroads over the late nineteenth century.<sup>53</sup> The nature of the problem in the annual Vol. 30 series is apparent in the constant-value railroad construction series appearing in Table 2. In the process of disaggregating post-bellum construction into railroad and non-railroad

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<sup>50</sup> “Investment Flows,” p. 254.

<sup>51</sup> Melville J. Ulmer, *Capital in Transportation, Communications, and Public Utilities: Its Formation and Financing*, (Princeton: Princeton Univ. Press, 1960). “Gross National Product,” pp. 37-38. On p. 40, Gallman discusses his misgivings about Ulmer’s cost index.

<sup>52</sup> “Measurement of U.S. Nineteenth Century National Product,” Gallman Papers. Work by Butler and Gallman to remove the \$6.4 million spend on the Pennsylvania Mainline railroad between 1829 and 1845. yielded the following revisions in the 1834-45 series (measured in millions of 1860 dollars):

| Year | Canal Construction | Real GNP    | Year | Canal Construction | Real GNP |
|------|--------------------|-------------|------|--------------------|----------|
| 1834 | 3.9                | <u>1401</u> | 1840 | 16.1               | 1609     |
| 1835 | 4.7                | 1377        | 1841 | 9.5                | 1679     |
| 1836 | 7.4                | 1370        | 1842 | 2.7                | 1680     |
| 1837 | 11.9               | 1487        | 1843 | 1.2                | 1880     |
| 1838 | 15.1               | <u>1492</u> | 1844 | 1.8                | 1974     |
| 1839 | 16.6               | 1622        | 1845 | 2.4                | 2069     |

The revisions changed real GNP by more than the rounding error only in 1834 and 1838, as indicated by underlining. “Note on the Adjustment of Canal Construction Estimates” Gallman papers.

<sup>53</sup> Sutch to Gallman, 26 Sept. and 19 Nov. 1993; Gallman to Sutch, 14 and 21 Jan. 1994.

components, Gallman used Ulmer's estimates of gross capital expenditures (excluding land) by steam railroads and then subtracted estimates of equipment spending based on Shaw's output data to derive his series of annual gross investment for railroad construction.<sup>54</sup> This procedure apparently yielded negative residuals in the 1896-98 period, leading Gallman to replace these estimates with the zeros shown in the Table. (As noted above, the original series also contain errors resulting from misplacing the decimal point during the 1875-77 period.) As Figure 5 illustrates, the timing of the original residual-based series is poorly correlated with numbers of mileage constructed available from *Railway Age*.<sup>55</sup> Over the 1869-1909 period, the correlation coefficient was only 0.07.

Based on better data on the cost of construction from Albert Fishlow and information on the number of miles of railroads built, Gallman produced in 1994/96 a revised series on railroad construction investment over the 1870-1909 period.<sup>56</sup> Although Gallman did create some GNP series using the revised figures, it is questionable whether these data should be considered a "finished product." From personal conversations, I know that Gallman believed that re-estimating railroad investment was a highly fruitful subject for future research. For the convenience of those who would prefer to use the revised series (and avoid the obvious problems inherent in the original railroad series), I have included Gallman's 1994/96 revisions for railroad construction in Table 2. Again, the effects on the annual GNP estimates are small.

Throughout his work Gallman relied on what he considered the best available price series, chiefly Dorothy Brady's numbers. But he clearly noted that the "prices count a lot" and having "more reliable" price series would improve our ability to form better estimates of both constant and current GNP.<sup>57</sup> The differences between the

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<sup>54</sup> Gallman, Vol. 30, p. 37, footnote 45. Ulmer, *Capital*, p. 256, 274.

<sup>55</sup> *Railway Age* (128:1) 7 Jan. 1950 p, 246. This series is also available at the NBER macrohistory website and is quite similar to the railroad construction series reported in *Poor's Manual* from 1880 on.

<sup>56</sup> Based on Series Q 329, 321, and 287 from *Bicentennial Edition Historical Statistics*. The Q 329 series had an unexplained gap between 1879 and 1893. Gallman instead interpolated using the changes in Q 321, and 287 series, the number of railroad miles operated. The correlation with the *Railway Age* series is close, but not exact. Using his improved capital stock estimates, Gallman created a revised series on railroad construction investment over the 1870-1909 period. He allocated his decadal estimates of real gross investments in railways over the years based on the miles of track constructed annually (or on the changes in railroad miles operated). Letter to Sutch, 14 Jan. 1994 and spreadsheet dated 27 Jan. 1996, Gallman papers.

<sup>57</sup> Letter to Diane Lindstrom, 10 June 1988, Gallman papers.

movements of the implicit price deflators displayed in Figure 4 highlight the importance of treating prices with care.

Another area that seems ripe for reconsideration is the estimation of the product of the service sector, especially for the ante-bellum period. As noted above, the estimation of non-commodity production and its impact on measured volatility figure prominently in the debates between Romer, Balke-Gordon, and others. Moreover, Gallman considered the service sector estimates for the antebellum sector the weakest in the series and worked with Thomas Weiss to improve the benchmark estimates in their Volume 34 paper. The Volume 34 decadal estimates, which include data on distribution, transportation, public utilities, banking, insurance, professional and personal services, education, government, and housing, could usefully serve as benchmarks for more comprehensive interpolations and extrapolations than those conducted to estimate the service flows in Volume 30.<sup>58</sup>

A further area that warrants further examination is the estimation of inventory changes over the 1870-1909 period. During the 1990s, Gallman endeavored to supplement his decadal inventory estimates with annual figures (see below). By differencing the inventory stocks, Gallman formed estimates of annual inventory investment, which he added to his Volume 30 series to create a GNP series closer to the conventional definition. The work to estimate inventory levels was conducted, principally by his research assistants, in the mid-1990s and has not been subject to the same scrutiny as the Volume 30 numbers.

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The common practice of presenting real GNP, nominal GNP, and the implicit price deflator as separate columns in tables misstates their interdependence. Obviously any two aggregate series yields the third, but the procedures used to the aggregates typically involve combinations of all three. That is, for some components, price indices and quantities are multiplied to derive values; for others, quantities are estimated from values divided by a price series; and for still others, implicit prices are derived from values divided by quantities. This implies that decisions about the price concepts must be made in the process of generating the real product series.

<sup>58</sup> My understanding of the procedure used to derive the ante-bellum service flows is as follows: Gallman had estimates for the 1869 value of services in 1860 prices and three extrapolating series: (a) the value of churches (available in 1870 and 1860); (b) the value of tax receipts of state and local governments (running back to 1849); and (c) the value of residential housing (with existing estimates available back to 1850 and Gallman's extrapolation to 1840). He first converted all of the extrapolators into 1860 dollars and then uses all three to estimate the 1859 benchmark from the 1869 value. Then he used real values of (b) and (c) to derive the 1849 benchmark and finally (c) alone to calculate the 1839 benchmarks. To interpolate between the 1839, 1849, and 1859 levels, Gallman employed Gottlieb's estimates of the stock of residential housing (which must be a fairly smooth series) and to extrapolate back of 1839, he used his lumber series (pp. 57-60, 63-64).

An additional concern centers on how the inventory stocks were estimated. They were estimated separately the stocks of animals (cattle, swine, sheep, horses, and mules) and of other goods (imported goods, crops, mined and manufactured goods). The procedure for estimating inventories of other goods followed “one employed by Kuznets (*National Product Since 1869*, 1946, 228) (where) inventories were taken as a fixed fraction of the value of imports and the value of outputs of the agricultural, manufacturing, and mining sectors.”<sup>59</sup> Note that this procedure, while reasonable over long periods, builds properties into the high-frequency time-series that may be misleading. Specifically, it assumes that the relationship between production and inventory accumulation does not vary over the business cycle.

Also note that if the ratios translating output into inventories fail to capture the effects of improvements in transportation and communications or organizational changes (such as the rise of modern business enterprise), these inventory figures may paint misleading picture of secular growth. As the Volume 30 paper observed that:

“Kuznets’ estimates of changes in inventories are, in considerable measure, extrapolations on rates of change of output. Since we have altered these rates of change, the inventory figures should be adjusted. But Kuznets himself has limited confidence in the procedures he used. Application of these procedures to pre-Civil War data would appear to be even more dubious, but no other method is presently available. Consequently, we decided to leave this component out of both the pre- and post-Civil War series”<sup>60</sup>

I leave it to others to judge whether to include or exclude the recently added series on annual inventory changes. This discussion serves to highlight that assembling and analyzing data on the evolution of inventory-output relationships over the nineteenth century is a potentially high-value area for future research.

Finally, Gallman made a number of estimates of the value of non-conventional output, including the value of improvements to farmland and of home production activities. To evaluate economic performance over the nineteenth century requires paying full attention to these important activities and to the shifts between market and non-market production.

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<sup>59</sup> “American Economic Growth before the Civil War,” p. 109.

## VII. Concluding Remarks

The Volume 30 series were the product of decades of painstaking labor and careful judgment by one of the best scholars ever to work in the field of American economic history. They form a key part of our best estimates of nineteenth-century US GNP, NNP, and capital formation and thus underlie much of what we know about America's economic growth. In his modest, scholarly way, Robert Gallman wanted to make his Volume 30 estimates better before releasing them to the world. Even without all the improvements he hoped to make, they remain among the best numbers we have for this period. Gallman worried that making his annual series available would only encourage their further misuse by business-cycle analysts, which angered him greatly. Again to address this concern, I ask that those using the series presented in this paper include the following statement in their citation: "*These data were not constructed for analysis as annual series.*"

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<sup>60</sup> "Gross National Product in the United States, 1834-1909," p. 39. It cites Kuznets, *Capital*, pp. 159-60 where he express concern that using the inventory-output ratios from the 1920s "may have introduced a false stability" into key economic relationships.



FIGURE 1: Comparison of Ante-bellum GNP Series, 1789-1834

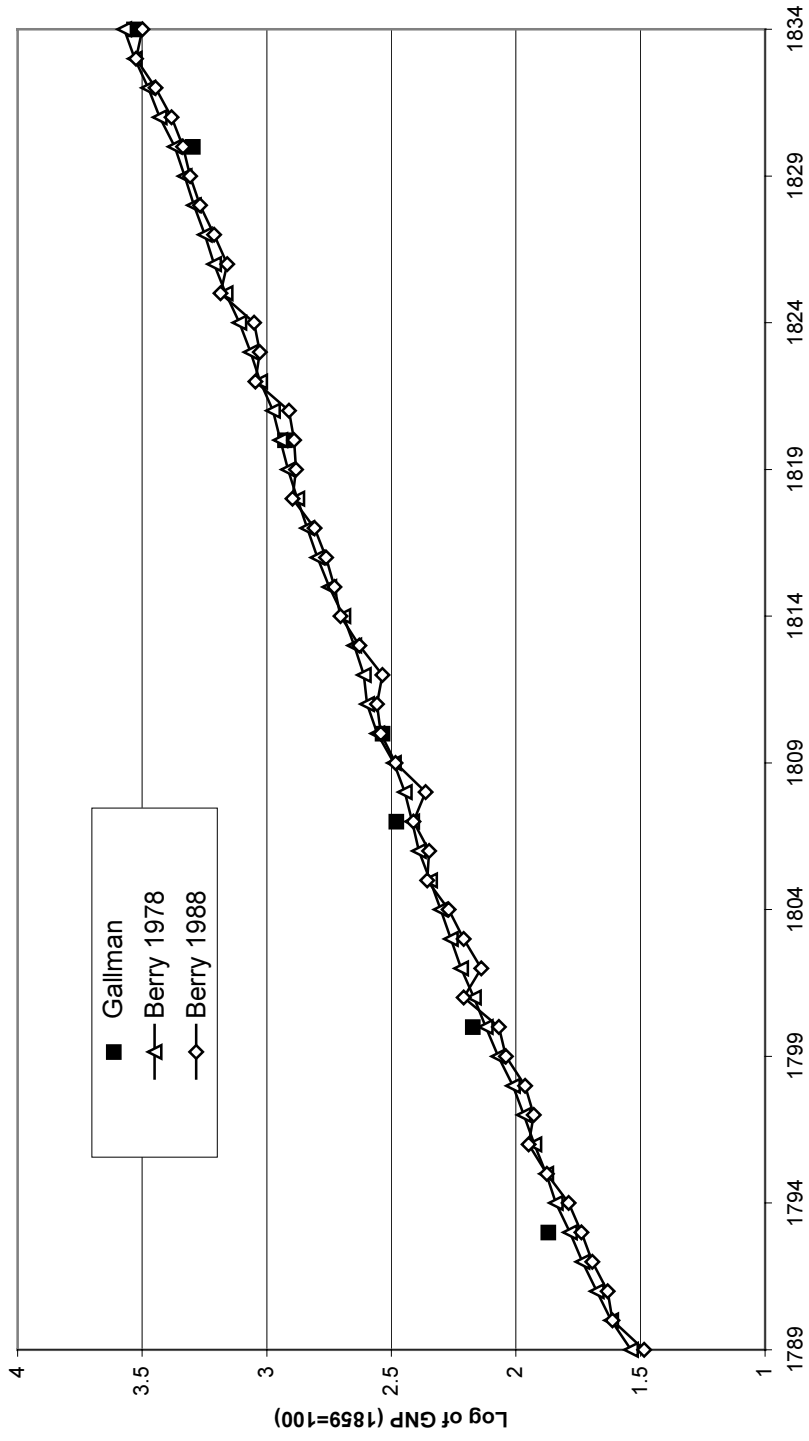


FIGURE 2: Comparisons of Ante-Bellum GNP Series, 1834-1859

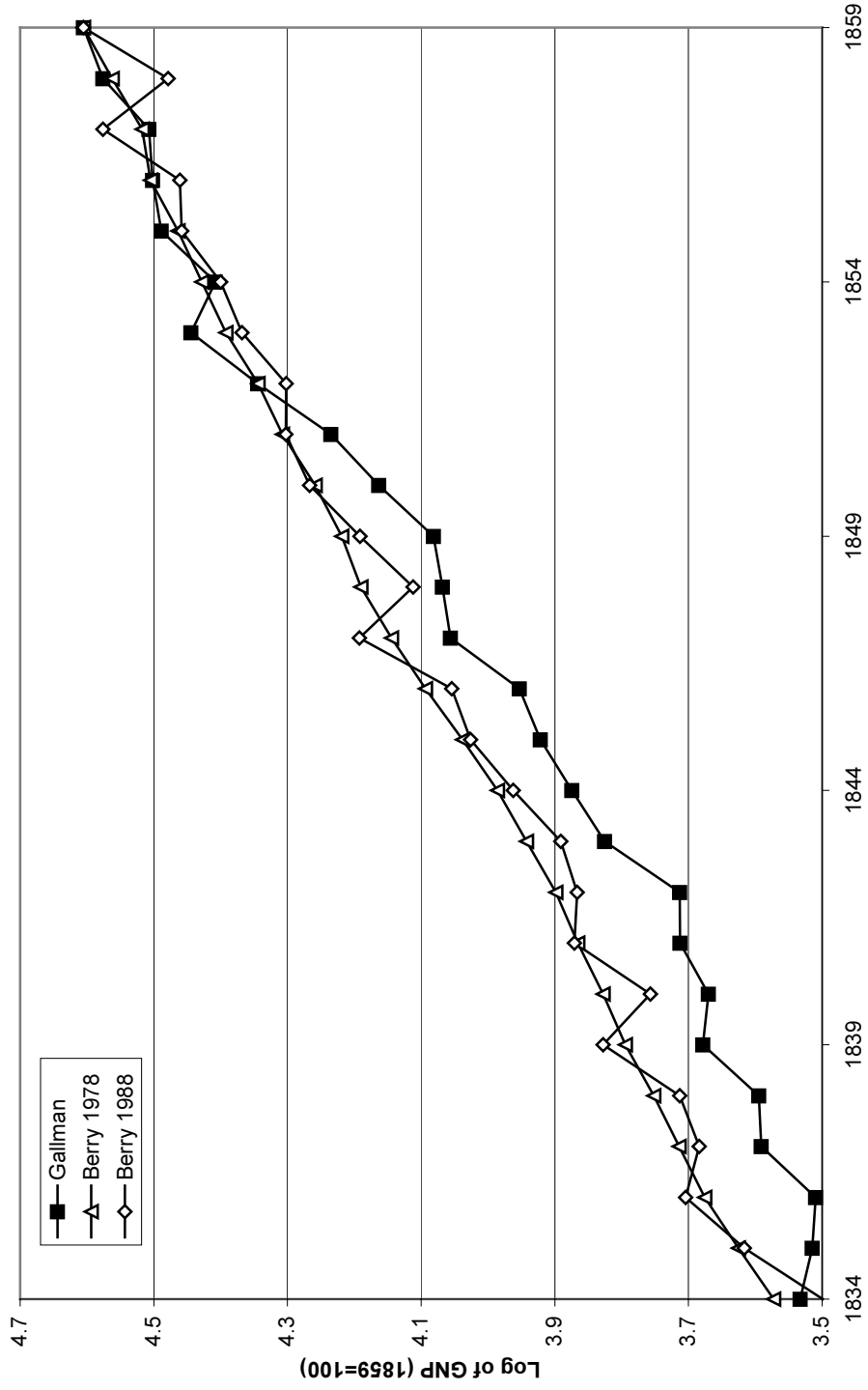


FIGURE 3: Comparison of Post-Bellum Real GNP Series

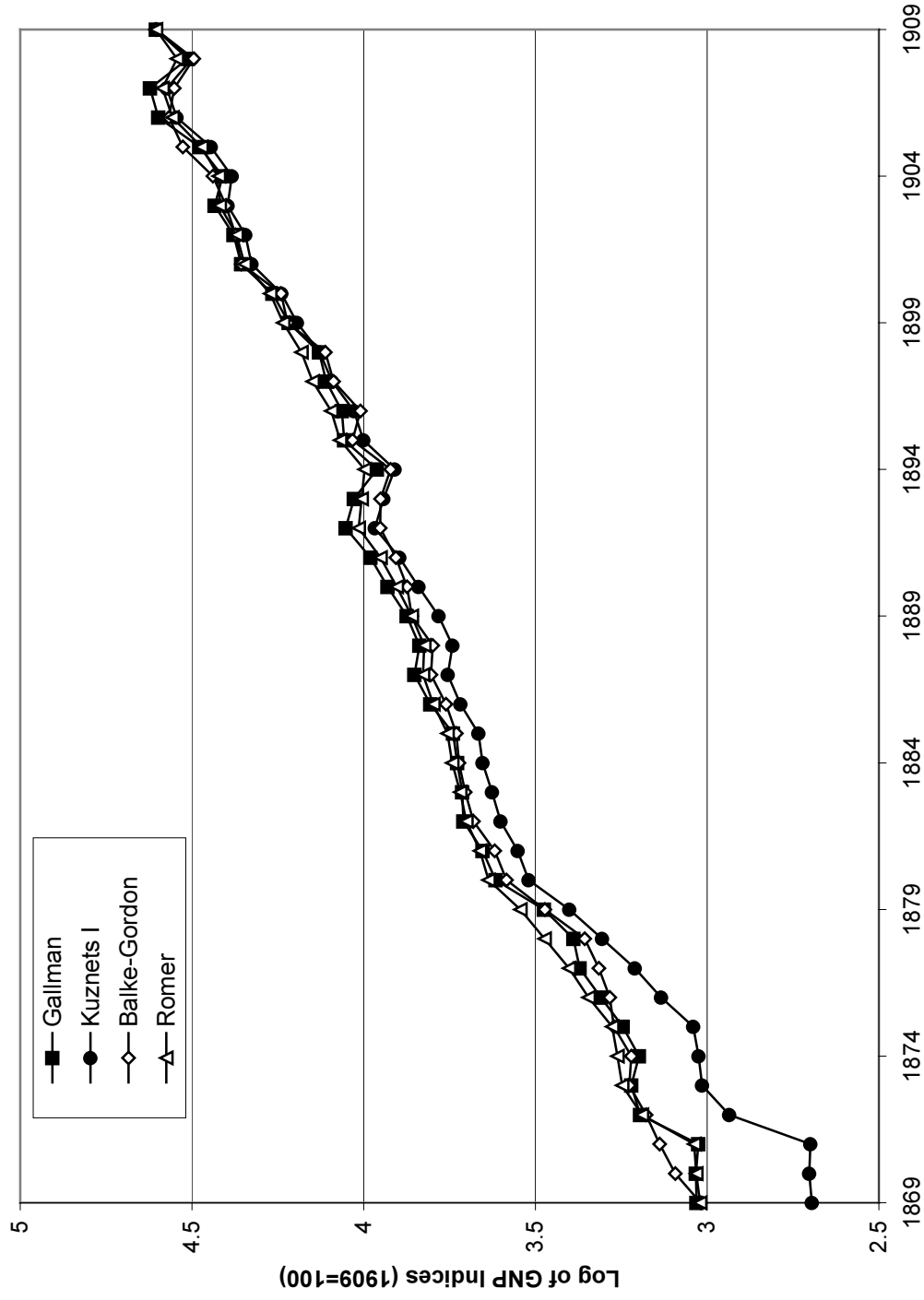
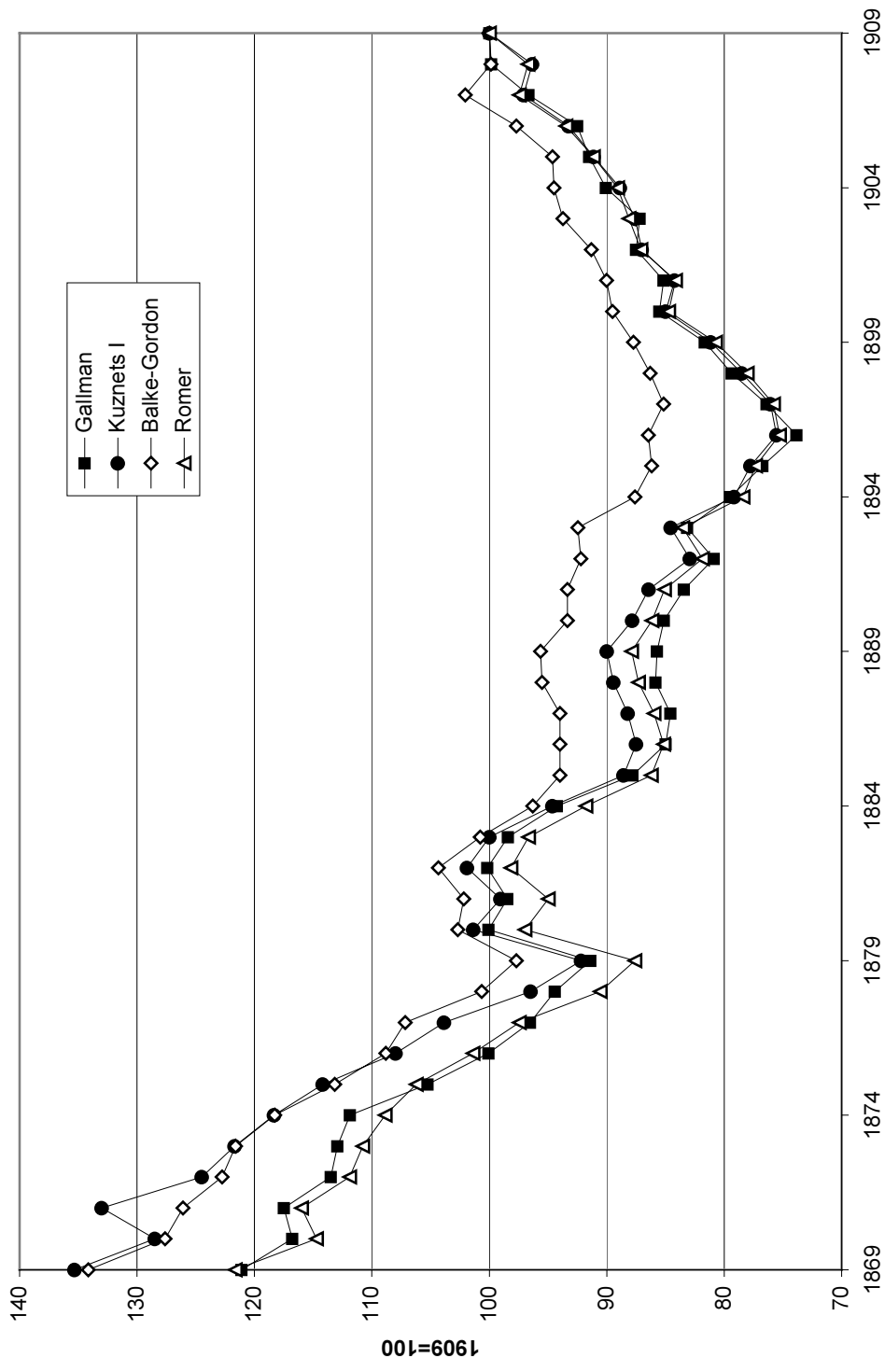


Figure 4: Implicit Price Deflators for Post-Bellum Income Estimates



**Figure 5: Railroad Mileage and Construction Estimates**

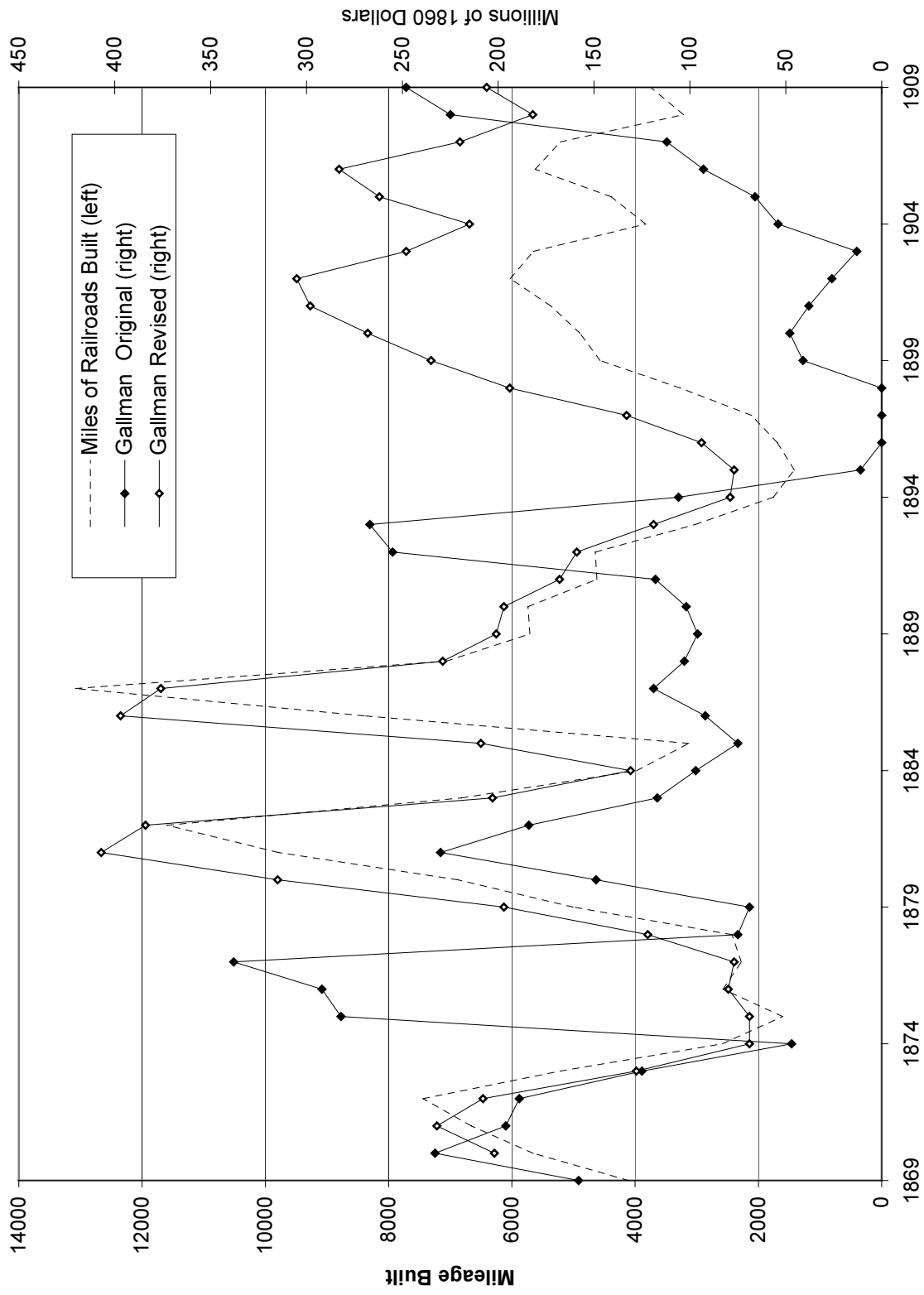


TABLE 1: Gallman's Annual National Product Series for 1834-1859 in Constant 1860 Prices.

| Census Year |  | Value of Goods Flowing to Consumers |               |               |             |          | Capital Formation, Less Changes in Inventories |                       |                        |       |            | Changes in              |        | Gross National Product (excl. Inv. Changes) |
|-------------|--|-------------------------------------|---------------|---------------|-------------|----------|--|-----------------------|------------------------|-------|------------|-------------------------|--------|---|
|             |  | Perishable Goods                    | Semi-Durables | Durable Goods | Total Goods | Services | Total Consumption                              | Manufactured Durables | Gross New Construction | Total | Foreigners | Total Capital Formation |        |   |
|             |  | Goods                               | Durables      | Goods         | Goods       |          |  | Producers'            | Railroad               | Canal | Other      | Claims                  | Ag'tst |   |
| 1834        |  | 753.6                               | 124.8         | 25.5          | 903.9       | 419      | 1322.9   | 32.0                  | 9.3                    | 5.5   | 66.7       | 81.5                    | -33.5  | 1402.9                                      |
| 1835        |  | 703.3                               | 148.5         | 30.7          | 882.5       | 426      | 1308.5   | 33.7                  | 11.2                   | 5.1   | 80.9       | 97.2                    | -61.7  | 1377.7                                      |
| 1836        |  | 688.7                               | 113.9         | 28.8          | 831.4       | 432      | 1263.4   | 31.7                  | 13.9                   | 7.5   | 75.1       | 96.5                    | -20.9  | 1370.7                                      |
| 1837        |  | 754.6                               | 99.9          | 34.4          | 888.9       | 440      | 1328.9   | 33.3                  | 16.1                   | 12.3  | 101.4      | 129.8                   | -5.0   | 1487.0                                      |
| 1838        |  | 718.5                               | 150.9         | 36.7          | 906.1       | 449      | 1355.1   | 33.9                  | 16.9                   | 15.6  | 118.2      | 150.7                   | -46.9  | 1492.8                                      |
| 1839        |  | 826.3                               | 107.8         | 31.1          | 965.2       | 457      | 1422.2   | 27.1                  | 15.1                   | 16.9  | 108.1      | 140.1                   | 33.2   | 1622.6                                      |
| 1840        |  | 832.7                               | 125.3         | 29.0          | 987.0       | 465      | 1452.0   | 25.5                  | 12.6                   | 16.3  | 111.0      | 139.9                   | -8.3   | 1609.1                                      |
| 1841        |  | 859.5                               | 140.6         | 36.2          | 1036.3      | 474      | 1510.3   | 31.2                  | 10.0                   | 9.5   | 111.0      | 130.5                   | 7.0    | 1679.0                                      |
| 1842        |  | 894.1                               | 89.0          | 40.0          | 1023.1      | 484      | 1507.1   | 32.4                  | 6.5                    | 2.7   | 104.3      | 113.5                   | 26.8   | 1679.8                                      |
| 1843        |  | 1044.6                              | 146.7         | 41.8          | 1233.1      | 493      | 1726.1   | 34.2                  | 5.8                    | 1.3   | 107.1      | 114.2                   | 5.7    | 1880.2                                      |
| 1844        |  | 1008.7                              | 217.4         | 51.9          | 1278.0      | 502      | 1780.0   | 44.4                  | 7.2                    | 1.9   | 136.4      | 145.5                   | 4.2    | 1974.1                                      |
| 1845        |  | 1057.7                              | 209.4         | 60.2          | 1327.3      | 514      | 1841.3   | 51.0                  | 10.1                   | 2.4   | 164.0      | 176.5                   | 0.9    | 2069.7                                      |
| 1846        |  | 1022.1                              | 218.8         | 68.4          | 1309.3      | 531      | 1840.3   | 59.9                  | 16.9                   | 4.2   | 187.4      | 208.5                   | 27.0   | 2135.7                                      |
| 1847        |  | 1133.2                              | 302.6         | 82.9          | 1518.7      | 550      | 2068.7   | 75.5                  | 27.2                   | 5.8   | 184.5      | 217.5                   | 5.8    | 2367.5                                      |
| 1848        |  | 1144.7                              | 298.2         | 90.3          | 1533.2      | 570      | 2103.2   | 68.6                  | 33.4                   | 4.8   | 177.1      | 215.3                   | 8.8    | 2395.9                                      |
| 1849        |  | 1145.4                              | 334.9         | 96.6          | 1576.9      | 594      | 2170.9   | 66.5                  | 35.1                   | 5.0   | 177.3      | 217.4                   | -25.7  | 2429.1                                      |
| 1850        |  | 1178.0                              | 402.1         | 108.5         | 1688.6      | 616      | 2304.6   | 75.7                  | 41.9                   | 5.7   | 211.7      | 259.3                   | -4.4   | 2635.2                                      |
| 1851        |  | 1270.5                              | 401.4         | 127.8         | 1799.7      | 647      | 2446.7   | 86.9                  | 55.3                   | 4.7   | 252.0      | 312.0                   | -14.1  | 2831.5                                      |
| 1852        |  | 1409.2                              | 498.1         | 156.6         | 2063.9      | 682      | 2745.9   | 102.6                 | 72.3                   | 4.1   | 292.2      | 368.6                   | -57.9  | 3159.2                                      |
| 1853        |  | 1513.1                              | 598.6         | 162.0         | 2273.7      | 721      | 2994.7   | 112.3                 | 86.8                   | 4.7   | 326.4      | 417.9                   | -34.2  | 3490.7                                      |
| 1854        |  | 1457.0                              | 445.9         | 162.3         | 2065.2      | 758      | 2823.2   | 124.1                 | 78.1                   | 5.5   | 346.9      | 430.5                   | -12.2  | 3365.6                                      |
| 1855        |  | 1551.7                              | 555.2         | 177.0         | 2283.9      | 790      | 3073.9   | 143.1                 | 61.4                   | 5.1   | 375.4      | 441.9                   | -10.0  | 3648.9                                      |
| 1856        |  | 1496.1                              | 565.5         | 187.0         | 2248.6      | 828      | 3076.6   | 154.7                 | 62.3                   | 4.1   | 414.0      | 480.4                   | -14.8  | 3696.9                                      |
| 1857        |  | 1617.1                              | 433.3         | 184.2         | 2234.6      | 863      | 3097.6   | 138.3                 | 62.7                   | 3.4   | 394.5      | 460.6                   | 21.5   | 3718.0                                      |
| 1858        |  | 1824.5                              | 567.4         | 197.5         | 2589.4      | 892      | 3481.4   | 124.1                 | 54.4                   | 2.5   | 346.1      | 403.0                   | -25.7  | 3982.8                                      |
| 1859        |  | 1825.9                              | 622.5         | 200.4         | 2648.8      | 919      | 3567.8   | 133.1                 | 44.3                   | 1.6   | 345.9      | 391.8                   | 7.2    | 4099.9                                      |

Source: Gallman Papers

When citing these series include the following statement: "These data were not constructed for analysis as annual series."



|      |      |      |      |       |      |       |      |     |        |        |      |        |         |       |       |     |
|------|------|------|------|-------|------|-------|------|-----|--------|--------|------|--------|---------|-------|-------|-----|
| 1901 | 7586 | 2549 | 1429 | 11564 | 3008 | 14572 | 2793 | 38  | 2372.8 | 2410.8 | 337  | 5540.8 | 20112.8 | 806   | 807   | 298 |
| 1902 | 7337 | 2643 | 1523 | 11503 | 3087 | 14590 | 3190 | 26  | 2621.2 | 2647.2 | 150  | 5987.2 | 20577.2 | 314   | 315   | 305 |
| 1903 | 7783 | 2774 | 1546 | 12103 | 3296 | 15399 | 3626 | 13  | 2471.1 | 2484.1 | 221  | 6331.1 | 21730.1 | 635   | 634   | 248 |
| 1904 | 7791 | 2801 | 1521 | 12113 | 3394 | 15507 | 3083 | 54  | 2443.3 | 2497.3 | 148  | 5728.3 | 21235.3 | -135  | -136  | 215 |
| 1905 | 8013 | 2941 | 1734 | 12688 | 3625 | 16313 | 3637 | 66  | 2543.3 | 2609.3 | 153  | 6399.3 | 22712.3 | 746   | 747   | 262 |
| 1906 | 8910 | 3172 | 1968 | 14050 | 4016 | 18066 | 4559 | 93  | 2750.5 | 2843.5 | 137  | 7539.5 | 25605.5 | 1477  | 1478  | 283 |
| 1907 | 9155 | 3128 | 1886 | 14169 | 4165 | 18334 | 4810 | 112 | 2876.7 | 2988.7 | 104  | 7902.7 | 26236.7 | 5     | 5     | 220 |
| 1908 | 8265 | 3137 | 1633 | 13035 | 4057 | 17092 | 3328 | 225 | 2650.6 | 2875.6 | 201  | 6404.6 | 23496.6 | -1459 | -1459 | 182 |
| 1909 | 9046 | 3427 | 2043 | 14516 | 4429 | 18945 | 3778 | 248 | 2963.4 | 3211.4 | -134 | 6855.4 | 25800.4 | 960   | 1199  | 206 |

As Corrected

|      |  |  |  |  |  |  |  |    |       |       |  |        |        |  |  |  |
|------|--|--|--|--|--|--|--|----|-------|-------|--|--------|--------|--|--|--|
| 1875 |  |  |  |  |  |  |  | 28 | 883.2 | 883.2 |  | 1179.2 | 6372.2 |  |  |  |
| 1876 |  |  |  |  |  |  |  | 29 | 838.0 | 838.0 |  | 1282.0 | 6795.0 |  |  |  |
| 1877 |  |  |  |  |  |  |  | 34 | 817.1 | 817.1 |  | 1261.1 | 7207.1 |  |  |  |

Notes: Examination of the underlying spreadsheets converting current-value railroad investment estimates into constant-value estimates reveals a decimal-place error occurs in the original calculations for 1875-77. The affected series are indicated by underlining. The corrected series adjusted railroad construction, total construction, total capital formation, and GNP. The Gallman's revised railroad construction estimates may be used to replace this original series. The revised inventory series differs by rounding and errors in the underlying data.  
Source: Gallman Papers

When citing these series include the following statement: "These data were not constructed for analysis as annual series."



TABLE 3: Gallman's Annual National Product Series in Current Prices.

| Calendar Year | Millions of Dollars                 |               |               |             |          |                   |                     |               |         |                        | Capital Formation, Less Changes in Inventories |                         |                 |              | Gross National Product (excl. Inv. Changes) | Inventory Changes |
|---------------|-------------------------------------|---------------|---------------|-------------|----------|-------------------|---------------------|---------------|---------|------------------------|--|-------------------------|-----------------|--------------|---|-------------------|
|               | Value of Goods Flowing to Consumers |               |               |             |          | Total Consumption | Mnfd Prdcr Durables |               |         | Gross New Construction | Changes in For. Claims                         | Total Capital Formation | Product Changes |              |   |                   |
|               | Perish. Goods                       | Semi-Durables | Durable Goods | Total Goods | Services |                   | Construction        | Manufacturing | Product |                        |  |                         |                 | Construction |   |                   |
| 1869          | 3319                                | 940           | 401           | 4660        | 1499     | 6159              | 359                 | 1064          | -187    | 1236                   | 7395   |                         |                 |              |   |                   |
| 1870          | 3036                                | 992           | 398           | 4426        | 1427     | 5853              | 334                 | 1103          | -149    | 1288                   | 7141   | 232                     | -45             |              |   |                   |
| 1871          | 3029                                | 1090          | 417           | 4536        | 1466     | 6002              | 322                 | 1003          | -192    | 1133                   | 7135   | 186                     | -150            |              |   |                   |
| 1872          | 3111                                | 1251          | 537           | 4899        | 1587     | 6486              | 520                 | 1409          | -252    | 1677                   | 8163   | 269                     | 432             |              |   |                   |
| 1873          | 3321                                | 1126          | 506           | 4953        | 1608     | 6561              | 566                 | 1314          | -108    | 1772                   | 8333   | 52                      | 39              |              |   |                   |
| 1874          | 3570                                | 1063          | 459           | 5092        | 1656     | 6748              | 404                 | 1028          | -107    | 1325                   | 8073   | -180                    | -147            |              |   |                   |
| 1875          | 3430                                | 1124          | 471           | 5025        | 1686     | 6711              | 354                 | 1004          | -105    | 1253                   | 7964   | -117                    | -33             |              |   |                   |
| 1876          | 3495                                | 1053          | 440           | 4988        | 1753     | 6741              | 359                 | 946           | 19      | 1324                   | 8065   | -164                    | -289            |              |   |                   |
| 1877          | 3634                                | 1123          | 444           | 5201        | 1845     | 7046              | 334                 | 896           | 3       | 1233                   | 8279   | 202                     | 180             |              |   |                   |
| 1878          | 3486                                | 1047          | 418           | 4951        | 1884     | 6835              | 356                 | 920           | 133     | 1409                   | 8244   | -150                    | -450            |              |   |                   |
| 1879          | 3571                                | 1188          | 460           | 5219        | 2046     | 7265              | 395                 | 953           | 88      | 1436                   | 8701   | 304                     | 665             |              |   |                   |
| 1880          | 4543                                | 1623          | 606           | 6772        | 2310     | 9082              | 652                 | 1184          | 44      | 1880                   | 10962  | 1047                    | 1067            |              |   |                   |
| 1881          | 4519                                | 1472          | 611           | 6602        | 2280     | 8882              | 699                 | 1603          | 24      | 2326                   | 11208  | 285                     | 109             |              |   |                   |
| 1882          | 5112                                | 1604          | 661           | 7377        | 2425     | 9802              | 758                 | 1584          | -94     | 2248                   | 12050  | 855                     | 855             |              |   |                   |
| 1883          | 5079                                | 1543          | 656           | 7278        | 2422     | 9700              | 660                 | 1552          | -28     | 2184                   | 11884  | 219                     | 218             |              |   |                   |
| 1884          | 4956                                | 1403          | 638           | 6997        | 2456     | 9453              | 457                 | 1658          | -21     | 2094                   | 11547  | 36                      | 36              |              |   |                   |
| 1885          | 4352                                | 1504          | 659           | 6515        | 2484     | 8999              | 401                 | 1526          | -43     | 1884                   | 10883  | 197                     | -197            |              |   |                   |
| 1886          | 4171                                | 1569          | 726           | 6466        | 2495     | 8961              | 567                 | 1818          | -88     | 2297                   | 11258  | 129                     | 129             |              |   |                   |
| 1887          | 4406                                | 1567          | 745           | 6718        | 2531     | 9249              | 682                 | 1932          | -124    | 2490                   | 11739  | 459                     | 458             |              |   |                   |
| 1888          | 4501                                | 1606          | 747           | 6854        | 2541     | 9395              | 633                 | 1867          | -155    | 2345                   | 11740  | 333                     | 335             |              |   |                   |
| 1889          | 4737                                | 1666          | 765           | 7168        | 2598     | 9766              | 657                 | 1830          | -90     | 2397                   | 12163  | 309                     | 308             |              |   |                   |
| 1890          | 4450                                | 1764          | 827           | 7041        | 2576     | 9617              | 678                 | 2598          | -115    | 3161                   | 12778  | 191                     | 191             |              |   |                   |
| 1891          | 4854                                | 1771          | 855           | 7480        | 2710     | 10190             | 682                 | 2314          | -26     | 2970                   | 13160  | 536                     | 536             |              |   |                   |
| 1892          | 4594                                | 1864          | 890           | 7348        | 2717     | 10065             | 705                 | 3001          | -53     | 3653                   | 13718  | -383                    | -383            |              |   |                   |
| 1893          | 5404                                | 1674          | 763           | 7841        | 2795     | 10636             | 677                 | 2490          | -41     | 3126                   | 13762  | 84                      | 85              |              |   |                   |
| 1894          | 4792                                | 1451          | 661           | 6904        | 2718     | 9622              | 520                 | 2160          | 2       | 2682                   | 12304  | -1179                   | -1179           |              |   |                   |
| 1895          | 5068                                | 1671          | 767           | 7506        | 3003     | 10509             | 590                 | 2091          | -126    | 2555                   | 13064  | 108                     | 108             |              |   |                   |
| 1896          | 4819                                | 1601          | 733           | 7153        | 3031     | 10184             | 617                 | 1769          | 86      | 2472                   | 12656  | -86                     | -85             |              |   |                   |
| 1897          | 5255                                | 1741          | 782           | 7778        | 3264     | 11042             | 585                 | 1938          | 139     | 2662                   | 13704  | 700                     | 698             |              |   |                   |

When citing these series include the following statement: "These data were not constructed for analysis as annual series."

|      |       |      |      |       |      |       |      |      |      |      |       |       |       |
|------|-------|------|------|-------|------|-------|------|------|------|------|-------|-------|-------|
| 1898 | 5607  | 1779 | 817  | 8203  | 3357 | 11560 | 674  | 1887 | 408  | 2969 | 14529 | 534   | 535   |
| 1899 | 6247  | 2086 | 981  | 9314  | 3780 | 13094 | 892  | 2090 | 266  | 3248 | 16342 | 1109  | 1108  |
| 1900 | 6696  | 2232 | 1019 | 9947  | 3992 | 13939 | 1054 | 2536 | 412  | 4002 | 17941 | 1324  | 1326  |
| 1901 | 7491  | 2333 | 1111 | 10935 | 4533 | 15468 | 1074 | 2682 | 334  | 4090 | 19558 | 722   | 723   |
| 1902 | 7711  | 2471 | 1214 | 11396 | 4742 | 16138 | 1247 | 3023 | 153  | 4423 | 20561 | 647   | 646   |
| 1903 | 8089  | 2664 | 1275 | 12028 | 5154 | 17182 | 1324 | 2909 | 225  | 4458 | 21640 | 774   | 774   |
| 1904 | 8299  | 2689 | 1277 | 12265 | 5379 | 17644 | 1166 | 2879 | 152  | 4197 | 21841 | 246   | 248   |
| 1905 | 8657  | 2974 | 1474 | 13105 | 5819 | 18924 | 1373 | 3271 | 165  | 4809 | 23733 | 735   | 734   |
| 1906 | 9447  | 3476 | 1743 | 14666 | 6519 | 21185 | 1729 | 3990 | 149  | 5868 | 27053 | 1684  | 1684  |
| 1907 | 10262 | 3588 | 1817 | 15667 | 6875 | 22542 | 1871 | 4428 | 119  | 6418 | 28960 | 1340  | 1341  |
| 1908 | 9528  | 3357 | 1559 | 14444 | 6796 | 21240 | 1253 | 4062 | 235  | 5550 | 26790 | -1114 | -1116 |
| 1909 | 10927 | 3823 | 1370 | 16120 | 7540 | 23660 | 1498 | 4467 | -161 | 5804 | 29464 | 1744  | 1743  |

Notes: Revised Inventory Series corrects for typos and adjusts the livestock values over the 1869-79 period. The original series used Historical Statistics livestock prices which are in gold dollar. The revised series uses prices in greenback dollars to maintain consistency.

Source: Gallman Papers and *Annual Reports* of the US Commissioner of Agriculture, 1869-78.

*When citing these series include the following statement: "These data were not constructed for analysis as annual series."*

#### Table 4: Development, Use, and Refinement of the Volume 30 Series

Estimates commodity production:

Robert E. Gallman, "Commodity Output, 1839-1899," in William N. Parker [ed.] *Trends in the American Economy in the Nineteenth Century*, Studies in Income and Wealth, Volume 24 (Princeton: Princeton University Press, 1960) pp. 13-67.

Estimates gross national product and components in current and 1860 dollars:

Robert E. Gallman, "Gross National Product in the United States, 1834-1909," in Dorothy S. Brady [ed.] *Output, Employment, and Productivity in the United States after 1800*, Studies in Income and Wealth Vol. 30 (New York: Columbia Univ. Press, 1966) pp. 3-76.

Adds decadal average inventory changes:

Robert E. Gallman, "The Social Distribution of Wealth in the United States of America," *Third International Conference of Economic History*, (Mouton, 1965)

Uses to analyze structural change:

Robert E. Gallman and Edward S. Howle, "Trends in the Structure of the American Economy Since 1840, in Robert W. Fogel and Stanley L. Engerman, (eds.) *The Reinterpretation of American Economic History* (New York, Harper & Row, 1971) pp. 25-37

Incorporates depreciation:

Robert E. Gallman and Edward S. Howle, "The Structure of U.S. Wealth in the 19<sup>th</sup> Century."  
Lance Davis and Robert E. Gallman, "The Share of Saving and Investment in Gross National Product During the 19<sup>th</sup> Century, United States of America," in F.C. Lane (ed.) *Fourth International Conference of Economic History, Bloomington, 1968* (Mouton, 1973), especially Table 8, pp. 456-57.

Calculates Net National Product:

"The Pace and Pattern of American Economic Growth" in Lance E. Davis et al., *American Economic Growth: An Economist's History of the United States* (New York: Harper and Row, 1972), pp. 15-60.

Analyzes Net Capital Formation:

Lance E. Davis and Robert E. Gallman, "Capital Formation in the United States during the Nineteenth Century" in Peter Mathias and M. M. Postan, (eds.) *Cambridge Economic History of Europe Vol. VII The Industrial Economies, Capital, Labour, and Enterprise, Part 2, The United States, Japan, and Russia* (Cambridge: Cambridge Univ. Press, 1978) pp. 1-69.

Improves Service Sector Estimates:

Robert E. Gallman and Thomas Weiss, "The Service Industries in the Nineteenth Century," in Victor R. Fuchs [ed.] *Production and Productivity in the Service Industries*, Studies in Income and Wealth, Volume 34 (New York: Columbia University Press, 1969) pp. 287-381.

Improves Agricultural Investment Estimates (Inventories and Non-Conventional Investment)

Robert E. Gallman, "Changes in Total Agricultural Factor Productivity in the Nineteenth Century," *Agricultural History* XLVI:1 (Jan. 1972) pp. 191-209.

Robert E. Gallman, "The Agricultural Sector and the Pace of Economic Growth: U.S. Experience in the 19<sup>th</sup> Century," in David C. Klingaman and Richard K. Vedder, *Essays in 19<sup>th</sup> Century Economic History* (Ohio Univ. Press, 1975) pp. 35-76.

Explores Improvements in Construction Estimates and Uses Consumer Durable Flows to Estimate Stocks:  
Robert E. Gallman, "Investment Flows and Capital Stocks: U. S. Experience in the Nineteenth Century," in Peter Kilby [ed.] *Quantity and Quiddity: Essays in U.S. Economic History* (Middleton, CN: Wesleyan Univ. Press, 1987) pp. 214-54.

Improves Inventory Estimates:

Robert E. Gallman, "The United States Capital Stock in the Nineteenth Century" in Stanley L. Engerman and Robert E. Gallman, (eds.) *Long-Term Factors in American Economic Growth, Studies in Income and Wealth, Vol. 51* (Chicago: University of Chicago Press, 1986) pp. 165-213.

Robert E. Gallman, "American Economic Growth before the Civil War: The Testimony of the Capital Stock Estimates" in Robert E. Gallman and John Joseph Wallis, (eds.) *American Economic Growth and Standards of Living before the Civil War* (Chicago: University of Chicago Press, 1992) pp. 79-115.

Incorporates Most Recent Changes:

Robert E. Gallman, "Economic Growth and Structural Change in the Long Nineteenth Century," in Stanley Engerman and Robert E. Gallman, [eds.] *Cambridge Economic History of the United States, Vol II*, (Cambridge: Cambridge Univ. Press, 2000).

**TABLE 5: Comparison of Benchmark and Decade Average Growth Rates**

Gallman's 1860-Price GNP Series

|      | Level (in Millions) |                   |       | Annualize Growth Rates<br>Between Successive<br>Periods Using: |                    |
|------|---------------------|-------------------|-------|--|--------------------|
|      | Single<br>Year      | Decade<br>Average | Ratio | Single<br>Years  | Decade<br>Averages |
| 1834 | 1403                | --                | --    | --   | --                 |
| 1839 | 1623                | 1560              | 1.04  | 2.9%   | --                 |
| 1844 | 1974                | 1941              | 1.02  | 3.9%   | 4.4%               |
| 1849 | 2429                | 2549              | 0.95  | 4.1%   | 5.4%               |
| 1854 | 3366                | 3296              | 1.02  | 6.5%   | 5.1%               |
| 1859 | 4100                | --                | --    | 3.9%   | --                 |
| 1869 | 5347                | --                | --    | --   | --                 |
| 1879 | 8336                | 8417              | 0.99  | 4.4%   | --                 |
| 1889 | 12426               | 12604             | 0.99  | 4.0%   | 4.0%               |
| 1899 | 17527               | 17353             | 1.01  | 3.4%   | 3.2%               |
| 1909 | 25800               | --                | --    | 3.9%   | --                 |

Notes: Decade Averages are centered 10-year moving averages.  
That is, 1839 is the average from 1834 to 1843.

Source: Tables 1 and 2