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Abstract:

This paper examines the magnitude and timing of American business cycles from 1869 to 1928, with particular emphasis on the pre-World War I period. A new real output series is constructed which resurrects the conclusion that pre-World War I business cycles were twice as severe as post-World War II business cycles. While the new series and the standard Kuznets-based estimates display similar average volatility over the entire pre-World War I period, the Kuznets-based estimates are more volatile than the new series from 1889 to 1913, while the new series is more volatile prior to 1889. This is due to modifications made to both the regression procedures used to extrapolate GNP from commodity output, and to commodity output itself. An abundance of domestic and international evidence is presented to show that the United States experienced severe downturns in both the mid-1870s and mid-1890s, downturns much worse than any recession since World War II.

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I. INTRODUCTION

While an immense amount has been written attempting to measure and explain the depth and duration of the Great Depression during the 1930s, relatively little attention has been given to pre-Great Depression business cycles. There has been no consensus regarding the severity and causes of U.S. business cycles from the end of the Civil War to the beginning of the Great Depression. Available evidence often paints a puzzling, limited, and self-contradictory picture of post-Civil War business cycles. This confusion may be best illustrated by example. In the opening paragraph of a leading graduate macroeconomics textbook, Blanchard and Fischer (1989) stated that "occasionally, recessions turn into depressions, such as the U.S. depression from 1873 to 1878, [and] the Great Depression of the 1930s . . ."[1] Yet on the very next page of this book, a graph of real GNP shows the 1870s to be dramatically different from the 1930s. From 1873, an NBER peak year, to 1878, an NBER trough, the real GNP series *increased every year* and grew at an average annual rate of 4.62 percent.[2] By contrast, between 1929 and 1933, real GNP fell every year with an annual average decrease of 8.83 percent.[3]

During the Great Depression in the 1930s, many scholars believed that the downturns in the 1870s and 1890s were "depressions," to be compared to the depression of the 1930s.[4] Since this time, the prevailing view has changed a number of times, generally toward the belief that pre-Great Depression business cycles were no more severe than post-World War II business cycles.

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[1]Blanchard and Fischer (1989), p. 1.
[2]See Romer (1989), Table 2, pp. 22-23.
[3]See Department of Commerce (1986), Table 1.10, p. 37.
[4]Eckler (1933) stated that "numerous comparisons of the present situation with that in the seventies and in the nineties, revealing considerable similarities, have been made" (p. 75). From examining the behavior of six annual series (railway operating revenues, value of total merchandise imports, pig iron production, cotton consumption, coal production, and deflated bank clearings), he concluded that "the most recent depression is the sharpest of all, but the next sharpest is the first, that of the seventies" (p. 81). The average percentage decrease of the six series is over 50 percent during the Great Depression of the 1930s while the average decrease is around 30 percent in the 1870s and 1890's. Similarly, Schumpeter (1939) believed that ". . . some aspects, at any rate, of the depression were quite as dark in 1873 to 1877 as they were in 1929 to 1933" (p. 337).

After World War II, scholars began focusing their attention on constructing historical aggregate time series as well as on developing the methodology of business cycle reference dating. Shaw (1947) created yearly estimates of real commodity output for the period after 1889. Historical series of gross national product began with the work of Kuznets (1946, 1961), who extended Shaw's annual commodity output series back to 1869 and extrapolated GNP from the commodity output data. Lebergott (1964) developed yearly historical estimates of unemployment from 1890 to 1930, Frickey constructed estimates of industrial production extending back to 1860, while the pioneering work of Burns and Mitchell (1946) described and developed the methodology of NBER reference dates.

While this work showed that the downturns since the Civil War were not as severe as the Great Depression of the 1930s, it did lend support to the claim that the cyclical downturns prior to the Great Depression were quite severe in comparison with post-World War II recessions. Until recently, one of the least controversial facts in U. S. macroeconomic history was the reduced volatility of business cycles after World War II.[5]

This interpretation has been dramatically challenged by Romer, who contends that the apparent stabilization in the post-World War II period arose from inappropriate techniques in the construction of the pre-Great Depression data, and not from actual stabilization in the postwar period. In a series of papers, Romer argued that historical data from before the Great Depression overstate the true volatility of real GNP (1986a, 1988, 1989), unemployment (1986a, 1986b), and industrial production (1986c, 1991). More recently, she has attacked NBER business cycle dating procedures (1994), claiming that the NBER has overestimated the length of contractions and underestimated the length of expansions in the pre-Great Depression period. These papers have challenged

[5]Burns (1960) devoted his entire 1959 Presidential Address to the American Economic Association attempting to explain the stability of the postwar period. Subsequently, Lucas (1977), Bailey (1978), Tobin (1980), and DeLong and Summers (1986b) have discussed the perceived increased stabilization of the post-World War II economy as well.

the view that the pre-Depression period was, in any meaningful sense, more volatile than the post-Word War II period.

While Romer succeeded in raising new doubts about the reliability of the standard historical data, her revisions of industrial production, unemployment, and GNP have not gone unchallenged. O'Brien (1992) showed that Romer's industrial production estimates are quite sensitive to the method of detrending and to the exact time periods compared. O'Brien concluded that, contrary to Romer's interpretation, industrial production has been far less volatile in the post-World War II period.[6] Lebergott (1964, 1986, 1992), Weir (1986, 1992), Keyssar (1986), and Carter and Sutch (1992) have created competing unemployment series which are generally more volatile than the Romer unemployment estimates. In addition, Balke and Gordon (1989) have constructed an alternative series for real GNP which exhibits nearly as much volatility on average as the standard Kuznets-based estimates.

Perhaps nothing has shaped economists' perceptions of the severity of pre-Great Depression business cycles as much as the historical GNP data. The standard series, constructed by Kuznets (1946, 1961) and modified by Kendrick (1961) and Gallman (1966), confirmed large downturns in the 1870s, the 1890s, and after World War I.[7] On average, the standard series from 1869 to 1928 is roughly twice as volatile as post-World War II GNP.[8]

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[6]O'Brien (1992) showed that Romer's industrial production series "turn out to be very sensitive to which prewar and postwar data series are compared, to which method is used to detrend the series, and to which exact time periods are being compared. In the end, there is good reason to believe that, contrary to Romer, industrial production has been substantially less volatile since World War II" (p. 60).

[7]The Kendrick and Gallman adjustments largely affected the long-run trend of real GNP and not the cyclical component of the original Kuznets series. Kendrick made several adjustments involving the treatment of government spending and tax revenues in order to convert the Kuznets estimates to the same conceptual basis as the current Commerce Department definition of GNP. Gallman's corrections affect primarily the census years, particularly 1869 and 1879. He raised 1869 GNP by using a different ratio to scale up railroad construction from the output of construction materials.

[8]Unless stated otherwise, volatility will be measured as the standard deviation of deviations from trend where trend is defined as the log-linear interpolation between "normal" benchmark years. See Section II.B for precise details.

Romer bases her criticism of the standard Kuznets' GNP estimates not on the fragmentary sources used to construct commodity output, but on the method Kuznets used to extrapolate GNP from the commodity output data. Romer has argued that the standard series exaggerates the size of prewar business cycles by assuming that GNP moved nearly one for one with commodity output valued in producer prices. Kuznets assumed that the non-commodity components of GNP, such as the value added in transportation, distribution, as well as all services, moved roughly proportionately with commodity output. Romer's main point is that real GNP actually moves much less over the cycle than commodity output since the non-commodity components of GNP tend to be much more insulated from aggregate shocks. Consequently, cyclical movements are noticeably smaller in the Romer series than in the standard series.

This controversy regarding the cyclical behavior of real output over time has implications for both the scope and the effectiveness of activist stabilization policy in the post-World War II era, and for deciding between competing theories of the business cycle. If Romer's claims are correct, they support the argument that increased activist stabilization policies did little, if anything, to affect increased macroeconomic stability in the post-World War II period. The small decrease of output volatility in the postwar period may largely be the result of structural and institutional changes, perhaps leaving little room for activist stabilization policies. Moreover, a smaller reduction in business cycle volatility also bolsters real business cycle theories. If business cycles have not changed substantially over time, then real business cycle models can be constructed without having to resort to large, unobserved differences in the variance of technological shocks over time.

This paper offers new insights in several areas. Modifications are made to the regression procedures used by Romer (1989) and Balke and Gordon (1989) to estimate GNP. In addition, I also revise the Shaw-Kuznets real commodity output series, on which all previous U.S. GNP estimates have depended to varying degrees.[9] A new U.S. GDP series is constructed which resurrects the conclusion that pre-World War I business cycles were twice as severe as post-World War II business cycles, even without Kuznets' assumption that movements in GNP and commodity output are proportional. The close correspondence between the new U.S. estimates, and other available domestic and international data provides further evidence that the new estimates have likely improved our understanding of the magnitude and timing of pre-World War I business cycles.

II. PREVIOUS ESTIMATES OF PRE-1909 U.S. GNP

The biggest challenge in constructing estimates of U.S. GNP before 1909 is that data are missing for most of the non-commodity producing sectors of the economy. Because of these data limitations, previous researchers have been forced to extrapolate the large unobserved component of GNP from the relatively narrow base of commodity output.

The following sections describe the alternative methods which have been used to construct historical national accounts for the United States. The first section describes what has come to be called the standard series.[10] The subsequent Romer (1989) and Balke and Gordon (1989) revisions are then reviewed.

A. The Standard Series

Historical estimates of gross national product for the United States began with the work of Simon Kuznets (1946, 1961). Kuznets estimated pre-World War I GNP by two different methods in his 1961 book *Capital in the American Economy*. The components series estimated annual GNP in a given sector by assuming that percentage deviations

[9]Kuznets (1961) and Romer (1989) relied on commodity output exclusively, while Balke and Gordon (1989) also added estimates from the transportation and communication, and construction sectors.

[10]The term "standard series" was used by Balke and Gordon (1989), p. 49, while Romer (1989), p. 23, referred to the Kuznets-Kendrick-Gallman series as "traditional estimates." For convenience, the term "standard series" will be used throughout.

from trend of GNP in that sector are equal to percentage deviations of commodity output at producer prices in that same sector. Total GNP was simply scaled up by multiplying the five major subcomponents of commodity output (consumer perishables, consumer semidurables, consumer durables, producer durables, and construction materials) by fixed ratios.

Kuznets recognized the possibility that the components series might exaggerate cyclical volatility because "the series available as annual interpolators were most frequently the more sensitive indexes and would yield annual values exaggerating the short-term changes compared with those reflected in more comprehensive and hence more accurate measures."[11] To account for the problem of potentially volatile annual components and therefore aggregate GNP, Kuznets also published an alternative estimate of GNP, labeled the regression series. Unlike the components series, the regression series was derived at the aggregate level. The regression series was constructed by fitting a nonlinear smooth freehand "regression curve" between deviations from trend of GNP and deviations from trend of commodity output for the period 1909 to 1938. Trend values were obtained by first calculating the average values of GNP and commodity output for overlapping decades; these values were then used to represent trend GNP or commodity output for the midpoint of the decade. Annual trend values were finally obtained by linearly interpolating between these midpoints.

Given the deviations from trend of commodity output from 1869 to 1908, and the commodity output coefficient estimates from the 1909-1938 freehand curve, annual estimates of real GNP from 1869 to 1908 were constructed by Kuznets in the following manner.[12] First, he backcasted the 1909-1938 relationship between deviations from trend of commodity output and GNP to obtain estimated deviations from trend of GNP for the

[11] Kuznets (1961), p. 546.

[12] See Kuznets (1961), Table C-1, p. 537, for a table of selected values underlying the nonlinear freehand curve estimates.

1869 to 1908 period. Point estimates for GNP were then created by adding the estimated percentage deviations from trend of real GNP to the trend values of GNP. While the regression estimates are not quite as volatile as the components series, the regression series still showed that GNP almost moved one-for-one with commodity output over the 1909-1938 period and therefore during the 1869-1908 period as well.[13]

Both Kendrick (1961) and Gallman (1966) revised the Kuznets components series and not the relatively smoother regression series.[14] Kendrick made several adjustments involving the treatment of government spending and tax revenues in order to convert the Kuznets estimates to the same conceptual basis as the then current Department of Commerce definition of GNP. Since the government sector was such a small part of U.S. GNP prior to World War I, and slightly countercyclical at times during the prewar period, the Kendrick revisions slightly reduce the volatility of the Kuznets components series, resulting in a series which is quite similar in volatility to the Kuznets regression series.

Gallman (1966) made several adjustments to the Kuznets components series which increased the benchmark estimates for the early years, and therefore reduced the trend rate of growth prior to 1889. However, annual movements remained largely unaffected by the Gallman revisions. Gallman's primary correction raised the level of GNP in 1869 by both revising the level of the Shaw estimates of commodity output and by using a different ratio to scale up railroad construction from the output of construction materials.

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[13]Romer (1989), p. 8, used a simple linear regression to attempt to replicate the Kuznets regression series. Over the 1909 to 1938 period, Romer estimated the following equation:

$$\text{gnpdev}_t = .895\text{comdev}_t + e_t$$

where gnpdev and comdev denote the log differences from the trend values. That is, Romer found that cyclical movements in GNP are approximately 90 percent as large as those in commodity output using roughly Kuznets' methods and data.

[14]Since researchers are interested in the separate components of GNP as well as the aggregate estimates, it is easy to see why the component series has been adopted for historical use especially since the five-year moving average estimates of the components series and the regression series are nearly identical.

It is interesting to note that the so-called standard series described by Romer and Balke-Gordon has been constructed by these authors and had not previously appeared anywhere in print. The standard pre-1909 series is the Kuznets components series with both the Kendrick and Gallman revisions included. More specifically, this series is constructed by using the Kuznets-Gallman estimates of net national income in 1929 dollars from Friedman and Schwartz (1982) and adding in Kuznets' unraveled five-year moving average estimates of capital consumption. Finally, the net adjustment factors derived by Kendrick (1961) are added to make the series roughly consistent with Department of Commerce procedures. These adjustment factors are calculated as the difference between the final Kendrick series and the Kuznets components series. A detailed appendix is available from the author which describes the precise sources and methods used for all the data presented in this paper.

B. The Romer Series

Romer modified Kuznets' regression methodology to obtain prewar GNP estimates that are much less volatile than the original Kuznets regression estimates. While Kuznets examined the relationship between GNP and commodity output over the 1909-1938 period, Romer estimated her regression for the period 1909-1985, omitting 1929-1946 from the estimation period. Kuznets' stable, nonlinear freehand regression was also replaced by a linear regression, corrected for first-order serial correlation using the Cochrane-Orcutt technique, in which the commodity output coefficient was allowed to trend downward over time. In addition, Romer used the relatively smooth GNP series from Romer (1988) for the 1909-1928 period, and not the more volatile estimates which Kuznets relied on.[15] Finally, Romer differed from Kuznets by fitting trends through

[15]Section V discusses U.S. GNP volatility from 1909 to 1928 in great detail. The choice of competing series between 1909 and 1928 has dramatic ramifications regarding the estimated volatility of GNP from 1869 to 1908.

"normal" years as opposed to "average" years, and Romer used log differences from trend rather than ratio differences.

To construct the GNP series for 1869-1908, Romer estimated the relationship between the percentage deviations from trend of real GNP and real commodity output over periods in which "good data exist for both these series," that is, over the periods 1909-1928 and 1947-1985.[16] To allow the estimated relationship to vary over time, she chose the following specification:

(1) $$gnpdev_t = [\alpha + \beta(trend)][comdev_t] + \varepsilon_t$$

where $gnpdev_t$ is the log deviation from trend of real gross national product, $comdev_t$ is the log deviation from trend of real commodity output, and trend is a simple linear trend set equal to zero in 1909. In order to estimate equation (1) and form GNP estimates for the period 1869-1908, she first calculated sub-period trend values of commodity output and GNP over the entire period 1869-1985. Trend values were calculated by linearly interpolating between benchmark estimates of the logarithms of GNP and commodity output with the years 1873, 1884, 1891, 1900, 1910, 1924, 1947, 1955, 1962, 1972, and 1981 serving as benchmark years. These dates were chosen to represent years in which the economy was at a point of "midexpansion in the cycle."[17] For the pre-1909 period, trend values of real GNP were determined using the standard Kuznets-Kendrick-Gallman series. The trend values for the 1909-1928 period were computed using Romer's (1988) interwar estimates, while the trend values for 1947-1985 were calculated from the then standard Department of Commerce (1986) series.

Pre-World War II trend values of real commodity output were determined using the Shaw-Kuznets series as first reported in Kuznets (1961). The post-World War II

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[16]Romer (1989), p. 14.

[17]Romer (1989), p. 19. While it can be argued that not all of the benchmark dates represent periods of midexpansion in the business cycle, Romer claimed that "specifying alternative benchmarks matters very little" (p. 33). Yet this practice begs the question to some extent since it assumes that one knows the cyclical behavior of GNP prior to estimation.

trend values were calculated from the sum of GNP in the three commodity producing sectors of the economy – agriculture, forestry, fisheries; mining; and manufacturing – as reported by the Department of Commerce in the *NIPA* (1986).

Romer estimated equation (1) using the Cochrane-Orcutt correction for first-order autocorrelation. The resulting parameter values over the 1909-28 and 1947-85 sample period are:[18]

$$gnpdev_t = \underset{(.0760)}{[.5808} - \underset{(.0016)}{.0007}(trend)][comdev_t] + e_t \tag{2}$$

$$SEE = .0132,\ \text{Final Durbin-Watson} = 1.93,\ rho = \underset{(.1034)}{.7178}$$

where the standard errors are in parentheses and the time trend is set equal to zero in 1909.

With the coefficient estimates from equation (2), new estimates for real GNP for the period 1869-1908 were created in the following manner. First, Romer projected the linear time trend back to 1869, which causes the resulting coefficient [α - β(trend)] to range from .58 in 1908 to .61 in 1869, even though the trend coefficient is statistically insignificant. That is, real GNP was about 60 percent as volatile as real commodity output in the prewar period according to this regression specification. Equation (2) was then used to estimate the deviations of GNP from trend for the pre-1909 period. Finally, point estimates for GNP were created by adding the percentage deviations from trend of real GNP to the trend values of GNP. By construction, the Romer series is identical to the standard Kuznets-Kendrick-Gallman series in the benchmark years. In addition, since the coefficient on commodity output is roughly 0.6 in the prewar period instead of approximately 1.0, as implicitly assumed by Kuznets, cyclical movements are noticeably smaller in the Romer series than in the standard estimates.

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[18]Equation (2) reports my attempted replication of Romer's equation 1. My results (see Table 4) are nearly identical to those reported in Romer (1989), p. 20. Romer reported a commodity output coefficient of .5830, while I find a coefficient of .5808. The time trend coefficients and the standard error of regression I report are identical to Romer's equation 1.

C. The Balke-Gordon Series

Balke and Gordon (1989) developed an alternative measure of real U.S. GNP for the period 1869-1908 which is almost as volatile on average as the standard Kuznets-based series. First, unlike the standard and Romer estimates, which rely exclusively on the relationship between commodity output and GNP, Balke and Gordon used previously untapped data sources that give direct measures of output in the transportation, communications, and construction sectors in addition to output in the commodity sector. Second, Balke and Gordon's estimates of real GNP incorporated the detailed research by Hoover (1960) and Rees (1961) on actual prices paid by consumers in the years prior to World War I, rather than the Shaw-Kuznets producer price series used by Romer. Third, Balke and Gordon did not correct for first-order serial correlation since their final specification shows no evidence of residual autocorrelation. Finally, they did not include the post-World War II era in their estimation period as Romer has done, but did extend the interwar estimation period from 1909-1928 to 1909-1938.

Like Romer, Balke and Gordon chose the standard series for 1869-1908 to establish the trend level of real GNP as well as roughly the same benchmark years that Romer used.[19] Similarly, Balke and Gordon also adopted the Shaw's commodity output as an explanatory variable in preference to the perhaps superior Frickey (1947) - Fabricant (1940) series because of the limited coverage of final goods output in the Frickey series before 1899, and so that the results can be directly compared with Romer's GNP series. Balke and Gordon also included additional independent variables, described in described in Siegler (1997), in order to estimate real GNP. The transportation and communications variable is the linked Frickey (1947) - Kendrick (1961) series derived by Balke and Gordon. The measure of construction output is the linked Gottlieb (1965) and Department of Commerce (1986) construction series.

[19]Balke and Gordon add 1869 as a benchmark year.

III. Regression Volatility Bias

Unlike the historical national accounts data for the United States, the pre-World War I data for many other countries are substantially more comprehensive. Many of these countries had official statistical bureaus in place by 1869 so that data collection was far more frequent and complete than in the United States. In addition to the generally better primary source materials, there is neither a break in the method used to estimate aggregate output, as occurred in the U.S. in 1909, nor the need to extrapolate GNP from the narrow base of commodity output.[20]

I use the relatively superior international data sources to recommend revisions to the Romer and Balke-Gordon methods for estimating pre-World War I U.S. GNP. The strategy is to replicate the Romer and Balke-Gordon regression techniques for each country in the sample. These constructed prewar regression estimates are then compared to the more complete actual estimates for each country. While Romer seems to be correct to argue that commodity output and GNP did not move one for one in either the prewar or postwar periods, the constructed Romer-like prewar estimates are still shown to be at least 15 percent less volatile on average than the actual estimates. Although Chow tests generally confirm that the commodity output coefficient has remained stable over time, the regression process has led Romer, and Balke-Gordon, to underestimate the volatility of the prewar economy.[21] In forming the backcasted values of GNP for 1869-1908, Romer and Balke-Gordon set ". . . all the error terms equal to their mean, which is zero."[22] By setting the error terms equal to zero, Romer and Balke-Gordon are producing

[20] See Siegler (1997), Chapter 2 and Appendix 1 for precise details regarding the sources and construction of the international data. The international sample includes Australia, Canada, Denmark, Finland, France, Germany, Italy, Japan, Spain, Sweden, and the United Kingdom.

[21] For each of the eleven countries in the sample, I used the Chow test to assess whether the commodity output coefficients are the same for the years 1869-1908 versus the years 1909-1928 and 1947-1985. Sweden is the only case where the null of equal parameters in both periods is rejected at the 5 percent significance level. In no case is the commodity output coefficient greater than 0.78 (Canada) in the prewar international sample.

[22] Romer (1989), p. 20.

artificially smooth prewar GNP series since each backcasted value is forced on to the line of best fit. One reason that Romer obtained a low prewar/postwar volatility ratio is that she was comparing fitted prewar values to actual postwar GNP. Failing to account for the noise in the prewar estimates biases the regression results toward indicating too little volatility in the prewar period.

In Table 1, the last column labeled (SDDTF/SDDTA) reports the ratio of the standard deviation of deviations from a piecewise log-linear trend of the forecast (SDDTF) real output series from the Romer and Balke-Gordon equations to the standard deviation of deviations from trend of the actual (SDDTA) international real output estimates. The Romer equations underestimate actual prewar volatility in eight of the eleven countries, and, on average, are only 0.869 times as volatile as the actual estimates.[23] With Italy dropped from the sample, this number falls to 0.834.[24] If only the post-World War II period (1947-1985) is used to forecast real output from 1869-1908, excluding the 1909 to 1928 years from the Romer equation, the forecasted prewar international series are only 0.826 times as volatile as the actual estimates. The postwar period produces even a smoother prewar forecast than with the entire 1909-1928 and

[23]The time trend has not been included in the Romer equations in Table 1. In most cases, the time trend was small and insignificant. Including a time trend also worsened the prewar forecasting accuracy in nearly every country in the sample. Including a time trend set equal to zero in 1909 increased the average root mean squared error (RMSE) from .0229 to .0288, the mean absolute error (MAE) from .0169 to .0214, and Theil's inequality from .335 to .418. Since the prewar U.S. estimates are quite close with or without a time trend included, I did not include an ad hoc time trend since prewar forecasting accuracy was only worsened. I did correct for AR(1) errors in each case however since all uncorrected equations exhibited first-order autocorrelation. The Cochrane-Orcutt AR(1) correction imposes a common-factor restriction on the estimated regression. Incorrectly imposing a common-factor restriction may produce false inferences, often the opposite of what the data in fact support. See Hoover (1988) for a discussion of these issues.

[24]Both the Romer and Balke-Gordon equations produce prewar real output volatility much larger than the estimates reported in Fua (1969). Both trade and transportation output were calculated from employment data which should artificially dampen the prewar Italian estimates. Since Italy is an outlier in both equation specifications, I report results with Italy both included and excluded from the sample. Given that more recently constructed estimates of prewar Italian output, reported in Fratianni and Spinelli (1984), are substantially more volatile than the Fua estimates, it seems justified to report international estimates both including and excluding Italy. The estimates from Fratianni and Spinelli (1984) were not used in this section because they do not report the sectoral breakdowns needed to produce Balke-Gordon and Romer-like results.

1947-1985 sample since the 1909-1928 years increase the commodity output coefficient in nearly every case, unlike the U.S. case.[25]

The Balke-Gordon specification, estimated over the years 1909-1938, which includes output from the transportation, communication, construction and commodity producing sectors, forecasts 1869-1908 real aggregate output much better in terms of both forecasting accuracy and overall volatility. However, the Balke-Gordon specification also underestimates volatility in eight of the eleven countries in the prewar period. On average, the Balke-Gordon equations are 0.964 times as volatile as the actual estimates. If Italy is dropped from the sample, the Balke-Gordon equations are only 0.915 times as volatile as the actual estimates.

Siegler (1997) argued that the international historical national accounts data are somewhat suspect for Denmark, Germany, and Italy. In all three countries, pre-World War I output for some sectors of each economy were computed from either linear interpolations between benchmark years or from labor force estimates. Both of these procedures tend to understate the true volatility of both sectoral and aggregate real output. If these three countries are dropped from the international sample, the overall forecasting accuracy of the Balke-Gordon specification improves while the forecasting accuracy of the Romer specification worsens using any of the three measures of forecasting accuracy presented in Table 1.[26] It is not surprising that the Romer regression equations, which underestimates fluctuations more so than the Balke-Gordon equations, forecast more accurately for the excessively smoothed Danish, German and Italian real output data. For the remaining eight countries, which have the most comprehensive historical national

[25]Section V discusses the anomalous behavior of the U.S. GNP and commodity output series used by Romer during the 1909 to 1928 period.

[26]With Denmark, Germany and Italy dropped from the sample, the average RMSE increases from 0.0229 to 0.0275, the MAE increases from 0.0169 to 0.0204, and Theil's U increases from 0.335 to 0.364 using the Romer specification. In contrast, the forecasting accuracy of the Balke-Gordon specification improves with the RMSE decreasing from 0.0187 to 0.0186, the MAE from 0.0140 to 0.0139, and Theil's U from 0.287 to 0.240.

accounts data, both the Romer and Balke-Gordon specifications underestimate actual prewar volatility more so than in the eleven country sample. The ratio of standard deviation of deviations from trend of the forecast and actual values decreases from 0.869 to 0.814 with the Romer specification, and from 0.964 to 0.923 with the Balke-Gordon specification.

Given the weight of the evidence presented in this section, it seems reasonable to conclude that the prewar fitted Romer regression estimates are at most only 0.85 times as volatile as the actual estimates since the regression techniques fail to account for noise in the prewar period. For the United States, Romer reports a prewar/postwar volatility ratio of 1.34. This ratio compares prewar fitted values to postwar actual values. The international evidence suggests that prewar volatility should be adjusted upward to account for error which the fitted prewar estimates ignore. If we accept that the regression estimates are only 0.85 times as volatile as actual real output, the Romer U.S. volatility ratio should be adjusted up to 1.57 (1.34/.85 = 1.57).

Another way to examine the same problem is to compare prewar fitted regression values for the U.S. to postwar fitted values from equation (2). While the prewar fitted/postwar actual volatility ratio is 1.33 (3.93 percent/2.95 percent), the correct comparison should be between *both prewar fitted and postwar fitted values*.[27] Equation (2) yields a postwar fitted SDDT of 2.49 percent, which increases the volatility ratio to 1.58 (3.93 percent/2.49 percent). This correction is nearly identical to what the international regression estimates also indicated.

The evidence presented shows that a commodity output coefficient of 0.6 is quite close to what the international data suggest as well. However, the regression equations used by both Romer and Balke-Gordon have been shown to understate the actual volatility of pre-World War I real output because these authors have compared prewar

[27]Romer reports this ratio as 1.34, while my attempted replication yields 1.33 [see equation (i) from Table 4].

fitted values to postwar actual values. By examining both prewar fitted values to prewar actual values in the international sample, as well as comparing prewar fitted values to postwar fitted values for the U.S. and other countries, it has been shown that the Romer regression estimates are at most 0.85 times as volatile as actual real output. The following section provides additional modifications which further increase the perceived volatility of pre-World War I U.S. business cycles.

IV. Commodity Output Revisited

In this section, I modify the Shaw-Kuznets real commodity output series, on which all previous U.S. GNP estimates have depended to varying degrees. Three problems have caused the Shaw-Kuznets real commodity series, and subsequently real GNP, to be excessively smooth in the pre-World War I period. First, the annual interpolating series, based largely on state bureau reports, are extremely limited in geographic coverage and are biased toward more developed, less volatile states. Second, only the largest firms and those in continuous operation over the entire sample period were typically included in these state reports. As a result, the annual interpolating series fail to account for the extremely high business failures which occurred during the severe contractions in the mid-1870s and mid-1890s. Third, both Shaw and Kuznets were forced to deflate the nominal estimates with excessively volatile wholesale and raw commodity price indexes, thus causing the real commodity output estimates to understate actual volatility.

Romer has almost certainly overestimated the reliability and consistency of the Shaw-Kuznets series.[28] While Romer asserted many times that the Shaw-Kuznets series

[28] Romer offered the following descriptions of the Shaw series: "the Shaw series is a particularly good interpolating series because it is very consistent over time" [Romer (1989), p. 32]; "these data . . . appear to be quite accurate as far back as 1869" [Romer (1989), p. 2]; "the Shaw series appears to be quite accurate" [Romer (1989), p. 5]; "there is no evidence of systematic bias in the series" [Romer (1989), p. 5]; "the Shaw series is quite accurate" [Romer (1989), p. 6].

is quite accurate over time, both Shaw and Kuznets agreed that the quality of the commodity output data deteriorates as one goes back in time. Shaw reported estimates for 1869, for 1879, and annually for the 1889-1939 period, while Kuznets interpolated between benchmarks to extend the annual series back to 1869. Shaw rated the quality of his annual series used for interpolation between benchmark years: for the 1899-1919 period, Shaw rated 8 series as good, 25 series as fair and 12 series as poor; for the 1889-1899 period, no series is rated as good while 32 of the 40 series are rated as poor.[29] The geographic coverage of the Shaw estimates is surprisingly limited as well. Shaw stated "that at least four states are included in every census period except 1889-1899, when only one is. This implies fair geographic extensiveness of coverage after 1899, and poor before."[30] Shaw's ratings are quite generous considering that the assumption that data from only four states implies fair geographic coverage. Even the most comprehensive years cover "only about one-fourth of manufacturing . . . (and) geographically the sample contains no state in the lower south, middle west, or far west."[31] In addition, Shaw noted that ". . . of the 10 largest states no annual figures were found for New York and California. . ."[32] This geographic bias is probably responsible, to some extent, for the relatively low volatility of the Shaw-Kuznets series in the prewar period. It certainly seems plausible that states in the Lower South recovering from the Civil War, and the more agricultural and railroad building states in the Midwest and the Far West may have exhibited much higher volatility than a more settled state such as Massachusetts. In ongoing research, I am using state level business failure data to examine the magnitude of differences in volatility across states during this period.

Another problem with the annual interpolating series used by Shaw is that the state bureau reports are biased toward large firms, and typically include only firms in

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[29]Shaw (1947), p. 101.
[30]Shaw (1947), p. 97.
[31]Shaw (1947), p. 94.
[32]Shaw (1947), p. 92.

continuous operation from year-to-year. The state bureau reports from Massachusetts, Ohio, and Pennsylvania were relied on heavily by Shaw to construct year-to-year commodity output starting in 1889.[33] However, both Massachusetts and Pennsylvania collected data from "identical establishments," thus neglecting firm entry and exit.[34] However, comprehensive data on business failures from Dun & Bradstreet confirm that business failure rates in the mid-1870s *exceeded* business failure rates during the worst years of the Great Depression, while failure rates in the 1890s were nearly as high (see Figure 1).[35] Also, by relying on data from only the largest firms, the Shaw series further understates actual volatility.[36] The practice of surveying only large firms in continuous operation over time strongly suggests that comprehensively measured commodity output would be more volatile than the estimates presented by Shaw.

Kuznets believed his annual extensions of real commodity output back to 1869 were even worse than Shaw's estimates after 1889. Kuznets (1961) stated that "we know in advance, from the derivation of the series on finished commodity output, that the estimates for the years before 1889 are on a much weaker basis than those for 1889 and later, so that there is a prima facie case against placing too much reliance upon *annual* estimates of national product for 1869-1888."[37] In fact, Kuznets never published annual

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[33]Shaw (1947), p. 94.

[34]Shaw (1947) stated that Pennsylvania "for 1892-1894, 381 identical establishments in 51 industries were reported; 1896-1905, 710 identical establishments in 84 industries" (p. 204). Similarly, in Massachusetts from "... 1886-1906 figures were presented for identical establishments. . ." (p. 205).

[35]The Dun & Bradstreet data are based on the incorporated and unincorporated companies listed in the Dun & Bradstreet *Reference Books*. The number of firms listed exceeded 400, 000 in 1870 and had reached over 2,000,000 by 1930. The *Reference Books* are widely regarded as quite complete and include most manufacturing, retailing, wholesale, transportation and contracting firms in the U.S. However, the professions, farms, railroads, amusements, one-person services and firms in the "FIRE" sector (finance, insurance, real estate) are excluded. Given that farming and railroads were a larger share of the economy in the 1870s and 1890s, compared to the 1930s, failure rates during the 1870s and 1890s would likely be even higher than the rates shown in Figure 1 had these sectors been included. A failure is defined as a closure leading to or likely to lead to a loss to creditors. Mergers and acquisitions are excluded from the index. The sharp drop in 1934 is due to changes in the bankruptcy laws. See Bureau of the Census (1976), Series V-23, for aggregate index.

[36]Prior to 1901, Shaw (1947) reported that the Ohio Bureau "... had collected data from large concerns only" (p. 205).

[37]Kuznets (1961), p. 538.

estimates of gross national product before 1889 partly because of these problems.[38] Both Shaw and Kuznets were forced by necessity to interpolate between census years to obtain annual estimates. It seems likely that the process of interpolation led to excessive smoothing of the data as well, especially since Kuznets' work was primarily concerned with the long-run growth of the U.S. economy and not the cyclical properties. To the extent that the commodity output series is excessively smooth due to the method of construction, it would bias the Romer and standard estimates, and to some extent the Balke-Gordon estimates, toward indicating too little volatility in the prewar period.

Perhaps more importantly, neither Shaw nor Kuznets used any data on the prices actually paid by consumers to convert nominal estimates of finished commodity output into real commodity output.[39] Instead, Shaw converted his nominal into real output by using wholesale price indexes. As he went farther back in time, he was forced to substitute price indexes of crude commodities for final product price indexes. Shaw (1947) stated that "some of the gaps were filled by using indexes of the chief materials which enter into a commodity."[40] Shaw acknowledged that "it is generally recognized that prices of materials usually fluctuate more than prices of end products."[41] The deflators used by Kuznets to extend real commodity output back from 1889 to 1869 also rely on crude materials or semi-finished goods prices as well.[42] Kuznets (1961) stated that "long after the calculations used in this volume had been completed, it became possible to check the price indexes used in converting flows of goods to consumers to 1929 prices with the consumer price indexes computed by Clarence Long and by Albert Rees. . ."[43] That is, Shaw and Kuznets were unable to use data on prices actually paid by

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[38] Annual estimates have only surfaced from unpublished T-tables which have been widely circulated. It is also possible to unravel the five-year moving average estimates reported in Kuznets (1961).
[39] See Balke and Gordon (1989), pp. 60-63, for a discussion of the commodity output deflators.
[40] Shaw (1947), p. 288.
[41] Ibid., p. 289.
[42] See Kuznets (1946), pp. 90-101.
[43] Kuznets (1961), p. 510.

consumers, compiled by Hoover (1960), Long (1960), and Rees (1961), since the consumer price data were published after Shaw and Kuznets had completed their work on commodity output.

Hoover's consumer price data cover the period 1850-1880 and are based on the prices actually paid by one or two respondents in more than 40 cities in 16 states. While price data for the 1880s are relatively scarce, Long (1960) has constructed a reasonably comprehensive retail price series.[44] Rees' contribution was to find as much solid evidence as possible on the prices actually paid by consumers on an annual basis from 1890 to 1914.[45] Because of the large amount of annual data collected on final prices paid by consumers, the Hoover-Long-Rees consumer price series is probably one of the most accurate of all available data series for the pre-World War I period.

Kuznets (1961) correctly noted that "the new consumer price indexes show less decline from the 1870's to the 1890's . . . than the price index implicit in our estimates..."[46] Aside from their reliance on raw and semi-finished goods prices, there is another important reason why the Shaw-Kuznets price index is too volatile. Kuznets (1961) stated "that distributive costs rose most rapidly from 1869 to 1899 when producers' prices (the denominator) were declining."[47] The consumer price indexes computed by Hoover, Long, and Rees include these rising distributive costs which the producer price indexes used by Shaw and Kuznets neglect.

It is easy to see why the use of the less volatile, more appropriate, consumer price deflators would increase prewar commodity output and GNP volatility. For example, suppose that nominal commodity output is $1,000 in year 1, and $900 in year 2. Assume,

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[44] For many of the retail prices on food, fuel, clothing, and household items, Long (1960) used data from "a small number of retail stores in New York City and Brooklyn, and two localities in Pennsylvania" (p. 57). In addition, retail price data were taken from a Massachusetts Bureau of Statistics of Labor report which included retail prices from Iowa, Massachusetts, Ohio, Wisconsin, Missouri, and New Jersey (p. 57).

[45] See Rees (1961), Chapter 4, pp. 74-119, for a description of how the cost of living index was created.

[46] Kuznets (1961), p. 512.

[47] Ibid., p. 515.

for simplicity, that the Shaw-Kuznets price index falls from 100 in year 1 to 90 in year 2. In this case, real commodity output is $1,000 in both years, measured in year 1 prices. However, the use of raw and semi-finished goods prices and the neglect of rising distributive costs causes the Shaw-Kuznets price index to fall too much during the period of generally falling prices from 1873 to 1896.. Suppose that the more appropriate consumer price index only decreases from 100 to 95. Then, real commodity output falls from $1,000 in year 1 to roughly $947 in year 2 [($900/95)*100]. When the Shaw-Kuznets deflators are used, there is no evidence of a recession; whereas, real commodity output does correctly decline once the nominal estimates of finished commodity output are deflated by prices actually paid by consumers.

The use of prices actually paid by consumers to deflate finished commodity output, instead of producer prices, substantially increases the prewar volatility of real commodity output. The SDDT of real commodity output increases from 6.59 percent to 8.77 percent for the 1869-1908 period. This correction, along with accounting for the bias in the prewar regression estimates discussed in Section III, reaffirms that real U.S. GNP was roughly twice as volatile in the prewar period, even assuming that real commodity output was only 60 percent as volatile as real GNP.

These two corrections increase prewar GNP volatility from 3.95 percent to 6.19 percent. Assuming that the commodity output coefficient is 0.6, if the SDDT of commodity output is 8.77 percent, then the SDDT of prewar fitted GNP is 5.26 percent [(0.6)*(8.77) = 5.26]. In Section III, it was shown that the Romer regression estimates were at most only 0.85 times as volatile as actual real output. Accounting for the regression volatility bias in the prewar fitted estimates yields a SDDT of actual prewar GNP of 6.19 percent [(5.26)/(0.85) = 6.19]. This results in a pre-World War I/post-World War II volatility ratio of 2.10 [(6.19)/(2.95) = 2.10] which is extremely similar to the 1.96 volatility ratio of the standard Kuznets-based estimates.[48] If the post-World War II period is extended from 1947-1985 to 1947-1997, then the pre-World War I/post-World War II volatility ratio increases to 2.36 with the new estimates of real output. These volatility conclusions are also relatively robust to different measures of trend and cycle.[49] The relative standard deviations of real output from 1869-1908 to 1947-1997 is 2.19 when standard deviations are computed from the first-difference of the logs of real output. In addition, the ratio of standard deviations between 1869-1908 and 1947-1985 from Hodrick-Prescott (1997) filtered data is 1.74, and 1.88 when the post-World War II period is extended from 1947 to 1997.[50] The following section carefully examines the behavior of all competing historical estimates of U.S. output, and reexamines the timing and severity of American business cycles from 1869 to 1928.

V. HISTORICAL BUSINESS CYCLES REVISITED

The new estimates of real output not only reaffirms the traditional interpretation that pre-World War I business cycles were twice as volatile as business cycles since

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[48]Even if the true volatility of real commodity output is halfway in between the Shaw-Kuznets estimates and those presented above, the SDDT of real GNP is still 5.42 percent [((8.77 + 6.59)/(2))*(0.6)*(1/.85) = 5.42]. This still yields a prewar/postwar volatility ratio of 1.84 [(5.42)/(2.95)].

[49] The division of real output into trend and cycle remains an unresolved issue in empirical macroeconomics. See Canova (1998) for a discussion of different detrending methods.

[50] A method of decomposing a series into a trend and stationary component has been developed by Hodrick and Prescott (1997). The HP filter defines trend $\{\mu_t\}$ for a series x_1 through x_T as the solution to the problem:

$$\min \sum_{t=1}^{T}\left(x_t-\mu_t\right)^2+\lambda\sum_{t=2}^{T-1}\left[\left(\mu_{t+1}-\mu_t\right)-\left(\mu_t-\mu_{t-1}\right)\right]^2$$

The problem is to select the $\{\mu_t\}$ sequence so as to minimize the above sum of squares. In the minimization problem, λ is an arbitrary constant which reflects the cost of incorporating fluctuations into the trend. Increasing the value of λ acts to "smooth out" the trend. If $\lambda = 0$, the solution to the problem occurs when $x_t = \mu_t$. As $\lambda \to \infty$, the trend approaches a linear time trend. Following Backus and Kehoe (1992), λ was set equal to 100 for all variables. The HP filter is based on the assumption that nonstationary movements in a time seres are captured by a smooth and slowly changing trend. Graphically, the HP filter roughly corresponds to drawing a smooth, nonlinear, freehand trend line through a series.

World War II, but are also quite consistent with many other measures of economic activity in the United States and abroad. The U.S. Romer series (USR) is the only estimate of real output in the twelve-country, international sample that does not exhibit an absolute decline during any year from 1870 to 1887 (see Table 2).

While the new series and the standard Kuznets-based estimates both show that the pre-World War I period was roughly twice as volatile as the period since World War II, the timing and severity of contractions differ substantially between the two series. In general, the Kuznets-based estimates from 1889 to 1913 are more volatile than the new series, while the new series is more volatile prior to 1889. Since all previous estimates of historical GNP have relied on the Shaw-Kuznets commodity output series to varying degrees, the break in the quality of the standard commodity output series has likely caused all previous researchers to underestimate the severity of economic fluctuations prior to 1889. While the new series has not remedied all of the shortcomings of commodity and aggregate output, the use of better price data and explicitly accounting for the biases in the regression procedures have likely provided a more accurate picture of the severity and timing of pre-World War I economic fluctuations, particularly in the period before 1889.

The Romer series declines in only 4 years during the 1870-1913 period with three of these declines being less than 1 percent. Only Denmark, whose data are highly suspect [See Siegler (1997)], experienced fewer years of decline during the prewar period than the U.S. Romer series. The new U.S. series declines in 9 years from 1870 to 1913, which is quite close to the eleven-country average of 9.55 years of decline.[51] The standard Kuznets-based estimates also exhibit 9 years of absolute decline, while the Balke-Gordon estimates decline in 7 years prior to World War I.

[51] The average would likely be slightly higher if real output data for Japan were available during the 1869-1884 period. Rosovsky (1996) argued that this period was quite volatile in Japan. Unlike any other country in the international sample, the Japanese economy experienced a 60 percent cumulative inflation from 1878 to 1881, and a subsequent 25 percent deflation from 1881 to 1884.

In addition, the years of decline in the new U.S. estimates of real output more closely match the Canadian experience than do the other U.S. estimates. Since the quality of the Canadian estimates is excellent, the close correspondence between these two bordering countries provides further evidence that the new series may better represent the actual behavior of U.S. real output prior to 1913.[52] Figure 2 plots the first differences of the logarithms of real output for both the Canadian and revised U.S. estimates prior to World War I. The magnitude and timing of the changes between the two series are quite striking. While the movements match closely in most years, the new U.S. estimates lead Canadian output fluctuations by one year in some cases. Since the U.S. economy was much larger than the Canadian economy during this period, it seems reasonable that any shocks to the U.S. economy would also affect the Canadian economy sometime later.

Compared to previous historical estimates of U.S. GNP, the years of absolute decline in the new series also more closely match the National Bureau of Economic Research (NBER) contraction dates. Early NBER business cycle reference dates were identified using a substantial amount of both qualitative and quantitative sources to identify peaks and troughs. The qualitative evidence was taken from the *Business Annals* which were compiled by William Thorpe and published by the NBER in 1926. This volume summarized "the business conditions in seventeen countries as they appeared to intelligent and expert observers. The chief sources are commercial and trade journals,

[52] For the 1870 to 1926 period, the primary data source for Canada is Urquhart (1986). While the data were first published in 1986, Urquhart (1993) later documented the construction of GNP in current prices for 20 sectors in total. Van Ark (1994) claimed that "there is no exaggeration in classifying this work as one of the best-documented historical national accounts in the world" (p. 1927). All of the 20 sectoral estimates are made on an annual basis except for trade, business, and personal services, for which the intercensal years were calculated by linear interpolation. Therefore, any biases in the Urquhart estimates are likely to understate true volatility. The weakest component of the Urquhart estimates is the price deflator, which is used to convert nominal GNP into real GNP. However, Altman (1989) has constructed an alternative real GNP series using the sectoral nominal estimates from Urquhart and a variety of sector-specific wholesale price indexes. Since one would expect wholesale prices to be more volatile than retail prices, it is likely that the Altman's real GNP estimates also underestimate the true volatility of real output to some extent.

reviews, magazines, and papers, consular and diplomatic reports, and government records."[53] For the United States, periodicals such as *Dun's Review* and *The Commercial and Financial Chronicle* were relied on heavily to determine the state of the economy during the nineteenth and early twentieth centuries. Burns and Mitchell (1946) stated that the *Business Annals* were used to "write down an interval within which a cyclical turn in general business probably occurred."[54]

While the *Business Annals* were used to determine rough intervals, statistical series were used to determine precise monthly reference dates. Romer (1994) has argued that prewar cycles in the official NBER chronology are not strictly comparable to those for the postwar chronology since prewar dates may have been based on detrended data while the postwar dates reflect cycles in unadjusted data. Romer presents an algorithm that matches postwar peaks and troughs quite closely. When this algorithm is applied using the index of industrial production for 1884-1940 from Miron and Romer (1990), the new dates systematically place peaks later and troughs earlier than do the NBER dates.

Table 3 presents the NBER reference dates from 1869-1913 and the Romer reference dates from 1884-1913, in addition to the years in which the alternative measures of real output decline from 1869 to 1913. It is evident from Table 3 that the new series matches both sets of business cycle chronologies better than the Romer or other alternative output series.

A. 1870s

Based on both statistical data and contemporaneous accounts in the business press, the NBER identified a business cycle peak in June of 1869 and a trough in December of 1870. Similarly, the new series declines in 1870 as well. In contrast, all

[53]Thorpe (1926), p. 103.
[54]Burns and Mitchell (1946), p. 77.

other estimates increase in 1870.[55] There is remarkably little written about this episode although Friedman and Schwartz (1963) associate this contraction with "the slow rate of growth [of the money supply] from January 1868 to January 1870."[56]

The next contraction identified by the NBER is the longest in U.S. history extending from October 1873 to March 1879. Kindleberger (1993) described the crisis of 1873 as the first truly international crisis. The bankruptcy of Jay Cooke and Company (Northern Pacific Railroad) on September 18 helped trigger a panic in New York. Cooke's bank collapsed and several other major financial houses failed over the next two days, causing the New York Stock Exchange to close for ten days beginning on September 20. From the NBER peak to trough, almost 3 percent of all National banks failed. In terms of percentage of bank failures and losses per deposit dollar, this contraction is the worst of the entire National Banking Era (1863-1914).[57]

While the NBER has most likely overestimated the length of this decline, this was certainly a period of severe recession in the U.S. and around the world (see Table 2). The new U.S. series declines in 1874 and 1877, which is consistent with both the NBER reference dates and the estimates of real output in eleven other countries. It declines by 3.21 percent in 1874, and does not reach its 1873 level until 1876. It subsequently declines slightly again in 1877 by 0.89 percent. The Balke-Gordon estimates fall by 0.63 percent in 1874 while the Kuznets-based estimates decline by 1.27 percent in 1874 as well. In contrast, the Romer estimates display robust growth throughout this period. The Romer series increases by 1.40 percent in 1874, 1.53 percent in 1875, 6.87 percent in 1876, and 5.73 percent in 1877.

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[55]The Romer series increases by 1.12 percent, the standard Kuznets series increases by 2.81 percent, while the Balke-Gordon estimates increase 7.39 percent. The new series declines slightly, by 0.28 percent, in 1870.

[56] Friedman and Schwartz (1963), p. 31.

[57] See Gorton (1988), Table 1, p. 753.

The new series is also consistent with a comprehensive study of historical unemployment in Massachusetts conducted by Keyssar (1986). Keyssar stated that "statistics, coupled with . . . impressionistic evidence . . . suggest that upwards of 40 percent of all Massachusetts workers were unemployed in the course of the most depressed years of the late nineteenth century. An 1875 survey of economic welfare of 50,000 Bay State wage earners suggested that the unemployment rate in the middle of that depression exceeded 15 percent."[58] Lebergott's (1964) estimates for the U.S. are quite similar in magnitude to Keyssar's. While Lebergott did not construct annual unemployment estimates for the 1870s, based on fragmentary evidence from state and industry reports, he did discuss the severe and prolonged nature of unemployment during this decade. Lebergott tentatively estimated that the average unemployment rate from 1870 to 1879 was 10 percent. This is equaled for 1890 to 1899, and is only surpassed by the 18 percent average unemployment rate from 1930 to 1939.[59] Lebergott concluded "that a figure of 2 million -- or 13 percent of the labor force in that year [1876] -- would be a reasonable figure [of unemployment] in the light of these partial indications."[60]

Preliminary research using the Ohio Bureau of Labor Statistics reports for the mid-1870s also suggests that this period was most likely one of stagnant or falling real output. The 1878 report discusses "the continued depression in business circles since 1873" resulting in "the closing or partial closing of hundreds and thousands" of factories and mills.[61] This report, based on the study of 1024 firms in 85 industries with 22,650 employees, shows that there was an immense amount of underemployment even as late as 1878. Nearly 4,432 of the 22,650 employees report working 35 or fewer weeks per year.

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[58]Keyssar (1986), pp. 51-52.
[59]Lebergott (1964), p. 189.
[60] Ibid., p. 189.
[61]Ohio Bureau of Labor Statistics (1878), p. 24.

In addition, "in nearly every industry a majority of establishments in operation in the 1872-3 report in 1878 a decrease in employees as compared with the years first named."[62]

The reports of the Dun and Company also show the mid-1870s to be a very depressed period. These reports indicate a doubling of bankruptcies, from 5,183 in 1873 to 10,478 in 1878.[63] In addition, Rezneck (1950) examined records from the New York Society for Improving the Condition of the Poor. The Society estimated that unemployment in New York City totaled "one-third of the city's workers."[64] The Society's relief rolls also reflected this "by soaring from 5,000 families on relief in 1873 to 24,000 in 1874, and to an average of more than 20,000 families during the later 1870s."[65]

Available domestic evidence on unemployment, bank and business failures, and poor relief during the 1870s, as well as the widespread real output declines internationally, is difficult to reconcile with the robust and uninterrupted growth of real GNP reported by Romer (1989), and much more consistent with the behavior of the revised estimates of U.S. real output described in this paper.

1880s

The NBER identified a business cycle peak in March 1882 and a trough in May 1885. The new series falls by 2.64 percent in 1884 and 0.16 percent in 1885. Similarly, real GNP in Canada fell 2.55 percent from 1882 to 1885. The standard Kuznets-based estimates place the recession earlier, with GNP falling by 1.12 percent in 1883. In contrast, neither the Romer or Balke and Gordon estimates decline in any year during this NBER contraction.[66]

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62 Ibid., pp. 10-11.
63 Rezneck (1950), pp. 496-497.
64 Ibid., p. 498.
65 Ibid., p. 498.
66 Between 1883 and 1885, the Balke-Gordon estimates increase by 2.54 percent, while the Romer estimates increase by 3.67 percent.

Like the previous contraction, it appears that the collapse of railroad building transmitted to other sectors as well. New York bank clearings dropped from more than $46 billion in 1882 to $25 billion in 1885. Business failures also increased dramatically as well (see Figure 1). Liabilities of bankrupt firms increased from $65 million in 1880 to $226 million in 1884. Carroll Wright (1886), the first U.S. Commissioner of Labor, reported that unemployment rate in the Northeast had reached 13 percent by October 1884.

The next NBER contraction occurred from March 1887 to April 1888 while the Romer algorithm shortens this contraction even more to 5 months from February 1887 to July 1887. None of the series declines in 1887, although the Romer, Balke-Gordon and standard estimates all decline by less than one percent in 1888. The new series increases by less than one percent in 1888. Real output does not fall in any other country in the international sample in 1888 (see Table 2).

1890s

All real output series are consistent with the contraction beginning in January 1893 and extending to mid-1894. The Romer series declines by 0.82 percent in 1893 and 0.89 percent in 1894, but the magnitude of these declines are far smaller than the fall of 4.48 percent which the new series exhibits in 1894. The Balke-Gordon series also declines in both 1893 and 1894, but the cumulative decline is only 3 percent which is also less than the 1894 decline in the new series. However, the standard Kuznets-based series exhibits a far larger decline than the new series during this time. The Kuznets-based estimates decline 5.14 percent in 1893 and an additional 4.48 percent in 1894. For comparison, real Canadian output falls by 5.74 percent from its 1892 peak to 1895.

Temin (1998) argued that the Sherman Silver Purchase Act of 1890 caused concern that the U.S. was going to shift from a gold to a silver standard. New technology and discoveries of silver had caused the relative price of silver to fall substantially in the previous 20 years. Beginning in 1893, there was a run on the dollar and interest rates increased as individuals rushed to sell government bonds. Temin (1998) concludes that "the cycle of 1893 was caused by flirting with devaluation."[67]

The behavior of the competing series also differs substantially during the next contraction as well. The NBER dates the peak in December of 1895 and the trough in June of 1897. The Romer dates also place the peak in December of 1895, but the trough occurs earlier in January of 1897. The new series declines 3.12 percent in 1896 while the Balke-Gordon series declines 2.30 percent. Once again, the standard Kuznets-based estimates show a much larger decline of 7.15 percent in 1896. However, the Romer series actually increases by 2.64 percent in 1896.

Like the 1893 crisis, Temin (1998) also argues that this contraction was monetary in nature, caused by the uncertainty over Bryan's nomination for President, and his famous "cross of gold" speech at the 1896 Democratic convention.

1900s

The only substantial decline in the Romer series occurs in the short, but severe contraction of 1908 when real GNP falls by 4.27 percent. The new series declines by 6.48 percent which is quite similar in magnitude to the cumulative decline in 1907-1908 of the Balke-Gordon series.[68] Once again, the standard Kuznets-based estimates show the largest decline of 10.53 percent in 1908.

The banking panic in 1907 caused banks to suspend payments, and convinced contemporaries of the deficiencies of the National Banking system. This contraction led to the establishment of the National Monetary Commission in 1909 and the Federal Reserve in 1913.

1909-1928

It is also important to note the importance of Romer's 1988 article in obtaining the GNP estimates for the period 1869-1908 she reported in 1989. Romer (1988)

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[67] Temin (1998), p. 22.

[68] The Balke-Gordon series declines 1.56 percent in 1907 and 5.62 percent in 1908.

constructed a GNP series for 1909-1928 as an alternative to the official Department of Commerce (1986) and Kendrick series (1961) for these two decades. In her view, the Department of Commerce series is quite poor because the methods used to construct the series are completely undocumented and the series "behaves in a way that is contrary to other reliable indicators for this period."[69] A comparison of the Kendrick real GNP series (which Romer modified to obtain her new estimates from 1909-28) and the Commerce real GNP series to other cyclical indicators for the years around World War I and the contraction of 1920-1921 led Romer to conclude that the Kendrick series is more accurate.[70] Romer stated that "the three reliable alternative series confirm the behavior of the Kendrick series. Only the two series whose accuracy is highly suspect confirm the behavior of the Commerce series."[71]

The NBER has dated the business cycle peak in January of 1920 and the trough in July of 1921.[72] Friedman and Schwartz (1963) argued that the 1920-1921 recession was quite severe, and the result of monetary restraint.[73] The Federal Reserve Bank of New York, which had pegged the discount rate at 4 percent since April 1919, raised the discount rate to 4.75 percent in December 1919, to 6 percent in January 1920, and to 6.75 percent in June 1920. Similar discount rate increases were also made at other Federal

[69]Romer (1989), p. 34. For a complete discussion of the perceived flaws in the Department of Commerce series from 1909-28, see Romer (1988), pp. 94-102.
[70]The Commerce Department series and the so-called Kendrick series were both created by John Kendrick. The Commerce series for 1909-1928 was created by Kendrick in the early 1950's when he was an employee at the Bureau of Economic Analysis. He formed this series by piecing together estimates of the various components of GNP from secondary sources. The Kendrick series is based almost entirely on the Kuznets components estimates. In conversation with Kendrick, Romer reported that Kendrick stated that "I suspect the latter series [the 1961 Kendrick series] is better, but I am not certain that is so" [see Romer (1988), p. 94].
[71]Romer (1988), p. 102. According to Romer, the behavior of the Kendrick series is confirmed by the Shaw commodity output series, the Fabricant series on manufacturing production and the Romer (1986b) unemployment rate series. The Commerce estimates are viewed to be consistent with the Federal Reserve Board index of industrial production and the Lebergott unemployment series.
[72]See Diebold and Rudebusch (1992), Table 1, p. 995, for the complete NBER business cycle chronology.
[73]The discussion below is a summary of Friedman and Schwartz (1963), pp. 205-239.

Reserve Banks. Nominal interest rates throughout the economy increased as well.[74] With the exception of the Great Depression, the decline in the monetary base from October 1920 to January 1922 was also the largest recorded in so short a period.

While monetary factors may or may not have been responsible for the downturn, a detailed examination of the available evidence suggests that the downturn was quite severe. Between 1920 and 1921, real manufacturing output fell 22.10 percent, real transportation and communication output fell 20.57 percent, and real exports declined 22.24 percent. Real construction output did increase by 9.81 percent from 1920 to 1921, but had declined 14.06 percent from 1919 to 1920, and was still 4.26 percent below the 1919 level in 1921.[75] Since one would expect construction to be a leading sector, the behavior of construction output during this time is not inconsistent with the other measures of economic activity.

In contrast, the Shaw-Kuznets real commodity output series declined only 2.99 percent while the Kendrick GNP estimates fell 2.38 percent from 1920 to 1921. I argue in Section IV that the Shaw-Kuznets commodity output series is excessively smooth for many reasons including the deflation procedures used to construct real estimates. However, Romer (1988) argued that "the different behavior of the Shaw [commodity output] and Fabricant [manufacturing] series is due to the fact that the Shaw series includes nonmanufactured foods while the Fabricant series does not. Because of an agricultural boom in 1921, total commodity output does not fall as much as does manufacturing production." Yet as McMillin and Parker (1994) noted, "Romer (1988) argues that positive supply shocks to farm products moderated the recession of 1921, but no empirical evidence is presented. . ."[76] However, empirical evidence on the agricultural sector is relatively abundant during this period. Kendrick (1961) stated that

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[74]The interest rate on prime commercial paper increased 1.98 percent from 1919 to 1920. See Homer and Sylla (1991), Table 49, pp. 358-359.
[75] See Siegler (1997), Appendix 1, for a description of these data sources.
[76]McMillin and Parker (1994), p. 487.

"there is a greater choice of indexes of the physical volume of output in farming than in other segments of the economy."[77] An agricultural index is available which is based on the physical output of twelve important crops, and not on nominal values which later had to be deflated. This index shows no "agricultural boom" in 1921 since real agricultural output *declined by 13.91 percent* from 1920 to 1921.[78] It becomes difficult to argue that real commodity output and real GNP fell less than 3 percent from 1920 to 1921 given the weight of the evidence. Independent estimates of real output in the agricultural, manufacturing, transportation and communication, and export sectors all show declines of greater than 10 percent from 1920 to 1921. The 7 percent decline in the Department of Commerce estimates seems more in line with an abundance of available measures of economic activity.[79]

The pre-1909 volatility conclusions reported in Romer (1989) depend crucially on the choice of GNP from 1909-1928. Romer (1988) produced an alternative GNP series for the 1909-1928 period which is less volatile than other competing historical estimates. The standard deviation of deviations from trend of the Romer GNP series from 1909-1928 is 3.54 percent. All eleven countries were more volatile than the Romer estimates indicate for the U.S. from 1909-1928. For the eleven country sample, the average standard deviation of deviations from trend is 7.05 percent.

Table 4 reports several regressions which modify both the Romer and Balke-Gordon equations in order to test for the robustness of their reported estimates. Equation (iii), in Table 4, estimates the regression relationship between the Shaw-Kuznets

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[77]Kendrick (1961), p 343.

[78]This index was originally published by the U.S. Department of Agriculture in 1935, but is now part of the NBER Historical Database, NBER series 01005A. The combined index was computed by weighting the production of each commodity by the average farm price per unit during the years 1910-1914. The index is based on revised figures for corn, wheat, oats, barley, rye, buckwheat, flaxseed, potatoes, sweet potatoes, cotton, tobacco, and tame hay. Other available measures of the agricultural sector during this time show similar declines as well. Real gross farm product declined 10.87 percent from 1920 to 1921 [NIPA (1986), Table 1.25, series 7, p. 87]. Even the Kendrick estimates of real gross farm product show a 6.06 percent decline from 1920 to 1921 [Kendrick (1961), Table A-III, column 8, pp. 298-300].

[79]As additional support, Kendrick (1961), Table A-X, reported that labor hours fell 10.06 percent between 1920 and 1921.

estimates of commodity output and Romer's (1988) GNP series for the period 1909-1928. This equation implies a 1869-1908/1947-1985 volatility ratio of 1.32. However, if the standard Kendrick series is used for the years 1909-1928, the prewar/postwar volatility ratio increases to 1.77 [equation (iv)]. Also note that this 1.77 ratio is comparing prewar fitted values to postwar actual values. If the Department of Commerce estimates are used instead of the Romer (1988) or Kendrick (1961) series, the prewar/postwar volatility ratio increases to 2.09. Thus, Romer's (1989) volatility conclusions are critically dependent on her rejection of the Commerce and Kendrick estimates for the years 1909-1928. The available domestic and international evidence suggests that the Kendrick and Department of Commerce estimates are probably more accurate than the interwar estimates used by Romer (1988).

VI. CONCLUSION

The abundance of international and domestic cross-checks provides substantial evidence that the U.S. experienced severe downturns in both the mid-1870s and mid-1890s, downturns much more severe than any downturn since World War II. Both the 1869-1908 and 1869-1928 periods were roughly twice as volatile as the postwar period has been.

While the revised estimates presented in this paper and the standard Kuznets-based estimates for the United States both show that the pre-World War I period was roughly twice as volatile as the period since World War II, the timing and severity of recessions differs substantially between the two series. The standard Kuznets-based estimates are more volatile than the new series after 1889, but are somewhat less volatile than the new estimates prior to 1889. The domestic and international cross-checks discussed in Section V show that the new estimates have likely remedied some of the shortcomings of previous estimates, and have provided a more accurate picture of the timing and severity of pre-World War I U.S. business cycles.

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Table 1
Regression Forecasting and Volatility Accuracy
Forecast Period: 1869-1908

Equation:	Romer with AR(1), 1909-1928 and 1947-1985			
Country	**RMSE**	**MAE**	**Theil's U**	**SDDTF/ SDDTA**
Australia	0.0551	0.0396	0.388	0.777
Canada	0.0448	0.0330	0.380	0.686
Denmark	0.0167	0.0106	0.470	0.866
Finland	0.0132	0.0101	0.185	1.166
France	0.0243	0.0179	0.395	0.874
Germany	0.0051	0.0042	0.094	0.971
Italy	0.0101	0.0079	0.207	1.214
Japan	0.0287	0.0232	0.420	0.561
Spain	0.0178	0.0129	0.284	0.904
Sweden	0.0215	0.0153	0.434	1.036
UK	0.0149	0.0112	0.425	0.509
Mean	**0.0229**	**0.0169**	**0.335**	**0.869**
Standard Deviation	**0.0150**	**0.0109**	**0.123**	**0.227**

Equation:	Balke-Gordon 1909-1938			
Country	**RMSE**	**MAE**	**Theil's U**	**SDDTF/ SDDTA**
Australia	0.0178	0.0132	0.113	0.984
Canada	0.0251	0.0192	0.199	0.800
Denmark	0.0141	0.0087	0.436	0.752
Finland	0.0112	0.0081	0.161	0.989
France	0.0236	0.0170	0.367	0.893
Germany	0.0138	0.0106	0.245	1.019
Italy	0.0291	0.0233	0.564	1.454
Japan	0.0289	0.0225	0.354	0.887
Spain	0.0160	0.0112	0.211	0.836
Sweden	0.0118	0.0090	0.181	1.041
UK	0.0145	0.0112	0.330	0.954
Mean	**0.0187**	**0.0140**	**0.287**	**0.964**
St. Dev.	**0.0067**	**0.0056**	**0.136**	**0.187**

Notes: Three measures of forecasting accuracy are presented: the root mean square error (RMSE), the mean absolute error (MAE), and Theil's inequality coefficient (U). For all three measures, low values indicate accurate forecasts. The last column gives the ratio of the standard deviation of deviations from trend of the forecasts (SDDTF) from the regression specifications to the standard deviation of deviations from trend of the actuals (SDDTA) for the pre-1909 years. In all cases, the trend was calculated by linearly interpolating between the logarithms of real output in normal years.

Table 2
Years in Which Real GDP Declined, 1870-1913
United States Included

Year	AUS	CAN	DEN	FIN	FRA	GER	ITA	JPN	SPA	SWE	UK	USN	USR	USB	USK
1870					■	■						■			
1871	■				■		■								■
1872							■								
1873					■				■						
1874			■						■			■		■	■
1875		■								■					
1876	■	■			■	■	■								
1877			■	■		■	■		■	■		■			
1878		■		■	■				■	■					
1879					■	■					■				
1880						■									
1881				■			■								
1882	■														
1883		■					■								■
1884		■			■				■			■			
1885		■			■				■		■	■			
1886									■						
1887									■	■					
1888													■	■	■
1889							■		■						
1890	■							■	■						
1891				■		■									
1892	■			■			■	■			■				
1893	■	■							■				■	■	■
1894		■					■					■	■	■	■
1895	■	■			■				■						
1896								■	■			■		■	■
1897	■				■		■	■							
1898															
1899				■											
1900					■			■			■				
1901	■				■	■				■					
1902				■	■		■	■	■						
1903	■										■				
1904		■							■			■			■
1905	■							■	■						
1906								■							
1907														■	
1908	■	■			■		■				■	■	■	■	■
1909															
1910					■		■		■						
1911															
1912	■							■							
1913															
Total	**13**	**11**	**2**	**7**	**15**	**7**	**13**	**9**	**17**	**5**	**6**	**9**	**4**	**7**	**9**

Notes: USN denotes the U.S. new estimates of real output, USR denotes U.S. Romer GNP, USB denotes U.S. Balke-Gordon GNP, while USK denotes the standard Kuznets-based estimates for real U.S. GNP. An Appendix available from the author describes the data sources and definitions for each country.

Table 3
Alternative U.S. Business Cycle Chronologies and Estimates of Real Output, 1869-1913

Business Cycle Chronologies				Measures of Real Output Years of Absolute Decline			
NBER Dates 1869-1913		Romer Dates 1884-1913					
Peak	Trough	Peak	Trough	New	Romer	Balke-Gordon	Standard Kuznets
June 1869	Dec. 1870			1870			1871
Oct. 1873	Mar. 1879			1874, 1877		1874	1874
Mar. 1882	May 1885			1884-85			1883
Mar. 1887	April 1888	Feb. 1887	July 1887		1888	1888	1888
July 1890	May 1891						
Jan. 1893	June 1894	Jan. 1893	April 1894	1894	1893-94	1893-94	1893-94
Dec. 1895	June 1897	Dec. 1895	Jan. 1897	1896		1896	1896
June 1899	Dec. 1900	April 1900	Dec. 1900				
Sept. 1902	Aug. 1904	July 1903	Mar. 1904	1904			1904
May 1907	June 1908	July 1907	June 1908	1908	1908	1907-08	1908
Jan. 1910	Jan. 1912	Jan. 1910	May 1911				

Notes: The NBER business cycle chronology is from Diebold and Rudebusch (1992), Table 1, p. 995. The Romer business cycle chronology is from Romer (1994). An Appendix is available from the author which contains the sources and construction of the new estimates of U.S. real output and the standard Kuznets-based estimates. The Romer GNP estimates are from Romer (1989), Table 2, pp. 22-23, while the Balke-Gordon estimates are from Balke and Gordon (1989), Table 10, pp. 84-85.

Table 4 – United States Regression Summary

Regression[2]	Equation[3]	Adj. R^2	Error of Regression	Squared Residuals	Normality $X^2_{[2]}$	ARCH(1)	AR(1) AR(2)	RESET	Volatility Ratio
(i) R0985TAR	$gnpdev_t = [0.581 - 0.0007(tr)]comdev_t$ AR(1) = 0.718 (0.076) (0.0016) (0.103)	.841	0.0132	0.009550	2.02	3.38[a]	0.00 0.72	3.11[a]	1.33
(ii) R0985AR	$gnpdev_t = 0.553comdev_t$ AR(1) = 0.716 (0.041 (0.103)	.844	0.0131	0.009582	2.20	3.26[a]	0.00 0.70	3.07[a]	1.25
(iii) R0928AR	$gnpdev_t = 0.589comdev_t$ AR(1) = 0.740 (0.102) (0.180)	.681	0.0200	0.007201	1.71	0.12	0.22 1.08	15.31**	1.32
(iv) R0928SAR[4]	$gnpdev_t = 0.847comdev_t$ AR(1) = 0.711 (0.152) (0.175)	.560	0.0293	0.015415	6.34*	0.79	0.72 0.53	1.72	1.77
(v) R0938AR	$gnpdev_t = 0.734comdev_t$ AR(1) = 1.020 (0.054) (0.067)	.980	0.0227	0.014433	0.01	0.07	0.32 1.53	3.41[a]	1.68
(vi) R0938SAR	$gnpdev_t = 0.834comdev_t$ AR(1) = 0.928 (0.068) (0.096)	.968	0.0285	0.022704	10.50**	0.18	1.01 0.49	0.16	1.73
(vii) R0938	$gnpdev_t = 1.042comdev_t$ (0.039)	.943	0.0384	0.042768	5.64[a]	0.25	18.57** 9.82**	0.05	2.33
(viii) R4785AR	$gnpdev_t = 0.536comdev_t$ AR(1) = 0.659 (0.032) (0.130)	.929	0.0080	0.002286	23.46**	0.17	4.60* 3.69*	3.21[a]	1.21
(ix) BG0938	$gnpdev_t = 0.240comdev_t + 0.253tcdev_t + 0.173condev_t$ (0.114) (0.077) (0.017)	.983	0.0211	0.012039	0.92	0.03	0.15 0.46	0.13	1.88
(x) BG0938R[5]	$gnpdev_t = 0.254comdev_t + 0.299tcdev_t + 0.152condev_t$ (0.094) (0.063) (0.014)	.988	0.0174	0.008177	0.90	0.01	1.48 1.02	0.07	1.88
(xi) BG0928	$gnpdev_t = 0.194comdev_t + 0.262tcdev_t + 0.176condev_t$ (0.205) (0.138) (0.038)	.659	0.0258	0.011292	0.75	0.35	0.10 0.38	0.36	1.86
(xii) BG0928R[6]	$gnpdev_t = 0.300comdev_t + 0.189tcdev_t + 0.117condev_t$ (0.155) (0.104) (0.028)	.697	0.0195	0.006466	0.12	0.38	2.13 1.17	4.70*	1.51
(xiii) BG0985	$gnpdev_t = 0.417comdev_t + 0.117tcdev_t + 0.129condev_t$ (0.081) (0.064) (0.022)	.749	0.0184	0.018967	4.29	4.45*	10.92** 5.96**	0.44	1.59
(xiv) BG4785	$gnpdev_t = 0.671comdev_t - 0.040tcdev_t - 0.050condev_t$ (0.057) (0.047) (0.030)	.894	0.0096	0.003310	3.68	7.35*	13.47** 7.18**	1.16	1.45

Notes to Table 4:

1. The normality test reported is the C. M. Jarque and Anil K. Bera (1980) test for normal residuals, which is distributed chi-squared with 2 degrees of freedom. ARCH(1) is a Lagrange-multiplier test for first-order autoregressive conditional heteroskedasticity. The F-distribution equivalent is reported. AR(.) is a Lagrange-multiplier test for autocorrelated residuals. This test is better than the standard Durbin-Watson (DW) statistic since the DW test is biased towards not finding autocorrelated errors whenever a lagged value of the dependent variable appears as a regressor. Using the Cochane-Orcutt correction for AR(1) errors is equivalent to including a lagged dependent variable . Suppose that the structural equations is $Y_t = a + bZ_t + e_t$, the LM statistic is based on the R-squared from the auxiliary regression: $e_t = a + bZ_t + g_1 e_{t-1} + \ldots + g_m e_{t-m}$, where e_t is the residual from the structural equation. The F-distribution equivalent is reported, which is distributed F(.,.) under the null hypothesis of no residual autocorrelation up to the order indicated by the degrees of freedom in the numerator. The RESET test is used to test for both an omitted variable or incorrect functional form. The RESET test first estimates a model by OLS and saves the fitted values. The RESET test augments the original regression by adding a number of powers of the fitted values from the original regression. If these extra regressors have non-zero coefficients, there is evidence of specification error. The volatility ratio compares the SDDT of the forecast, fitted values for the 1869-1908 period to the ***actual*** SDDT of the postwar (1947-1985) U.S. GNP series. Note that this ratio understates true prewar GNP volatility since it compares fitted prewar values to actual postwar values. Throughout the table, the letter a denotes significance at the 10% level, * denotes significance at the 5% level, while ** denotes significance at the 1% level.

2. The regression R0985TAR denotes Romer's preferred specification from Romer (1989). The "R" stands for Romer, the "0985" means that the sample period extends from 1909-1928 and 1947-1985. "T" means that a linear time trend (set equal to zero in 1909) has been included while "AR" means that the equation has been "corrected for first-order serial correlation. BG0938 denotes the Balke-Gordon indicators regression for the years 1909-1938. The "BG" stands for Balke-Gordon, while "0938" denotes the sample period. Similarly, "0928" denotes the 1909-1928 sample period, while "4785" signifies the 1947-1985 period.

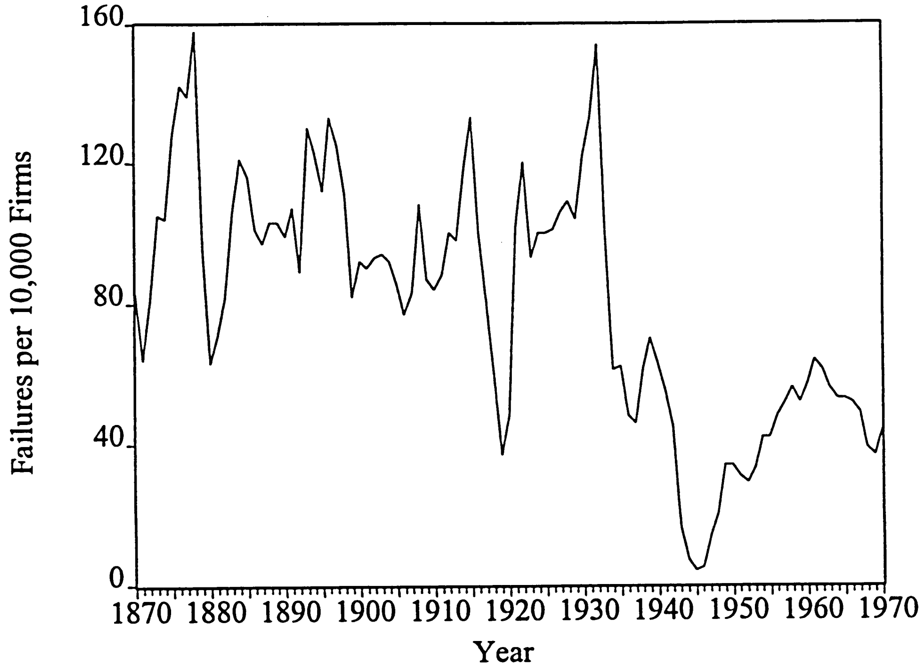
3. Below each coefficient, the standard error is given in parenthesis.

4. Equation (iv) replaces the Romer (1988) series for the years 1909-1928 with the Kendrick (1961) series for these years.

5. Replaces the Kendrick series used by Balke and Gordon with the Romer series for the years 1909 to 1928.

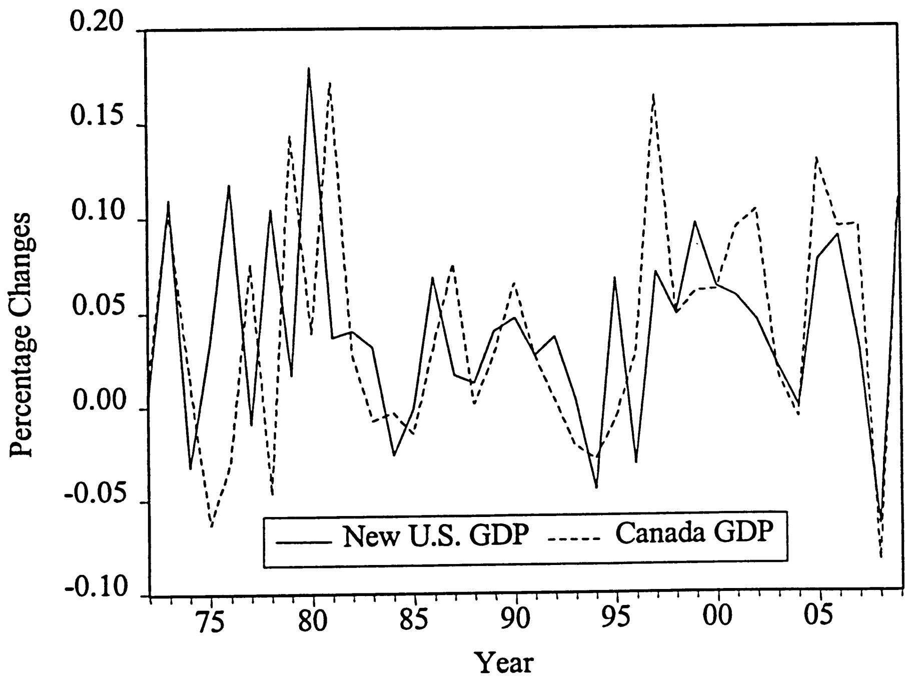
6. Replaces the Kendrick series used by Balke and Gordon with the Romer series for the years 1909 to 1928.

Figure 1 -- Dun & Bradstreet Business Failure Rates



Source: U.S. Bureau of the Census (1976), Series V-23.

Figure 2 -- Real Output for Canada and the United States, 1871-1909



Sources: Altman (1992), Table 1, pp. 458-459, for Canada.

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