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A NEW MONTHLY INDEX OF INDUSTRIAL PRODUCTION, 1884-1940

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ABSTRACT

The paper derives a new monthly index of industrial production for the United States for 1884-1940. This index improves upon existing measures of industrial production by excluding indirect proxies of industrial activity, by only using component series that are consistent over time, and by not making ad hoc adjustments to the data. Analysis of the new index shows that it has more within-year volatility than conventional indexes, has relatively unimportant seasonal fluctuations, and has cyclical turning points that are grossly similar to but subtly different from existing series.

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In recent years there has been renewed interest in the historical behavior of the U.S. macroeconomy. This interest reflects both a desire to use historical episodes as laboratories in which to test economic theories and a desire to understand how, and indeed if, the behavior of the U.S. economy has changed over time. To give a few examples of recent historical analyses, De Long and Summers (1986), Miron (1989), and Romer (1986a, 1986b, 1987, 1989) provide comparisons of output variability over time; Gordon (1982) estimates the relationship between price changes and output changes in the economy since 1890; Calomiris and Hubbard (1989) study the effects of credit rationing on the adjustment of output in the United States before 1909; and Schwert (1988) examines the relationship between stock market volatility and real economic events. These studies represent useful contributions in the fields of both economic history and macroeconomics.

I. THE NEED FOR A NEW INDEX

A potential weakness of much of the research described above, however, is the quality of the output data employed for the pre-1919 period. In 1919 the Federal Reserve Board (FRB) began to produce a comprehensive index of industrial production. For the period before 1919 there are many monthly indexes of industrial activity, but all of them have significant problems. For example, one of the most widely used monthly series is Babson's Industrial Production Index.[1] This index, however, is based on very few physical production series before 1905. Instead, for some decades as much as 55 percent of the index is based on the behavior of the gross value of imports

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and exports. As a result, this series is as close to being an index of trade as it is to being an index of industrial production. An additional problem with the Babson index is that, like almost all early series, it is available only in a seasonally-adjusted form. This is a drawback because the seasonal movements in economic activity are themselves interesting and because early methods of seasonal adjustment involved complicated procedures that typically did more than simply remove seasonal fluctuations from the data.

A second measure of monthly economic activity that has been widely used in recent literature is Macaulay's (1938) series on pig iron production.[2] The major drawback of this series is that it is based on only one commodity, whereas in most settings a more broadly based index would be desirable.

A third measure of monthly production that has been employed recently is the Index of Production and Trade constructed by Warren Persons (1931).[3] This index is based very heavily on bank clearings. For studies of the relationship between money and income this is a particularly serious drawback, since bank clearings and money are correlated by construction. In addition, the coverage of this series changes significantly over the 1877-1918 period.[4] This change in coverage may mean that apparent changes in behavior are due to changes in the data rather than to genuine economic forces.

II. DERIVATION OF THE NEW INDEX

A. Procedures

Given the limitations of the existing prewar monthly indexes of industrial production, we believe there is an urgent need for a new index. To that end, this paper presents a new monthly index of industrial production for the period 1884-1940. Our index is derived from reliable and consistent data

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on the monthly physical output of thirteen manufacturing and mineral products. These individual physical output series are combined using value-added weights to form an aggregate index. In the derivation of this index no regression procedures are used and very few adjustments are made to the data. The new index is presented only in its seasonally-unadjusted form. We carry our index through 1940, despite the existence of the FRB index of industrial production beginning in 1919, so that we can compare our index with the more comprehensive FRB series and so that there exists a consistent index that spans both the prewar and interwar eras.

Many of the specifics of the derivation of the new index, as well as the actual data, are presented in the Appendix. Nevertheless, it is useful to discuss the general procedures briefly.

Data. We use several criteria for deciding which component series to collect and to include in our index. The most important criterion is that the series be a genuine physical output series or an immediate proxy. We specifically exclude all nominal value series and all indirect proxies for business activity. We do, however, often use a close proxy for actual production. For example, we often use data on physical shipments rather than physical production because actual production data are rarely available for the prewar era. Similarly, we sometimes use a physical input series to proxy for the output of a manufactured good. For example, we use the head of cattle received by stock yards in Chicago to proxy for the output of dressed beef and the amount of silk imported as a proxy for the production of silk cloth. While series on shipments or inputs are obviously imperfect proxies for genuine production, they should be much more closely related to actual production than the indirect proxies, such as bank clearings and postage

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stamps issued, that have been used by previous authors. Indeed, one sign that the series we use are acceptable measures of production is that series like them are used even today in the derivation of the Federal Reserve Board index of industrial production.

A second criterion is that we only collect series for which reasonably reliable and consistent monthly data exist back to 1884. In particular, all of the series that we use are based on contemporaneous monthly surveys of major producers for the entire sample period. Most of the series that we use were collected by trade organizations or specialized commercial news organizations. For example, the data on pig iron output were collected by Iron Age, the major trade publication of the iron and steel industry. Similarly, the data on sugar meltings were collected by Willett and Gray, a firm that published The Weekly Statistical Sugar Trade Journal. We restrict ourselves to long, consistent time series because we specifically want to avoid splicing together possibly inconsistent series.

Following these criteria, we have collected monthly data on the output of 13 industrial products for the period 1884-1940.[5] The exact series used and the sources of the data are described in the Appendix. The series we have collected cover a wide range of goods. Among the most thoroughly represented industries are manufactured foods, textile products, iron and steel products, and petroleum and coal products. At the same time, however, there are some industries, such as forest products and stone, clay, and glass products, for which we have no series.

Adjustment for Production Days. While we feel it is useful to leave the individual series seasonally-unadjusted, it is nevertheless desirable to make the obvious correction for variations in the number of production days per

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month.[6] To do this, we divide each of the monthly production series by the number of calendar days in the month less the number of Sundays. While there was no doubt some variation across industries in the length of the workweek, especially in the 1930s, our procedure should eliminate most of the fluctuations in production due solely to fluctuations in production days.

Aggregation. Aggregating the thirteen individual series into an index of industrial production is accomplished by converting each series to an index, and then weighting the individual indexes by value-added weights. This is analogous to what is done in the derivation of the modern Federal Reserve Board index of industrial production. The original data on value added are from the Census of Manufactures or the Census of Mining. We use the version of these data given in Fabricant (1940) and Historical Statistics (1975). We choose 1909 as our base year because it is the Census year nearest the middle of our sample period and because it represents a point of mid-expansion in the cycle.

While the Appendix discusses specific issues related to the assignment of weights, the basic strategy is the following. For each of our series we use the obvious analog in the Census. For example, for our series on flour shipments, we use the value added in flour milling from the Census. Similarly, for our series on coffee imports, we use the value added in coffee roasting and spices. This procedure effectively weights each of our series by the value added in approximately the two- or three-digit SIC industry of which it is a component.

B. Benefits and Cautions

While no new index of industrial production can overcome the fundamental lack of data for the prewar era, we believe that our new index represents a

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substantial improvement over existing indexes. Most importantly, it only includes data on the output (or occasionally the inputs) of manufacturing firms and mines; it is not contaminated by other measures of economic activity such as bank clearings, prices, or foreign trade. As a result, the index can be used to test relationships that have occasionally been assumed in the derivation of other indexes. At the same time, the new index includes a fairly wide range of industrial commodities. Thus, it should yield more information about the behavior of the industrial sector of the United States than more limited series, such as the widely-used pig iron series.

Second, the new index is based only on output series that are reasonably consistent over time. We do not include series that change significantly in coverage or definition over our sample period. This procedure ensures that the index is comparable over the entire sample period. Thus, it should yield much more meaningful comparisons of industrial behavior in the late 19th and early 20th centuries than indexes that are not based on consistent data.

Finally, the new index is much less "adjusted" than other existing indexes. Most obviously, we do not seasonally adjust the index. More generally, the new index makes almost no adjustments to the base data. We do not use series with gaps that must be filled in by interpolation and do not impose assumptions about the smoothness of month-to-month variations in production. This lack of adjustment means that our new index should be reasonably uncontaminated by our own beliefs about the likely behavior of industrial production in the pre-World War II period.

While the new index has many desirable features, it is crucial to point out that it also has definite limitations. First, because the index is based only on series that exist over long sample periods, it will tend to miss new

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commodities that are introduced or new data series that become available only later in the sample period. This feature of our base data means that the index may understate the amount of growth that occurred over the entire sample period because new commodities tend to grow quickly. It may also provide less information about the precise nature of overall economic activity later in the sample period than broader interwar series such as the FRB index.

Another problem is that the focus on consistent, long time series yields an index that is partially based on close proxies for actual production and that is biased toward very primary commodities. The use of input series or shipments data to proxy for actual output could make the behavior of our index differ systematically from the true behavior of aggregate production if inventory fluctuations or production lags are significant. The bias toward primary commodities such as pig iron and coal could tend to make our prewar index more cyclically sensitive than the actual underlying economy because primary commodities are typically more volatile that highly processed goods.[7]

III. COMPARISONS WITH OTHER INDEXES

Having derived a new index of industrial production, it is useful to compare it with existing indexes. Figure 1 shows the logarithm of our basic (unadjusted) index for the entire 1884-1940 sample period along with the Babson and Persons indexes, which are only available in an adjusted form. Figure 2 shows the new index along with Macaulay's pig iron series and the FRB index of industrial production, both of which are available without seasonal adjustment.[8] The figures suggest three key facts about how our index compares with other measures. First, the new index is considerably more volatile than the Babson, Persons, and FRB indexes, but less volatile than the pig iron

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series. Second, the new index appears to have seasonal movements that are roughly as important as those of the pig iron series, but noticeably less important than those of the interwar FRB series. Third, the new index appears to display cyclical turning points that are grossly similar to but subtly different from other series.

A. <u>Volatility</u>

Table 1 compares the volatility of different indexes by presenting the standard deviation of the growth rate of each index. In the case of the Babson and Persons indexes, the series are available only on a seasonally-adjusted basis, so we examine the volatility of the growth rate of the published seasonally-adjusted indexes. For the remaining measures, we examine the volatility of both the unadjusted indexes and the residuals from a regression of the change in the logarithm of the index on seasonal dummy variables. The regressions are calculated separately for each sample period.

Table 1 shows that our monthly index is more volatile in every sample period than all of the alternative measures of monthly production, with the exception of the pig iron series. This difference in volatility, however, is almost purely a within-year phenomenon. Table 1 also shows the standard deviations of the annual data on our index and the alternative indexes.[9] Using annual data, our index is typically only slightly more volatile than the other indexes, and in some cases it is actually less volatile than the alternative measures.

The greater month-to-month variation in the new index does not appear to be due to the fact that our index is seasonally unadjusted: the same results hold for the residuals of the regression against seasonal dummy variables. The most likely explanation for the difference is that the seasonal-adjustment

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procedures used by Babson and Persons may smooth away more of the short-run variation in the data than does a simple regression against monthly dummy variables. This is a common feature of older seasonal-adjustment procedures.

While the method of seasonal adjustment is almost surely very important, some of the difference in volatility between our index and alternative indexes is no doubt also due to differences in the commodities represented by our index. The fact that we exclude series such as bank clearings or exports may affect the volatility of our index if those series have particular volatility characteristics. Furthermore, in comparison to the FRB index for the interwar period our index is simply based on a smaller number of commodities.[10] If there is variation in each individual component that is not perfectly correlated across series, an index based on a greater number of individual series will display less volatility, holding the volatility of individual series constant. This fact may explain why the FRB index for 1919-1940 is less volatile than our new index even though both series are unadjusted.[11] It may also suggest that our index provides a less good indication of aggregate volatility for the interwar era than the FRB index.

The finding that our index shows more month-to-month variation than other indexes may alter economists' view of the pre-World War II economy. In particular, the fact that at least 13 industrial commodities appear to have fluctuated quite significantly over very short time periods may indicate that the prewar economy was buffeted by frequent shocks. That these shocks resulted mainly in intra-year fluctuations in real production may suggest that the economy had a rapid, though not instantaneous, self-righting mechanism.

While the new index clearly has different volatility characteristics from most of the existing measures of industrial production, it is useful to

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note that nearly all of the indexes show a similar change in volatility between the prewar and interwar eras. Table 1 shows that every monthly index except the Persons Index of Production and Trade is more volatile after 1914 than before.[12] This finding mainly reflects the fact that the Great Depression is in the post-1914 sample period. However, even during the relatively tranquil 1922-1928 period the new index, like most others, is slightly more volatile than during the pre-1914 period.[13] This may suggest that the various structural changes that occurred around World War I, such as the rise of the Federal Reserve System, may have affected the volatility of the U.S. economy.

B. Seasonality

As mentioned above, purely seasonal movements appear to explain very little of the total month-to-month variation in our new index. This can be seen from the finding that the R^2 of the regression of the growth rate of the new index on seasonal dummy variables is .17 in the pre-1914 period and .04 in the post-1914 period. This is not to say, however, that seasonal movements in the new index are unimportant. Rather, the seasonal pattern in both periods is large in magnitude, with an amplitude of 10 percent in the pre-1914 period and 6 percent in the post-1914 period. It is also statistically significant at at least the 10 percent level in both periods.

A comparison of the seasonal behavior of the new index with the two other available unadjusted series indicates that the new index has seasonal movements that are similar in importance to those of the pig iron series, but distinctly less important than those in the interwar FRB index.[14] The similar importance of seasonal movements in the new index and the pig iron series could be due in part to the fact that pig iron is weighted heavily in the new

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index. However, this cannot be the entire explanation because the pattern of seasonal movements is quite different in the two series. In particular, the new index does not show the surge in production early in the year that is characteristic of the pig iron series, though it does show the surge in the fall that is also present in the pig iron series.

Examination of the seasonal behavior of the 13 individual series that make up the new index indicates that some of the apparent unimportance of seasonal fluctuations in the new aggregate index stems from the cancelling out of individual seasonal patterns. For some of the individual series seasonal fluctuations are quite important, accounting for as much as 30-40 percent of the total variation in growth rates. However, the seasonal patterns differ quite substantially across the series. For example cattle receipts and flour shipments have a large seasonal peak in the fall, wool receipts have a peak in the summer, and sugar meltings are very low in the fall but rise dramatically in the winter months.

The fact that the Federal Reserve Board index of industrial production shows a stronger aggregate effect of seasonal fluctuations in the interwar era may reflect the different composition of the FRB index. In particular, our index is more heavily weighted toward manufactured foods, which tend to have distinct seasonal cycles that vary greatly from product to product. Thus, our index may have more cancelling out of seasonal patterns than the FRB index, which includes many more heavy industrial goods. One factor that does not appear to account for the greater importance of seasonal movements in the FRB index is the fact that the FRB index is only available after 1919. Between the prewar and interwar eras there is some change in the seasonality of the new index, but that change goes in the direction of making the seasonal less

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important over time.

To the extent that the relative unimportance of seasonal fluctuations shown by the new index is a genuine phenomenon, this finding suggests that in the period before 1940 a very small fraction of aggregate short-run fluctuations were attributable to predictable seasonal shocks and a very large fraction were due to unpredictable shocks. The most obvious place to look for such unpredictable shocks would probably be random demand shocks from both foreign and domestic sources. The importance of unpredictable shocks in the prewar era presents an interesting contrast to the postwar era, where as much as 80 percent of the total variation in the monthly growth rate of industrial production is due to predictable seasonal factors.[15]

C. <u>Turning Points</u>

The graphs in Figures 1 and 2 indicate that the turning points of our new index are grossly similar to those of the other indexes of production. In particular, our index, like all of the others, shows significant recessions in 1893-94, 1907-08, 1920-21, 1930-33 and 1937-38.

At the same time however, there are some important differences between our index and various alternatives.[16] These differences are especially noticeable around the dates of major financial panics. For example, following the banking panic of May 1884, our index shows a much more immediate fall in production than does the pig iron series that has been used in other analyses. This is also the case around the panic of October 1907. The new index, like the Babson and Persons indexes, turns down perceptibly before the panic, whereas the frequently used pig iron series does not turn down until November 1907. These differences in the timing of real output movements around financial panics could have large effects in studies that seek to identify the

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direction of causation between panics and recessions.

A more general way to analyze the turning points of our index is to compare them to the NBER reference dates for business cycle turning points. With respect to the most severe recessions (1893-94, 1907-08, 1920-21, 1930-33, 1937-38), our index shows peaks and troughs that are quite close to those of the traditional NBER dating. In the case of the less virulent downturns, however, our index frequently has peaks and troughs that differ from the NBER dates by several months. For example, the NBER dates a peak in 1899:3 whereas our index continues rising with only slight interruption until 1899:11. These differences may be due to the fact that the NBER uses both real output and other indicators, such as interest rates and prices, to date cycles. Nevertheless, the finding that our new index has turning points that are sometimes quite different from NBER reference dates may alter how economists should date fluctuations in real output in the prewar era. Thus, as with the other characteristics of economic fluctuations examined in this paper, the derivation of a new index of industrial production may lead to new views about the pre-World War II macroeconomy.

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APPENDIX

This appendix describes the sources, availability, and necessary adjustments for the thirteen individual production series that are used in the derivation of the Miron-Romer index. It also describes the procedures used to combine the individual series into an aggregate index of industrial production.

I. Component Series

As described in the text, the individual series that we include in the new index come from a variety of primary sources. Many of the series that we use, however, have previously been collected by researchers of the National Bureau of Economic Research. These series are available on a tape entitled "National Bureau of Economic Research: Macroeconomic Time Series for the United States, United Kingdom, Germany, and France" that is stored at the Inter-University Consortium for Political and Social Research (ICPSR 7644).

In cases where the series we use is available on the NBER tape, we use the information in the following way. We first compare the data on the tape to the original source documents. Whenever there is a discrepancy between the tape and the original source, we update the series to be consistent with the primary source. We do this because there appear to be numerous coding errors in the tape. The only time when we do not follow this rule is when there is an obvious typographical error in the original source.

After checking and updating the data on the tape, we then make any further adjustments that are necessary to the series. In some cases there are no adjustments to make. In other cases there may be a change in the units reported or the in the coverage of the series that must be dealt with.

In what follows we describe the coverage and nature of each series and the appropriateness of using a given series as a measure of production. We then discuss the primary sources of the series that we use and all of our transformations of the data on the NBER tape into the series that are ultimately used to form the new aggregate index. The name listed for each series is the mnemonic under which the series is stored in a RATS data file that is available on diskette from the authors.

A. Pig Iron Capacity

PICAPM
Gross Tons (2240 Pounds) Per Day, Monthly Average
Available 1884:6 - 1940:12

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1. Basic Facts about the Series

This series shows the daily operating capacity of the average number of pig iron furnaces in blast in a given month. Since blast furnaces are not turned on and off frequently and are generally run at full capacity, this series should be closely correlated with the actual production of pig iron. Indeed, after 1902 when production data become available the correlation between production and capacity is nearly perfect. Furthermore, since pig iron is the primary input to the production of steel, this series should also provide a good proxy for basic steel production, though there may be a lag between the production of the two goods.

2. Original Source

The base data are from Iron Age, the major trade publication of the iron and steel industry, and are based on a comprehensive survey of iron and steel producers. The data available from Iron Age show the daily operating capacity of furnaces in blast on the first of the month. These data are usually broken down by the fuel used in the furnace: charcoal, anthracite, and coke. Since for some purposes the data on the capacity of charcoal furnaces are not reported, we restrict our data collection to the capacity of anthracite and coke furnaces. After 1930 the only data available are for the capacity of coke furnaces. Since this appears to be due to the fact that anthracite went out of use, we do not view this as a change in the coverage of the series and do not make any adjustment for it.

3. Transformations

This series is not available from the NBER tape and so was entered by hand. Whenever a capacity number for a given month was revised from one issue of Iron Age to another, we use the latest version as the true number.

To use the series we have as a proxy for monthly production, it is necessary to average the first day of the month observations to yield average daily capacity for the month. The formula that we use to do this is:

$$\text{Monthly average} = [1/(2*\text{Days}_t)]\ [(\text{Days}_t + 1)\text{Cap}_t \ + \ (\text{Days}_t - 1)\text{Cap}_{t+1}]$$

where Days is the number of days in the month and Cap is the daily capacity on the first of the month.

There are missing observations for 1918:2 and 1921:2 that cannot be eliminated because the data just are not available. To deal with this, we use the following procedure. We take the first of the month capacity observations for January and March and distribute the average of these two numbers over two months, using a formula analogous to that above. The actual formulas are:

January: 44/59*Capacity(Jan 1) + 15/59*Capacity(March 1)

February: 29/118*Capacity(Jan 1) + 89/118*Capacity(March 1).

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B. Anthracite Coal Shipments

ACSHIP
1000s of Long Tons (2240 Pounds) Shipped Over the Month
Available 1884:1 - 1940:12, with 1924:1-1926:12 missing

1. Basic Facts about the Series

This series shows the shipments of anthracite coal over a given month. This series should be highly correlated with actual production because inventory holdings at the mines tended to be fairly small in the period covered by our index.

2. Original Sources

The base data are from The Coal Trade (later called Sawards Annual), a major industry publication. The data, at least after 1905, appear to have been originally collected by the Anthracite Bureau of Information and are based on the reports of carrier companies. For some unknown reason no data were collected for the period 1924:1-1926:12. Beginning in 1933, the data are reported in net, rather than long tons.

3. Transformations

This series is available for 1884:1-1922:12 from the NBER tape (variable 212 of dataset 01A). We have checked the data on the tape against the original source. For the period 1884-1922 there are few discrepancies between the tape and the original source. In some years the original data change from one issue of The Coal Trade to another, presumably due to data revisions. As is appropriate, the NBER uses the later numbers. In 1903:12, 1913:11, 1915:4,8 and 1919:9 the numbers from The Coal Trade and the tape differ. However, it appears that there may be typos in the original source. We deduce this from the fact that the monthly numbers given in The Coal Trade do not add up to the annual figure while the NBER numbers do. This suggests that the NBER had additional information and that their numbers should be used.

For 1918-1922 we have data from both The Coal Trade and Saward's Annual. In 1918:1, 1920:3, 1922:9-10, and 1922:12 the numbers from the two sources differ slightly and the tape accords with The Coal Trade. We update the data on the tape to be consistent with Saward's Annual because after 1922 this is the only original source available. We also convert the data after 1933 from net tons to gross tons so that it is in the same units as the earlier data.

While the NBER codes the data for 1922:4-8 as missing because of the strike, we record coal shipments as zero in these months. A footnote in Saward's Annual states: "No shipments in April, May, June, July, and August, 1922, on account of strike." Furthermore, for this period we have actual production data and it is essentially equal to zero.

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C. Crude Petroleum Production, Appalachian Region

APPAPETR
1000s of Barrels Per Day
Available 1884:1 - 1940:12

1. Basic Facts about the Series

This series shows the average daily production of crude petroleum in the Appalachian region in a given month. This region is composed of New York, Pennsylvania, Kentucky, West Virginia, and parts of Ohio. For the period 1884-1890, data are only available for New York and Pennsylvania. This represents only a slight change in coverage because New York and Pennsylvania account for over 90% of Appalachian production in this period. Both petroleum series are on a daily average basis, where daily average has been calculated as monthly production divided by the number of days in the month.

For the late 1800s Appalachian production represents nearly 100% of total U.S. petroleum production (based on a comparison of available annual numbers). However, by World War I, Appalachian production accounts for only about 10% of total production. This suggests that the Appalachian series becomes a decidedly less good proxy for total production over time.

2. Original Sources

The base data are from Mineral Resources and Minerals Yearbook. These figures were compiled by the U.S. Geological Survey from monthly reports of pipe-line and other companies. They show the quantity of petroleum transported from producing properties. Beginning in 1919 there appears to have been some adjustment for stocks.

3. Transformations

This series is available from the NBER tape. It is presented as two series, variable 243 and variable 241 of dataset 01A. Variable 243 begins in 1894:1 and covers production in the entire Appalachian region and variable 241 extends back to 1884:1 and covers production only in New York and Pennsylvania.

Mineral Resources provides data on Appalachian production for 1890:1 - 1893:12 as well as the later data that appear on the tape. There is no evidence of any change in coverage or alteration of procedures. Therefore, we simply continue the tape series for Appalachian production with this series.

We have checked the data against the original source. Minor discrepancies in the New York and Pennsylvania series exist in 1884:2 and 1884:7. These discrepancies appear to be due to rounding errors. The data on the tape are updated to be consistent with the original source. Discrepancies in the Appalachian series exist in 1921:2 and 1924:1 and these are corrected to be consistent with the original source. In addition, there are many discrepancies between the tape and the original sources in 1935-36 and 1937

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and 1939. The discrepancies are always very small. The likely source of the discrepancies for 1935-36 is that Minerals Yearbook only gives data by state and hence it is impossible to aggregate exactly in the way that is done earlier for the Appalachian Region. The discrepancies for 1937 and 1939 are most likely due to data revisions that we cannot document. Evidence in favor of this is that the numbers from Minerals Yearbook say subject to revision. Furthermore, one can see that there are substantial revisions for 1937 and 1939 because the annual numbers given for those years in 1938 and 1940 are quite different from the preliminary numbers. This is not true of the numbers for 1938 and 1940 for which our numbers are identical to the NBER tape. Because it seems likely that the tape has revised data, we accept the tape's numbers for 1935-1940.

While NY and PA production account for almost all of Appalachian production prior to 1890, it is sensible to connect the two series with a simple ratio splice to ensure that there is no jump in the combined series. The year chosen for the splice is 1890:1 and the splice was done in levels. The procedure resulted in multiplying the NY and PA series for 1884:1 - 1889:12 by (70.0/68.0).

D. Sugar Meltings at Four Ports

SUGM4
1000s of Long Tons (2240 Pounds) Melted over the Month
Available 1890:1 - 1937:12

1. Basic Facts about the Series

This series shows the amount of raw sugar being made into refined sugar at the four main ports of sugar import. As such, it should provide an excellent proxy for the actual production of refined cane sugar.

2. Original Source

The base data are from Willett and Gray's Weekly Statistical Sugar Trade Journal, the major trade publication of the sugar industry. For most of the late 19th and early 20th centuries the Weekly Statistical Sugar Trade Journal tracks only the meltings in four Atlantic ports: New York, Boston, Philadelphia, and Baltimore. Following World War I, the Journal also tracks meltings in eight or more ports. Because the four-port series continues through 1937, we opt to use this consistent series for the entire sample period. However, while for the early period it is clear that 4 ports covered most of the meltings, by 1940, they appear to account for only about 50 percent of all meltings. This means that our procedure may cause us to miss some of the expansion in the sugar industry in the interwar period.

3. Transformations

This series is available from the NBER tape (variable 392 of dataset 01A) for the period 1890:1-1921:12.

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We expand the NBER series using monthly data from the original source to cover the period 1922:1-1937:12. The monthly data stop in 1937:12. Though there are weekly data on meltings at the Atlantic ports for 1938-1940, it is difficult to use these because no observations exist for the last week of each year. Neither carrying forward the previous week's growth rates or adopting the first week of January's growth rate seem to be appropriate. In particular, using either of these procedures for the eight-port series (for which both monthly and weekly data exist) yields a reading for December that is higher than the actual monthly observation.

We have checked the data on the NBER tape against the original sources. Minor discrepancies exist for 1897:3,4, 1898:10,11 and 1919:12. The data on the tape are corrected to be consistent with the primary source.

E. Cattle Receipts at Chicago

CATREC
1000s of Head Received During the Month
Available 1884:1 - 1940:12

1. Basic Facts about the Series

This series shows the head of cattle received in Chicago in a given month. Beginning in 1907 there exist actual data on cattle slaughtered. The receipt series appears to be highly correlated with slaughter, suggesting that cattle receipts are a good proxy for the production of dressed beef. The receipt series probably becomes a less good proxy for total slaughter over time because Chicago declines in importance.

2. Original Source

The base data are from the Chicago Board of Trade Annual Report. According to the source, the data show receipts at stock yards in Chicago and are derived from reports of the U.S. Department of Agriculture, terminal elevators, and transportation agencies. We obtained Xeroxes of the Annual Reports that were missing from Baker Library directly from the Chicago Board of Trade Records Center.

3. Transformations

This series is available from the NBER tape (variable 312 of dataset 01A). We have checked the data on the tape against the original source. Minor discrepancies were found in 1930:1, 1935:9, and 1940:9 and these were resolved in favor of the original source.

F. Hog Receipts at Chicago

HOGREC
1000s of Head Received During the Month
Available 1884:1 - 1940:12

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1. Basic Facts about the Series

This series shows the number of hogs received in Chicago in a given month. Beginning in 1907 there exist actual data on hogs slaughtered. The receipt series appears to be highly correlated with slaughter, suggesting that receipts are a good proxy for slaughter. The receipt series probably becomes a less good proxy for total slaughter over time because Chicago declines in importance.

2. Original Source

The base data are from the Chicago Board of Trade Annual Report. According to the source, the data show receipts at stock yards in Chicago and are derived from reports of the U.S. Department of Agriculture, terminal elevators, and transportation agencies. We obtained Xeroxes of the Annual Reports that were missing from Baker Library directly from the Chicago Board of Trade Records Center.

3. Transformations

This series is available from the NBER tape (variable 306 of dataset 01A). We have checked the data on the tape against the original source. Discrepancies were found in many years: 1885:7, 1889:2,6, 1893:2, 1894:1,2,7, 1895:3,11, 1898:1, 1899:1, 1900:1,5, 1901:4, 1902:10 1903:5, 1906:9, 1908:6, 1909:3, 1912:1, 1913:12, 1915:5,12, 1918:6, 1921:3, 1922:10, 1923:9, 1926:4, 1929:5, 1932:9, 1933:6, 1934:6. These appear to be due to rounding errors and some very large typographical errors in the NBER series. We resolve all discrepancies in favor of the original source.

G. Connellsville Coke Shipments

COKESHIP
Net Tons (2000 Pounds) Shipped during the Month
Available 1894:1 - 1935:12

1. Basic Facts about the Series

This series shows the tons of coke shipped from the Connellsville region of Pennsylvania. This series should provide a good indicator of total coke shipments in the U.S. because the Connellsville region accounted for at least 50 percent of total production in the pre-1940 period. Furthermore, because beehive coke was ordinarily not stored at the ovens in any great quantity, shipments should provide a reasonable proxy for actual production.

2. Original Sources

The base data are from Mineral Resources and Minerals Yearbook. For the period before 1928 the data in these sources are taken directly from the Connellsville Courier; for the period 1929-1935 the data are compiled by the Bureau of Mines from the weekly reports of the Courier. No data on

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Connellsville shipments are available before 1894 or after 1935.

3. Transformations

This series is not available from the NBER tape and so was entered by hand directly from the original source. No adjustments needed to be made to the base data.

H. Minneapolis Flour Shipments

FLRSHIP
1000S of Barrels Shipped from Minneapolis During the Month
Available 1884:1 - 1940:12

1. Basic Facts about the Series

This series shows the shipments of flour out of Minneapolis. Though many of the major mills were based in Minneapolis, it appears that on an annual basis, shipments out of Minneapolis accounted for only 10-20% of total wheat flour production. However, the annual total production data on which this calculation is based are quite imprecise. Furthermore, since flour milling is to some extent affected by agricultural production, one could reasonably expect Minneapolis shipments to be similar to total shipments. Indeed, after World War I monthly data on total production become available and the correlation between this series and Minneapolis shipments is quite high.

2. Original Source

The base data are from the Annual Report of the Chamber of Commerce and Board of Trade of the City of Minneapolis. We obtained Xerox copies of the Annual Reports from the Minneapolis Chamber of Commerce.

3. Transformations

This series is available from the NBER tapes (variable 379 of dataset 01A). We have checked the data on the tape against the original data. Several discrepancies were found. Those for 1885:3, 1886:9-11, 1887:9, 1889:7-12, 1902:5, 1905:12, 1907:9, 1920:9 and 1937:12 were resolved in favor of the original source. Most of these errors appear to be due to the fact that the NBER took the data from a summary volume in 1899 that had many errors. We have used the yearly reports instead. For 1920:6 we use the NBER number because it is in accord with the weekly and annual data in the Annual Report, whereas the original monthly number is not. Parts of 1886 and 1905 could not be checked because the original sources were missing or failed to report the necessary numbers.

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I. Wool Receipts at Boston

WOOLR
Millions of Pounds Received in Boston (Domestic and Foreign) per Month
Available 1888:1 - 1940:12

1. Basic Facts about the Series

This series shows the amount of raw wool coming into Boston from both domestic and foreign producers. As late as the 1930s receipts at Boston accounted for around one half of the total domestic wool clip and between 20 and 40 percent of foreign imports. Provided that inventories of raw wool are not large and do not have strong cyclical properties, this series should provide a reasonably good proxy for the output of woolen cloth.

2. Original Sources

The base data for 1888-1918 are from the Boston Chamber of Commerce Annual Report. For the period after 1918 the data are from the Survey of Current Business. The data in the Survey are described as being from the U.S. Department of Agriculture, but the U.S.D.A. compiled its data from the Boston Commercial Bulletin and the records of the Boston Grain and Flour Exchange. Thus, the series from the two sources appear to be based on similar underlying reports.

3. Transformations

Data on wool receipts are available from the NBER tape. Variables 163 and 165 of dataset 01A show the receipts of domestic wool in Boston per month. The two series differ in that the earlier series is measured in bales and the later series is measured in pounds. Variables 167 and 169 of dataset 01A show the receipts of foreign wool in Boston per month. Again the two series differ in the units in which wool is measured.

We have checked the data on the tape against the original sources. There were no major discrepancies, but there were many apparent rounding errors. We have corrected all of these discrepancies so that the various series are consistent with the original sources.

The fact that the units of measurement for both the domestic and foreign receipts series changed from bales to pounds in 1900 should not present a problem because bales were of a nearly standard weight and because there is some overlap in the series. Thus, we combine the two series for each type of receipts by ratio splicing the series in bales to the series in pounds in 1900:1. This amounts to multiplying the early domestic series (variable 163) for 1888:1-1899:12 by 7.26/29.03 and the early foreign series (variable 167) for 1888:1-1899:12 by 5.23/10.47.

We aggregate the foreign and domestic series into a series on total wool receipts. Since the domestic and foreign series are in the same units, a simple sum is appropriate.

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J. Coffee Imports

COFFEE
Millions of Pounds Per Month
Available 1884:1 - 1940:12

1. Basic Facts about the Series

This series shows the amount of raw coffee imported into the U.S. Because the U.S. does not grow coffee domestically, coffee imports should provide a comprehensive measure of the inputs to the coffee roasting and grinding industry.

2. Original Sources

The data on imports are from the Monthly Summary of the Foreign Commerce of the U.S. that is published by the Bureau of the Census. This source had different titles and different publishing agencies in the period before 1914. Among the alternative titles are Monthly Reports on the Commerce and Navigation of the U.S., Monthly Summary of Commerce and Finance of the U.S., and Monthly Summary of the Imports and Exports of the U.S. Libraries typically bind these various publications into one volume for the entire period that is labeled the Monthly Summary of the Foreign Commerce of the U.S. and there is no apparent change in coverage or the procedures used over time. For simplicity we refer to the original source in the following discussion as simply the Monthly Summary of the Foreign Commerce.

The only problem we have noted with the base data is that because of tariff changes, the observations for 1913:9 and 10 and 1922:9 and 10 may be erroneous. Specifically, imports for the first three days of 1913:10 are included in the September 1913 figure and imports for the last 8 days of 1922:9 are included in the October 1922 figure.

We do not to try to correct these observations because simple prorating of the data seems likely to yield more erroneous observations. The Underwood Tariff of 1913 lowered average rates on October 4th. Hence, one would not expect much importation in the first 3 days of October when tariffs were still high. Thus, it is of no consequence that these observations are included in the September figure. Similarly, in 1919 the Fordney-McCumber Tariff raised average rates on September 22nd. In this case, one would not expect much importation in the last days of September. Therefore, it does not matter that those days are included in October.

3. Transformations

This series is available from the NBER tape (variable 93 of dataset 07A). We have checked the NBER data against the original source. (Note: We have not checked the data for 1885:7-1886:6, 1887:7-1888:6, and 1939:7 because we were unable to obtain the source documents.) There were minor discrepancies between the NBER series and the Monthly Summary in 1903:2, 1906:9, 1909:4, 1915:8, 1932:2, and 1936:3. These observations were changed

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to be consistent with the original source. No further corrections are needed for the series.

K. Tin Imports

TIN
Long Tons (2240 Pounds) Per Month
Available 1884:1 - 1940:12

1. Basic Facts about the Series

This series shows the amount of bars, blocks, pigs, grain, and granulated tin imported into the U.S. as well as the tin content of imported ore. It is used to proxy for the output of refined tin and tin products produced in the U.S.

2. Original Sources

The data on imports are from the Monthly Summary of the Foreign Commerce of the U.S. See the original sources section for the coffee import series for a more thorough description of this source.

One problem noted by the NBER was that the first 3 days of October 1913 were included with the September number. We do not do anything about this because average tariffs were dropped on October 4, 1913. Hence, one would not expect many imports during the first 3 days of October.

3. Transformations

This series is on the NBER tape (variable 107 of dataset 07A). We have checked the data on the tape against the original source. (Note: We have not checked the data for 1885:7-1886:6, 1887:7-1888:6, and 1939:7 because we were unable to obtain the source documents.) To check the data on the tape, the data from the Monthly Summary of the Foreign Commerce had to be treated in the following way. The data in pounds was first rounded to the nearest 1000 and then divided by 2.24 to yield long tons. This number was then rounded to the nearest integer. This way of dealing with the data yielded a series that matched the NBER in most years. There were minor discrepancies in 1901:6, 1901:11, 1912:4, 1921:11, 1923:6, 1926:4, 1928:5, 1929:10, 1930:2, 1931:1,4,8, 1933:1,8, 1934:8,11, 1938:6, 1939:4,8,and 9. These were corrected to be consistent with the original source. The NBER codes the observation for 1893:7 as missing. However, the data from the Monthly Summary indicate that imports simply rounded to zero in this month. Consequently, we have replaced the missing value code with a zero for this observation.

L. Crude Rubber Imports

RUBBER
Millions of Pounds
Available 1884:1 - 1940:12

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1. <u>Basic Facts about the Series</u>

This series shows the amount of crude rubber imported. It is used to proxy for the output of rubber goods such as tires and rubber shoes produced in the U.S.

2. <u>Original Sources</u>

The data on imports are from the <u>Monthly Summary of the Foreign Commerce of the U.S.</u> See the original sources section for the coffee import series for a more thorough description of this source.

The only problem with this series is that the <u>Monthly Summary</u> tracks somewhat different products in different periods. After 1910:7 the <u>Monthly Summary</u> numbers cover the imports of India rubber. For the period 1890:10-1912:12, the <u>Monthly Summary</u> data include both India rubber and guayule gum. For the period 1884:1-1892:12, the <u>Monthly Summary</u> data include India rubber, guayule gum, and gutta percha. A comparison of the various series in the short periods of overlap suggests that the behavior of the different series is very similar. Thus, it seems reasonable to join the series together to form a single rubber imports series. However, some correction for changes in levels is necessary because imports of guayule gum are nontrivial.

3. <u>Transformations</u>

The rubber imports data are available from the NBER tape. The tape includes three series: variable 101 of dataset 07A covers the period through 1892:12 and includes data on India rubber, gutta percha, and guayule gum; variable 103 of dataset 07A covers the period 1890:10-1912:12 and includes data on India rubber and guayule gum; and variable 105 of dataset 07A covers the period 1911:1-1940:12 and includes data only on India rubber.

The <u>Monthly Summary of the Foreign Commerce</u> contains the data necessary to carry the series covering only India rubber (variable 105) back to 1910:7. We update this series with these additional observations.

We have checked the data against the original source. (Note: We have not checked the data for 1885:7-1886:6, 1887:7-1888:6, and 1939:7 because we were unable to obtain the source documents.) Minor discrepancies were found in 1896:4, 1900:7, 1926:5, 1932:8,9,11, 1935:3,4,8,11, 1936:8, 1937:8, and 1940,8,10. These observations were updated to be consistent with the original source.

The three different variants of the rubber import series are spliced together so that there are no jumps in the series. We choose to leave the longest series (variable 105) unspliced and to splice the other series to it. Specifically, we use the corrected and expanded variable 105 without further adjustment for 1910:7-1940:12. For 1890:10-1910:6 we splice variable 103 to variable 105 by multiplying variable 103 by the ratio of variable 105(1910:7) to variable 103(1910:7). For 1884:1-1890:9 we splice variable 101 to the already spliced series. That is, we multiply variable 101 by the ratio of the already spliced series (1890:10) to variable 101(1890:10).

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M. Raw Silk Imports

SILK
1000S of Pounds per Month
Available 1884:1 - 1940:12

1. Basic Facts about the Series

This series shows the amount of raw silk imported into the U.S. Since domestic silk production is minimal, this series should provide a comprehensive measure of the raw materials input to the production of silk cloth.

2. Original Sources

The data on imports are from the Monthly Summary of the Foreign Commerce of the U.S. See the original sources section for the coffee import series for a more thorough description of this source.

The only issue surrounding this series involves a slight change in coverage in the early 1920s. For the period up to 1924:12 the data available on raw silk imports include re-exports. Beginning in 1919:1 data excluding re-exports are available. This change is fairly minor because re-exports are very small, and because the two series behave very similarly in the five-year period when both exist. Nevertheless, it is sensible to ratio splice the two series together to prevent a slight discontinuity in the final data.

3. Transformations

The silk imports data are available from the NBER tape. Variable 131 of dataset 07A covers the period 1884:1-1924:12 and includes re-exports. Variable 133 of dataset 07A covers the period 1919:1-1940:2 and excludes re-exports.

We have used the Monthly Summary to extend variable 133 through 1940:12. In doing this we have followed the NBER procedures: we first round all the components to 1000s, then add raw silk imports and waste (the numbers on cocoons are not included) and then subtract off re-exports.

We have checked the data on the tape against the original source. Many minor discrepancies were found and the data from the tape were corrected to be consistent with the original source.

To deal with the minor change in coverage we use a ratio splice in 1924:12. We choose to leave the longer series (variable 131) unspliced and to splice variable 131 to it. Specifically, variable 131 for 1884:1-1924:12 was left unadjusted and variable 133 for 1925:1-1940:12 was multiplied by the ratio of variable 131(1924:12) to variable 133(1924:12).

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II. Procedures Used to Form the Index of Industrial Production

The aggregation of the thirteen series we have collected into an index of industrial production involves several additional steps. These steps include adjustment for production days, conversion of each series to an index, and combination of the individual indexes using value-added weights.

A. Adjustment for Production Days

With the exception of the series on petroleum production (APPAPETR) and pig iron capacity (PICAPM), all of our series show total output over the month. As a result, the series show predictable upticks in long months and downticks in short months. To remove this effect it is desirable to generate a series that is on a per production day basis. This is consistent with what is done today in the derivation of the Federal Reserve Board's seasonally-unadjusted Index of Industrial Production.

To make this adjustment we do the following. First, no correction is needed for the pig iron series. This is true because PICAPM shows the daily capacity of the average number of furnaces in blast during the month. Thus, it is already on a per day basis. Furthermore, because blast furnaces were not turned off for weekends, no adjustment is needed for the difference between calendar days and production days.

Second, the petroleum series in the original source is calculated as the monthly production of petroleum divided by the number of days in the month. To put it on a production day basis we first multiply the base series by the number of calendar days in the month and then divide by the number of production days.

All other series are put on a production day basis by dividing by the number of production days. The number of production days is calculated as the number of calendar days minus the number of Sundays. We do not exclude Saturdays because it appears that most industries worked six days a week until at least the mid-1930s.

B. Forming Individual Indexes

As described below, we use 1909 as the base year for our index. That is, 1909 is the year that is set equal to 100 for each individual index and for the aggregate index. We form the individual indexes by dividing the monthly observations for each series (adjusted for production days) by the average monthly value of that series in 1909.

C. Value-Added Weights

To combine the individual indexes into an aggregate index of industrial production we use value-added weights. Value-added weights are used because we want the index to represent the output of manufacturing industries. Thus,

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it should be irrelevant whether the inputs were expensive or cheap.

The original data on value added are from the Census of Manufactures or the Census of Minerals. We use the version of these data given in Fabricant (1940, Appendix C) and Historical Statistics (1975). For most categories Fabricant is identical to the Census.

1909 is chosen as the base year because it is the Census year nearest the middle of our sample period and because it is an ordinary year. Unlike 1904 and 1914 which were recession years, 1909 represents a point of mid-expansion in the cycle. Using a base year near the center of the sample period is desirable because it limits the importance of the compositional changes over time. Using a year of mid-expansion ensures that the differential effects of depressions will not affect the weights for the entire sample period.

The allocation of value added to various series is fairly straightforward. For most of our series there is an obvious analog in the Census. For example, for our series on flour shipments from Minneapolis, we use the value added in flour milling from the Census. Following this procedure, we end up weighting our series by the value added in approximately the corresponding two- or three-digit SIC industry. The following list shows the category from Fabricant used for each of our series. It also discusses any special adjustments that needed to be made to the Fabricant data.

1. Pig Iron Capacity. We assign this series the value added in blast furnace products and steel mill products. We include the value added of steel mills because pig iron capacity is a good proxy for steel production and because the value added in pig iron production alone does not adequately reflect the importance of this series. It is useful to note that the steel mill products category only includes very crude steel goods; it does not include highly fabricated goods such as machines.

2. Anthracite Coal Shipments. Historical Statistics gives the value added in coal mining. We divide this between anthracite and bituminous coal using the data on the gross value of anthracite and bituminous coal output also given in Historical Statistics. This procedure indicates that anthracite should be given 26.9% of the total value added in coal production.

3. Crude Petroleum Production, Appalachian Region. We assign this series the value added in petroleum refining, lubricants not elsewhere mentioned, and oils not elsewhere classified.

4. Sugar Meltings in Four Ports. We use the value added in cane sugar refining and cane sugar, not elsewhere mentioned.

5. Cattle Receipts at Chicago. Fabricant lists the value added in meat slaughtering. Even the original Census documents do not divide this value added among the various types of animals. To derive separate weights for cattle and hogs, we allocate the total value added in meat packing according to the gross value of the beef and pork (fresh and cured) produced in 1909. These data are available from the Census of Manufactures for 1914. Based on

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the gross value of the output, the total value added in meat packing is divided by giving 41.1% to cattle and 58.9% to hogs.

6. Hog Receipts at Chicago. See the description of cattle receipts.

7. Connellsville Coke Shipments. We assign this series the value added of coke oven products.

8. Minneapolis Flour Shipments. We assign this series the value added in the flour industry.

9. Wool Receipts at Boston. We assign this series the value added in woolen goods, worsted goods, wool pulling, and wool scouring. We chose these series because they seemed related to very basic wool cloth, not the more finished goods like clothing and carpet also listed in Fabricant.

10. Coffee imports. We use the value added in coffee roasting and spices. This series is listed on p. 637 of Fabricant (1940).

11. Tin Imports. We assign this series the value added of tin and other foils, tin cans, tinware not elsewhere classified, and tin and terne plate.

12. Crude Rubber Imports. We assign this series the value added of all rubber products. This seems appropriate because the only subcategories listed are rubber shoes and tires and tubes. There is no category such as basic rubber.

13. Raw Silk Imports. Fabricant and the Census only give the value added of silk and rayon goods combined. To isolate the part appropriate to silk, we use Fabricant's data on the gross value of silk and rayon products (from Appendix B). We divide the products according to fabric content; those products for which fabric content were unclear were simply excluded from the calculations. This procedure may understate the importance of silk in the earlier period because a larger than average amount of velvet and upholstery material may have been made of silk. This procedure suggests that 74.9% of the value added in silk and rayon is safely attributable to silk.

The value-added figures assigned to each series are used to derive weights that sum to one. The base data and the weights are given in Table A1. These weights are then used to combine the individual indexes into an aggregate index.

D. Adjustment for Missing Values

While many of our series exist from 1884-1940, there is a certain amount of attrition at both ends of the index. There is also some attrition in the middle because of missing data on coal shipments in the 1920s. The pattern of available series is the following:

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1884:1-1884:5	Sugar, Wool, Coke and Pig Iron are missing.
1884:6-1887:12	Sugar, Wool, and Coke are missing.
1888:1-1889:12	Sugar and Coke are missing.
1890:1-1893:12	Coke is missing.
1894:1-1922:3	All series are available.
1924:1-1926:12	Coal is missing.
1927:1-1935:12	All series are available.
1936:1-1937:12	Coke is missing.
1938:1-1940:12	Coke and Sugar are missing.

To deal with missing series we do the following. First, we recalculate the percentage weights, setting to zero the weight for the missing series. Second, to prevent discontinuous jumps in the series, we ratio splice the series whenever there is a change in coverage. Specifically, we take the index for 1894:1-1923:12, for which all the series exist, as the base series. Then, on either end, we ratio splice the less complete series to it. For example, for 1890:1-1893:12 no data on coke shipments exist. Therefore, we derive new weights and construct this less complete series through 1894:1. Then we multiply this less complete series by the ratio of the complete series in 1894:1 to the less complete series in 1894:1. This procedure is done repeatedly, working out chronologically from the complete series.

The one complication to this procedure arises for coal for which there is a gap in the data in 1924:1-1926:12. Since we have data for all series for several years after 1926, it seems reasonable to use this complete series unspliced. Therefore, what we do is ratio splice the less complete series to the complete series in 1923:12, but then use no splice in 1926:12. This should be fine, unless the trend of coal production over the missing years is very different from that of other series.

E. Adjustment for Tariff Effects on Wool Receipts

For most purposes, it is desirable to use our index in its least adulterated form. However, our index has a dramatic spike in mid-1897 that is due to changes in the tariff on the wool receipts that we use to proxy for wool textile production. This spike is sufficiently peculiar that it seems reasonable to present an alternative index for part of this year. To do this, we do not use the wool receipts series for the six months around the definite spike in wool receipts (1897:2-1897:7). In making this adjustment, we ratio splice the series excluding wool receipts to the complete series in 1897:8 but then use the complete series before 1897:2 without a splice. This ensures that the alternative only changes the observations for 1897:2-7, not all earlier observations.

F. Final Indexes

INDXP
Miron-Romer Index of Industrial Production, 1909=100
Available 1884:1 - 1940:12

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INDXPW
Miron-Romer Index with Adjustment for Wool Receipts, 1909=100
Available 1884:1 - 1940:12

Table A2 presents the new index in both its basic form and with the minor adjustment for the effect of the tariff change on wool receipts.

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NOTES

[1] This series is used by Dominguez, Fair, and Shapiro (1988) and Schwert (1988).

[2] This series is used by Calomiris and Hubbard (1989), Zarnowitz (1987), and Gorton (1988).

[3] This series is used by Gordon (1982).

[4] For 1877-1902, the Persons Index is based only on bank clearing in seven cities and pig iron production. After 1902 Persons's index includes data on merchandise imports, railroad earnings, and employment, as well as bank clearings and pig iron production (see Persons, 1931, pp. 111 and 131).

[5] Several of the series we use are available for at least part of the period from the records of the NBER that are on a tape deposited at the Inter-university Consortium for Political and Social Research. The Appendix describes in detail how we use the data from the tape in our analysis.

[6] This adjustment for production days is currently done by the Federal Reserve in the derivation of its seasonally-unadjusted index of industrial production.

[7] See Romer (1986b) for a more thorough discussion of this effect.

[8] The exact sources of the alternative series used are the following. For the Babson index we use the version given in Moore (1961), pp. 130-131. We ratio splice the two variants of the index in 1933:1. For the Persons index we use the Index of Production and Trade given in Persons (1931), pp. 91-167. The pig iron series is from Macaulay (1938), Table 27, pp. A252-A270. The FRB series is from the U.S. Board of Governors of the Federal Reserve System (1986), p. 303.

[9] In addition to the annual average of the various monthly series, Table 1 shows the behavior of the widely-used Frickey series that is only available on an annual basis. These data are from Frickey (1947), Table 6, p. 54.

[10] Specifically, the FRB index in this period is based on approximately 80 series, whereas our index includes only 13.

[11] It is also important to note that for the interwar period the FRB index includes several employment series. If there is labor hoarding, then employment will tend to be less volatile than output. This feature of the FRB index could explain some of its relative stability.

[12] The fact that the Persons series is more volatile in the prewar era may be due to the interaction of the use of bank clearings data and the frequency of financial panics in the era before 1914.

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[13] The standard deviation of our new seasonally-unadjusted index for 1922:1-1928:12 is 10.72. The fact that the interwar period is more volatile than the pre-WWI period has been emphasized by Miron (1989). The results presented here verify those findings with an independent source of data and show that the same conclusion holds when monthly, as well as annual, variation is considered.

[14] The R^2 of the regression of log growth rates on seasonal dummy variables is .05 for the prewar pig iron series, .05 for the interwar pig iron series, and .29 for the interwar FRB series.

[15] See Beaulieu and Miron (1989) for an analysis of seasonality in postwar manufacturing.

[16] It is important to note that these differences in timing are not due to the fact that our index is seasonally unadjusted. The same patterns emerge when our series is adjusted using a regression against seasonal dummy variables and a linear trend.

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TABLE 1

STANDARD DEVIATIONS OF ALTERNATIVE MEASURES OF INDUSTRIAL PRODUCTION
(Growth Rates)

Monthly Data

Series	1884:2-1940:12	1884:2-1913:12	1914:1-1940:12
Miron-Romer	9.17	7.05	11.07
Miron-Romer (SA)	9.00	6.44	10.88
Babson (SA)	3.16	2.54	3.64
Persons (SA)	2.92	3.03	2.73
Pig Iron	9.33	7.86	10.73
Pig Iron (SA)	9.13	7.68	10.46
FRB	NA	NA	4.40
FRB (SA)	NA	NA	3.71

Annual Data

Series	1885-1940	1885-1913	1914-1940
Miron-Romer	12.91	8.96	16.30
Babson	10.86	8.23	12.84
Persons	9.61	8.67	11.25
Pig Iron	29.33	19.53	37.26
FRB	NA	NA	16.03
Frickey	NA	10.04	NA

Notes: (SA) denotes seasonally adjusted. The seasonally-adjusted results for the Miron-Romer, pig iron, and FRB series are based on the residuals from a regression of the growth rate on seasonal dummies. Because of data unavailability, the calculations for the Babson index begin in 1889:2, those for the Persons index end in 1930:12, and those for the FRB index begin in 1919:2. The Frickey index is available only on an annual basis. The growth rates reported in the monthly section of the table are measured at monthly rates; those reported in the annual section are measured at annual rates.

Sources: See the text for a description of the sources of the alternative series and the derivation of the Miron-Romer index.

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TABLE A1

VALUE-ADDED WEIGHTS

Series	Value Added in 1909 Millions of Current $	Weights
Pig Iron Capacity	399.00	.3191
Anthracite Coal Shipments	124.05	.0992
Crude Petroleum Production	48.10	.0385
Sugar Meltings	31.60	.0253
Cattle Receipts	67.73	.0542
Live Hog Receipts	97.07	.0776
Coke Shipments	31.70	.0254
Flour Shipments	116.00	.0928
Wool Receipts	148.60	.1189
Coffee Imports	27.30	.0218
Tin Imports	26.70	.0213
Rubber Imports	74.60	.0597
Silk Imports	57.76	.0462

Sources: See text for a description of the sources of data on value added in 1909.

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TABLE A2

MIRON-ROMER INDEX OF INDUSTRIAL PRODUCTION, 1884-1940

(1909 = 100)

1884: 1	32.663	29.431	27.334	32.417	33.379	32.529
1884: 7	30.341	33.642	31.086	39.220	41.070	42.527
1885: 1	35.326	31.070	31.372	33.941	34.757	34.386
1885: 7	30.918	31.329	33.523	43.127	47.974	42.973
1886: 1	39.204	37.032	36.119	37.557	39.065	42.485
1886: 7	38.719	38.624	41.653	43.643	47.502	45.893
1887: 1	39.015	39.705	39.667	38.546	38.505	37.058
1887: 7	36.082	39.074	41.553	47.254	48.023	43.236
1888: 1	39.480	38.688	40.647	39.423	39.557	40.647
1888: 7	43.737	42.953	45.294	48.058	48.079	47.629
1889: 1	42.128	44.540	41.061	41.480	44.462	46.024
1889: 7	51.524	44.493	45.283	53.171	53.015	50.542
1890: 1	49.559	46.276	47.928	48.316	50.961	53.711
1890: 7	56.701	55.166	54.878	58.035	61.391	51.690
1891: 1	55.409	54.288	56.316	48.469	47.600	51.910
1891: 7	57.242	55.833	56.872	64.819	69.095	64.993
1892: 1	60.392	59.742	59.295	56.494	58.457	62.885
1892: 7	61.492	60.001	58.238	60.800	61.882	57.369
1893: 1	55.857	56.202	55.670	58.165	55.306	53.950
1893: 7	51.272	44.536	42.720	48.753	47.575	48.109
1894: 1	46.837	44.769	46.241	50.988	48.067	54.994
1894: 7	46.403	59.508	57.723	61.238	63.783	54.676
1895: 1	54.305	59.056	56.091	56.810	58.480	61.422
1895: 7	65.404	68.532	62.433	71.535	71.750	66.012
1896: 1	63.328	57.547	58.877	55.293	57.166	57.992
1896: 7	54.103	52.800	52.593	60.533	61.256	66.485
1897: 1	55.224	65.597	66.613	84.313	70.553	69.415
1897: 7	68.310	64.985	66.984	69.954	71.567	67.950
1898: 1	63.100	68.674	62.222	59.078	63.879	58.679
1898: 7	59.430	60.896	63.750	66.165	70.770	70.569
1899: 1	68.140	66.931	68.664	63.411	67.595	73.302
1899: 7	74.476	74.717	74.161	75.746	77.117	74.992
1900: 1	73.861	75.214	74.329	75.783	69.295	68.664
1900: 7	64.911	68.232	65.118	61.941	67.613	68.823
1901: 1	69.643	71.739	78.872	75.537	80.885	80.181
1901: 7	80.838	86.653	81.543	79.826	85.057	81.344
1902: 1	81.893	78.801	81.498	81.721	73.539	74.498
1902: 7	73.900	83.154	76.571	76.403	86.707	84.516
1903: 1	83.149	84.555	85.724	84.833	83.485	89.291
1903: 7	87.148	93.639	87.414	73.288	75.042	72.568
1904: 1	74.276	86.334	81.760	77.899	81.020	87.263
1904: 7	78.118	85.829	72.676	84.970	89.464	86.404
1905: 1	93.714	96.550	92.465	93.843	89.031	97.103
1905: 7	86.292	93.886	89.297	95.278	93.436	93.880
1906: 1	93.360	99.239	91.993	83.824	84.996	88.810
1906: 7	91.710	96.470	96.620	95.191	96.123	97.484
1907: 1	95.781	97.889	96.950	97.378	95.414	97.813
1907: 7	99.264	105.710	97.179	93.398	81.228	71.268
1908: 1	73.117	75.614	74.413	70.207	75.243	79.211
1908: 7	80.613	85.906	80.305	86.419	96.892	94.622
1909: 1	91.660	99.782	97.895	90.816	94.327	99.274
1909: 7	99.357	99.562	101.209	108.008	111.270	106.841
1910: 1	109.875	111.897	105.637	92.770	90.781	93.088
1910: 7	93.689	104.906	93.698	98.192	96.383	91.205
1911: 1	92.979	96.479	95.179	95.804	91.739	94.220
1911: 7	100.463	100.931	96.579	102.223	100.462	99.965
1912: 1	102.967	111.696	112.279	101.905	100.992	107.427
1912: 7	115.469	121.329	113.269	114.721	114.222	114.916

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TABLE A2 (CONTINUED)

1913: 1	118.687	117.834	112.744	108.121	106.299	111.631
1913: 7	109.059	115.755	116.286	108.856	107.716	107.199
1914: 1	98.734	108.798	115.228	117.876	112.619	107.625
1914: 7	109.263	98.375	103.849	95.612	90.894	92.329
1915: 1	95.962	112.322	122.909	123.367	126.742	119.807
1915: 7	122.857	124.795	129.052	134.790	145.126	156.137
1916: 1	158.881	161.200	154.670	148.696	152.434	153.823
1916: 7	131.197	140.186	129.589	141.590	143.638	151.944
1917: 1	167.560	138.983	159.420	167.068	169.931	180.591
1917: 7	150.507	168.540	159.861	157.079	158.831	151.446
1918: 1	138.945	148.571	151.569	159.383	181.297	165.793
1918: 7	177.825	152.389	161.296	151.073	152.910	146.861
1919: 1	142.696	149.133	175.749	174.088	165.780	151.116
1919: 7	183.409	147.749	158.924	151.000	184.366	183.408
1920: 1	188.548	200.361	205.850	184.287	155.123	165.860
1920: 7	160.519	163.336	134.146	124.872	142.416	121.442
1921: 1	123.392	131.139	130.893	123.679	106.174	114.304
1921: 7	108.381	119.869	117.457	133.106	143.169	151.867
1922: 1	152.772	176.200	169.564	137.692	134.225	157.703
1922: 7	171.185	150.457	141.971	202.040	185.052	211.121
1923: 1	213.366	207.595	219.442	218.093	220.596	218.777
1923: 7	183.047	164.666	136.006	159.379	156.197	189.616
1924: 1	174.347	203.993	171.978	207.044	166.825	155.102
1924: 7	141.532	146.605	161.537	192.922	201.284	186.075
1925: 1	211.625	191.158	207.232	189.900	194.892	185.285
1925: 7	189.792	192.751	179.293	198.567	215.119	220.923
1926: 1	231.678	215.503	226.918	211.027	192.517	178.711
1926: 7	210.252	184.094	208.725	195.042	219.704	207.721
1927: 1	223.671	190.618	202.582	232.712	212.356	209.936
1927: 7	213.196	201.001	189.340	187.029	200.560	177.709
1928: 1	210.119	203.581	213.080	214.013	197.230	190.558
1928: 7	193.207	190.626	211.114	223.226	206.807	224.832
1929: 1	263.791	294.849	241.635	255.798	246.418	240.253
1929: 7	237.105	221.448	217.829	215.283	222.017	221.397
1930: 1	223.833	226.560	218.751	219.995	209.518	223.314
1930: 7	201.930	202.824	184.965	210.960	167.043	182.274
1931: 1	176.986	185.612	192.290	197.385	179.835	210.721
1931: 7	202.097	179.401	172.174	180.480	198.151	201.333
1932: 1	152.278	140.377	167.411	153.193	141.321	159.795
1932: 7	145.559	147.121	141.451	153.656	135.835	136.726
1933: 1	129.017	113.479	115.877	109.910	128.269	151.576
1933: 7	221.452	210.920	207.182	190.378	170.434	162.880
1934: 1	184.349	164.288	170.521	187.549	197.562	202.631
1934: 7	187.069	140.726	150.742	134.765	159.877	100.768
1935: 1	164.291	201.865	184.372	171.052	146.230	170.133
1935: 7	198.033	172.670	173.749	171.206	145.481	180.875
1936: 1	164.985	173.532	162.884	197.327	178.358	194.893
1936: 7	198.554	194.232	213.904	193.485	202.694	227.087
1937: 1	215.962	232.051	207.278	216.205	223.829	232.285
1937: 7	200.692	220.668	234.997	221.343	215.345	231.944
1938: 1	177.320	171.663	161.271	140.976	138.488	139.900
1938: 7	130.150	149.443	157.510	164.739	167.273	167.767
1939: 1	172.516	156.213	182.798	158.482	184.297	172.813
1939: 7	179.191	179.728	192.803	215.692	207.562	281.021
1940: 1	275.583	200.597	232.237	262.499	221.192	252.392
1940: 7	282.412	285.488	320.230	304.910	309.145	372.697

Index Excluding Wool Receipts for 1897:2-1897:7

1897: 1	55.224	60.798	57.812	59.811	63.079	63.925
1897: 7	60.042	64.985	66.984	69.954	71.567	67.950

<u>Sources</u>: See the text for a description of the data and procedures used to derive the new Miron-Romer index.

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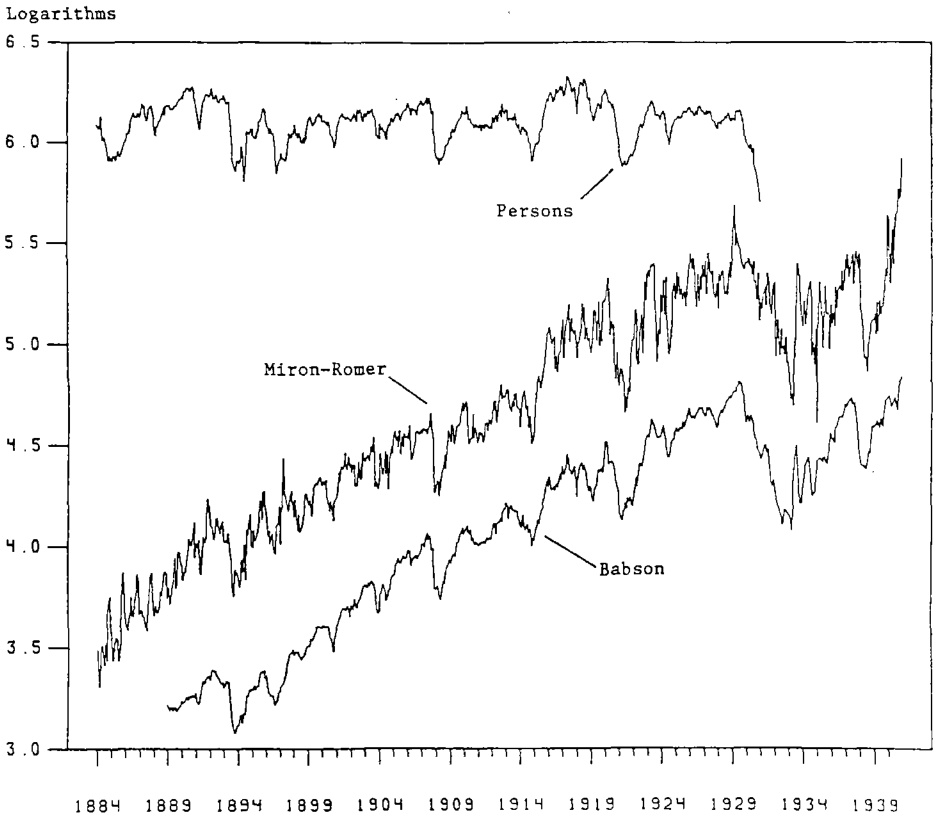
FIGURE 1

ALTERNATIVE MEASURES OF INDUSTRIAL PRODUCTION



Notes: To improved the clarity of the figure, we have added 1.5 to the logarithm of the Persons index in all years.

Sources: See the text for the sources of the Babson and Persons series and for a description of the derivation of the new Miron-Romer index.

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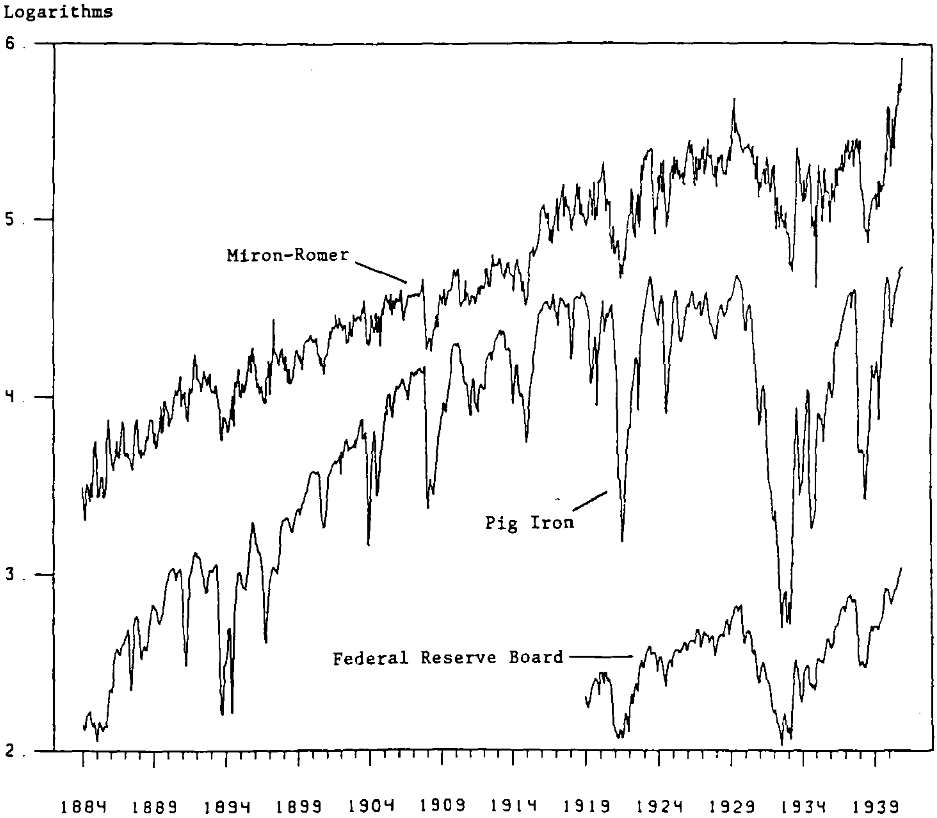
FIGURE 2

ALTERNATIVE MEASURES OF INDUSTRIAL PRODUCTION



Notes: To improve the clarity of the figure we have subtracted .15 from the logarithm of the Pig Iron series in all years.

Sources: See the text for the sources of the Pig Iron and Federal Reserve Board series and for a description of the derivation of the new Miron-Romer index.

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