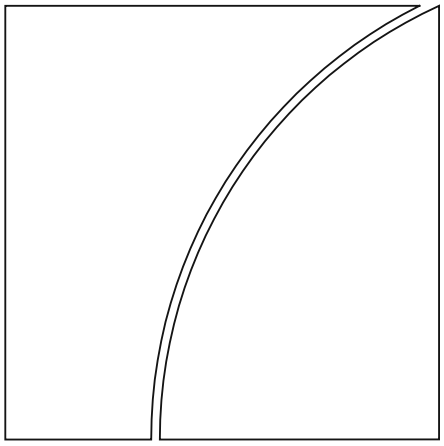


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Prewar US Business Cycles under Uncertainty: Reconstructing Quarterly GDP before 1947

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October 2026

Abstract

Official quarterly US GDP estimates begin in 1947; earlier quarterly histories must be reconstructed using annual benchmarks and historical indicators. To investigate uncertainty in these reconstructions, this paper systematically compares specifications drawn from the literature for reconstructing quarterly GDP during 1919–1946. The comparison evaluates predictions on concealed postwar quarters and separates variation across specifications from coefficient uncertainty within a model. Reconstruction choices matter, but their effects differ across episodes. Across 58 reconstruction specifications, the interquartile range of estimated peak-to-trough declines is 30.9–31.6% for the Great Depression, compared with 6.6–7.8% for 1937–1938. A reconstruction that augments the production-regression approach of Balke and Gordon (1986) with the Denton allocation used by Ramey and Zubairy (2018) has the lowest prediction error. Industrial production supplies information about quarterly movements, while annual accounts constrain the resulting path. Richer indicator panels, additional expenditure detail and more flexible relationships do not improve on this reconstruction's predictive accuracy. Its estimated 7.07% decline in 1937–1938 is milder than the approximately 10.5–10.6% declines in those published reconstructions. The reconstruction matches all six NBER recessions, but dates the first contraction two quarters earlier, from 1919Q3 to 1921Q1 rather than 1920Q1 to 1921Q3; its peak is the earliest allowed by the dating window.

JEL classification: E32, N12, C38, C43.
Keywords: Quarterly GDP reconstruction; US business cycles; economic history; industrial production; model uncertainty; Great Depression.

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1 Introduction

The frequency and severity of economic contractions shape how economists assess risk, explain asset prices and evaluate stabilisation. Yet before 1947, US quarterly GDP is reconstructed rather than observed. Annual accounts constrain the yearly mean, but leave the quarterly peaks, troughs and dynamics on which many historical conclusions depend undetermined. The question is how much of the inferred business cycle survives a change in the reconstruction.

Historical measurement has long shaped assessments of economic stability. Romer (1989) and Balke and Gordon (1988) reach different conclusions about historical GNP volatility; Romer (1986) attributes part of apparent industrial stabilisation to inconsistent measurement. Romer (1994) shows that consistent dating criteria change the prewar chronology and the apparent shortening of recessions. These issues matter for the stabilisation literature (Stock & Watson, 2003), studies of the Great Depression and fiscal policy (Gordon & Krenn, 2010; Ramey & Zubairy, 2018), and accounts of disaster risk and asset prices (Barro, 2006; Barro & Ursúa, 2008; Farhi & Gabaix, 2016; Gabaix, 2012; Nakamura et al., 2013).[1]

This paper contributes a systematic comparison of reconstruction methods and the historical conclusions they support. I compare 58 specifications derived from the literature, then use prediction errors on concealed postwar quarters to rank them. A separate coefficient simulation measures uncertainty within the best-performing specification. Together with changes in estimation assumptions, these exercises distinguish sensitivity to reconstruction choices from uncertainty in an estimated relationship. The historical analysis covers 1919–1946; estimation and evaluation extend through 1963.

The comparison separates three decisions that jointly determine quarterly GDP: which indicators to use, how to relate them to GDP, and how to reconcile a preliminary path with annual accounts. Production regression uses industrial production (IP), following Balke and Gordon (1986). Paired versions add the Denton allocation used by Ramey and Zubairy (2018).[2] Component reconstruction draws on the expenditure-specific approach of Gordon and Krenn (2010). Principal-component regression follows Stock and Watson (2002), while the joint Bayesian factor model draws on historical activity-factor methods and Bayesian mixed-frequency GDP estimation (Ritschl et al., 2016; Koop et al., 2023). Simple Denton benchmarks allocate annual GDP using a constant or a direct indicator (Sax & Steiner, 2013). These approaches are adapted to common data and annual accounts. The methods follow established practice (King et al., 2000; Proietti, 2005; Sax & Steiner, 2013); the contribution is their common evaluation and the resulting assessment of historical robustness.[3]

The analysis uncovers three main findings. First, reconstruction uncertainty is substantial, but varies over time. The interquartile range of estimated Great Depression declines is 30.9–31.6%, whereas the corresponding range for 1937–1938 is 6.6–7.8%. Within these central ranges, the De-

[1] The disaster literature commonly measures declines in annual per-capita output or consumption. This paper holds annual aggregate GDP fixed and studies quarterly reconstruction; it does not re-estimate annual disaster frequencies. Quarterly estimates inform the depth, timing and duration of contractions and recoveries conditional on those annual accounts.

[2] Ramey and Zubairy (2018) use published quarterly GNP histories as preliminary paths. Here the preliminary relationship is estimated from indicators and annual and retained quarterly accounts. Appendix G documents the original studies' inputs, coverage and accounting concepts.

[3] The comparison also informs recent international reconstructions. Camous et al. (in press) combine annual GDP from the Penn World Tables with historical IP from the IMF's International Financial Statistics using Chow–Lin disaggregation. Their extended data challenge earlier conclusions about rising output synchronisation. The prediction results here provide US evidence in favour of their use of IP to recover quarterly movements consistent with annual GDP.

pression's estimated depth is comparatively stable.[4] The smaller contraction is more sensitive both in percentage points and relative to its size. Agreement on annual GDP thus supports some historical claims much more strongly than others.

Second, the common prediction test favours a simple production relationship. The two lowest-error specifications use log IP, a constant response and Litterman residuals, supporting the production-regression approach of Balke and Gordon (1986). Proportional Denton allocation, as used by Ramey and Zubairy (2018), gives a further improvement. Additional expenditure detail, principal components and a changing IP response do not outperform this combination in the main comparison.[5]

Third, the best-performing specifications imply a milder 1937–1938 contraction than Balke and Gordon (1986) and Ramey and Zubairy (2018). The best-performing reconstruction gives a 7.07% decline, compared with approximately 10.5–10.6% in those series (at common annual GDP); it is close to Gordon and Krenn (2010). Its 99% coefficient interval is 6.34–7.96%, and the best-performing specifications under alternative assumptions imply 7.07–7.58% declines. The best-performing reconstruction overlaps all six NBER recessions but dates the first contraction two quarters earlier and the 1923–1924 and 1926–1927 peaks three and two quarters later, respectively. It also implies a smaller demobilisation decline and lower volatility and higher persistence than the published histories.

The paper reports the best-performing reconstruction alongside separate measures of across-specification variation and within-model uncertainty. Across-specification interquartile ranges describe reconstruction choices; coefficient intervals vary the estimated GDP–IP relationship at fixed data, dynamics and innovation variances. Supplementary Bayesian comparisons retain uncertainty about missing paths as well as parameters.

2 Historical GDP and the indicators used for reconstruction

The evidence supports a balanced 29-indicator panel over 1919–1963, a historical reconstruction through 1946 and a separate earlier extension. Source coverage and economic comparability determine these boundaries. Annual GDP supplies the accounting benchmark; observed postwar quarterly GDP supplies the evaluation target. The methods differ in their indicator needs: production regression uses IP, component reconstruction uses targeted expenditure indicators, and principal-component regression and the joint Bayesian factor model summarise larger panels. Denton allocation can reconcile either an estimated preliminary path or a direct indicator with the annual accounts.

2.1 GDP and indicator sources

Annual GDP and observed quarterly GDP provide the accounting and evaluation benchmarks. The Bureau of Economic Analysis (BEA) publishes annual GDP from 1929 and quarterly GDP from

[4] The Great Depression is particularly consequential for disaster-risk applications, where severe contractions shape asset prices (Barro & Ursúa, 2008; Farhi & Gabaix, 2016). Yet the central half of the reconstruction specifications agree closely on its depth, conditional on annual GDP.

[5] The best-performing reconstruction is defined by its lowest root mean squared prediction error (RMSE) on concealed quarters.

1947. MeasuringWorth supplies earlier annual GDP.[6] Its nominal and real series are separately rescaled to BEA in 1929, preserving earlier annual growth. Nominal GDP is in billions of current dollars; real GDP is in billions of 2017 dollars. Quarterly levels are seasonally adjusted annual rates, so their annual mean equals annual GDP:

$$A_y = \frac{1}{4}\sum_{r=1}^{4} Q_{yr}. \tag{1}$$

Small BEA rounding differences are reconciled when imposing accounting. The original BEA quarterly observations remain the evaluation targets. Published historical GDP and GNP reconstructions supply comparisons, rather than independent evaluation data. Uncertainty in annual GDP remains outside this exercise.

Historical indicators cover many economic activities, but their dates and definitions differ. The NBER Macrohistory Database contains production, labour, construction, retail, transport, trade, prices and financial series, alongside annual agricultural output and shorter monthly agricultural quantities. Federal Reserve IP and Bureau of Labor Statistics (BLS) consumer and producer prices complement these histories.[7]

2.2 Sample and indicator selection

Indicator selection begins with a systematic search of the NBER's sixteen chapter catalogues and complementary Federal Reserve and BLS sources. The search covers US production, labour, construction, sales, transport, trade, prices and financial conditions. Candidate indicators must measure a stated economic activity or condition relevant to aggregate GDP.

Coverage and source quality determine which histories can support a common panel. Each indicator must supply all three months of every quarter. Published harmonisations, documented source joins and source estimates are admissible; undocumented proxy substitutions and new interpolation are excluded. Appendix G records the source histories, qualifications and exclusions.

The common period follows the availability of broad, comparable indicators. Federal Reserve IP and several labour and retail series begin in January 1919 (Board of Governors of the Federal Reserve System, 2019). Department-store sales and harmonised construction histories end in December 1963. National department-store reporting transferred to the Census Bureau from February 1964 (Board of Governors of the Federal Reserve System, 1964, p. 446). Extending beyond 1963 requires different sources or fewer indicators.

These source boundaries yield a 1919–1946 historical reconstruction and a 1947–1963 evaluation overlap. The overlap provides 17 years of observed quarterly GDP and several contractions while limiting the distance from prewar economic structures. It permits a test of quarterly reconstruction conditional on annual GDP and indicators.

[6] Sources: BEA, *Gross domestic product*, https://www.bea.gov/data/gdp/gross-domestic-product; L. Johnston and S. H. Williamson, *Construction of annual estimates of U.S. GDP, 1790–1928*, MeasuringWorth, https://www.measuringworth.com/datasets/usgdp/constructiongdp.php. Both accessed 15 October 2026; BEA observations are obtained via FRED.

[7] Source: NBER, *Macrohistory Database*, https://www.nber.org/research/data/nber-macrohistory-database. Federal Reserve and BLS indicators are accessed via Federal Reserve Economic Data (FRED), https://fred.stlouisfed.org. Both accessed 15 October 2026. NBER coverage is not uniform: trade begins in July 1866, pig iron in January 1877 and department-store sales in January 1919. Their histories end in October 1969, December 1964 and December 1963, respectively. Some files contain estimates or gaps; Table 21 gives numerical coverage and Section G.4 records exclusions.

The early extension starts in 1909, when MeasuringWorth changes to Kendrick-based annual GDP estimates. Earlier estimates rely partly on interpolation between decennial benchmarks (see the construction notes in footnote 6). Ten indicators cover 1909–1918: nine from the main panel and the Persons activity index. Persons measures activity relative to trend and requires an explicit trend treatment (Section G.3.3), following Balke and Gordon (1986, p. 809). Table 1 summarises the periods.

Table 1: Sample boundaries and their rationale

Role	Period	Reason
Indicator panel	1919M1–1963M12	Common coverage of the 29 indicators: 540 months, or 180 quarterly levels.
Historical reconstruction	1919Q1–1946Q4	112 quarterly levels before the modern quarterly GDP benchmark begins.
Observed-GDP overlap	1947Q1–1963Q4	68 GDP levels; 67 quarter-to-quarter growth observations wholly within the overlap. Scored observations depend on the concealment design.
Earlier extension	1909–1918	Kendrick-based annual GDP begins; ten indicators cover the extension.

Among histories with sufficient coverage, selection limits further subdivisions of economic roles already represented. Broad measures represent aggregate activity; narrower indicators distinguish sectors, production stages or markets. For example, IP measures aggregate industrial activity, while durable-manufactures production distinguishes its durable-goods component. Pig iron and steel distinguish production stages; corporate yields and the corporate yield spread distinguish borrowing costs and credit risk. Adding indicators need not improve factor-based prediction: correlated indicator-specific noise or a less prominent predictive factor can reduce performance (Boivin & Ng, 2006). Table 20 gives the group-by-group selection rationale.

The broad panel contains 29 indicators and supplies principal-component regressions and the joint Bayesian factor model. Each indicator has 540 monthly observations, 180 quarterly levels and 179 first differences (Section G.3). Principal-component regression also uses a 15-indicator activity panel: production, labour demand, expenditure and goods movement, excluding standalone prices, money and financial-market indicators. Membership follows economic content rather than concealed-quarter prediction errors. Six retained activity indicators measure nominal flows. Table 2 identifies both panels.

Table 2: Indicators used by reconstruction method

Indicator	Production regression		Component reconstruction	PCR/Bayesian	
	1919–1963	1909–1918	1929–1963	1919–1963	1909–1918
Industrial production	X	–	–	X^A	–
Persons activity index	–	X	–	–	X
Durable-manufactures production	–	–	C, I	X^A	–
Steel production	–	–	–	X^A	X
Pig iron production	–	–	–	X^A	X
Lumber production	–	–	–	X^A	–
Stone, clay and glass production	–	–	–	X^A	–
Manufacturing employment	–	–	–	X^A	–
Manufacturing payrolls	–	–	–	X^A	–
Help-wanted advertising	–	–	–	X^A	–
Private construction contracts	–	–	I	X^A	–
Public works and utility contracts	–	–	I	X^A	–
Department-store sales	–	–	C	X^A	–
Freight carloadings	–	–	–	X^A	–
Merchandise exports	–	–	X	X^A	X
Merchandise imports	–	–	M	X^A	X
Federal budget expenditures	–	–	G	–	–
Consumer prices, all items (CPI)	–	–	–	X	–
Producer prices, all commodities (PPI)	–	–	–	X	–
Wholesale farm-product prices	–	–	–	X	X
Prices received by farmers	–	–	–	X	–
Wholesale food prices	–	–	–	X	X
Retail food prices	–	–	–	X	–
Wholesale prices excl. food/farm products	–	–	–	X	X
Stock price index	–	–	–	X	–
NYSE shares traded	–	–	–	X	–
Prime 90-day bankers' acceptance rate	–	–	–	X	–
Commercial-paper rate	–	–	–	X	X
AAA corporate yield	–	–	–	X	–
Corporate yield spread	–	–	–	X	–
Broad money	–	–	–	X	X

X denotes inclusion, except in the component column: C denotes consumption; I, investment; G, government purchases; X, exports; and M, imports. PCR/Bayesian denotes principal-component regression and the joint Bayesian factor model. The broad panel has 29 indicators (540 months each). Superscript A marks the 15-indicator activity panel used by PCR; the Bayesian model uses the broad panel. The early Bayesian model uses ten indicators (120 months each); no early principal-component regression is estimated. Production regression includes its Denton variant; Persons requires explicit treatment of trend. The component column identifies timing proxies, not measured expenditure components. Federal budget expenditures require the source reconciliation described in Section G.3.2. The corporate yield spread is the BAA corporate yield minus the AAA corporate yield, in percentage points. NYSE denotes the New York Stock Exchange. Appendix G gives sources and qualifications.

Component reconstruction uses targeted expenditure indicators and annual component accounts and prices, following Gordon and Krenn (2010). Table 2 assigns production, retail, construction and trade indicators to components. Federal budget expenditures supply government-spending information.[8] Appendix G explains the required accounting and source reconciliation. Manufacturing and goods remain better measured than agriculture and services.

3 A systematic comparison of reconstruction choices

Common annual accounts do not imply a common quarterly history. Indicators supply timing information, an estimated relationship translates that information into GDP, and an allocation rule reconciles the preliminary path with the accounts. The comparison varies each of these decisions. A method defines a broad approach, including its allocation rule; a specification fixes the indicators, functional form, coefficient stability, residual assumptions and factor dimension within that method.

3.1 Methods and specifications

The catalogue varies the economic information and flexibility of the estimated relationships (Table 3). Production regressions vary functional form and the stability of GDP's response to IP. Component reconstruction uses expenditure-specific indicators. Principal-component regression varies panel composition and factor dimension; the joint Bayesian model estimates GDP and its common activity signal together. Simple Denton benchmarks show what annual accounting and an imposed quarterly shape deliver without estimating a GDP relationship. Nominal counterparts are constructed separately.

Table 3: Reconstruction methods, motivating studies and specification counts

Method and motivation	Specification choices	Number
Production regression Balke and Gordon (1986); Romer (1989)	Levels or logs × constant or changing IP response × three residual models	12
Production regression with Denton allocation Ramey and Zubairy (2018)	The same twelve preliminary regressions, followed by Denton allocation	12
Component reconstruction Gordon and Krenn (2010)	Levels or logs × three residual models	6
Principal-component regression Stock and Watson (2002)	Two indicator panels × one, two or three components × four estimators	24
Joint Bayesian factor model Ritschl et al. (2016); Koop et al. (2023)	One factor from the 29-indicator panel, estimated jointly with GDP	1
Simple Denton benchmarks Sax and Steiner (2013)	Constant, IP or IP multiplied by PPI	3

The three residual models follow Chow and Lin (1971), Fernández (1981) and Litterman (1983). Principal-component regression also uses an annual-growth estimator. Tables 15.1–15.6 list every specification and its prediction error.

[8] Component-specific timing indicators generally avoid new chaining across source histories; continuous series or published harmonisations are used where available. Government spending is an exception. Linking documented spending sources is necessary to capture this component meaningfully, especially the timing of wartime expenditure that annual-only allocation would lose. These links require reconciliation of units, coverage and definitions. Federal budget expenditures remain a proxy for government purchases (Section G.3.2).

3.2 From indicators to quarterly estimates

Production regression relates GDP to IP and a time trend. The estimated relationship supplies a preliminary quarterly path; residual-based allocation then reconciles that path with observed GDP. For the regression in log IP,

$$\ell_q = \alpha + \delta t_q + \beta \log IP_q + u_q, \qquad p_q = \exp(\widehat{\alpha} + \widehat{\delta} t_q + \widehat{\beta} \log IP_q), \tag{2}$$

where $\ell_q = \log Q_q$ and t_q is a time trend in years, starting at zero in 1919Q1. Generalised least squares uses annual GDP and the BEA quarterly observations available in each estimation (excluding quarters concealed for the prediction test).

A changing production response allows the GDP–IP relationship to evolve with economic composition, following the motivation in Romer (1989). Alongside a constant response, the comparison estimates a response that changes linearly with time. Interacting time with detrended IP avoids freely introducing a quadratic GDP trend. Appendix B gives the equation and its estimation restrictions.

The twelve production-regression specifications combine two functional forms, two response assumptions and three residual processes. Level regressions use untransformed GDP and IP; log regressions use their logarithms. Chow–Lin specifies a stationary autoregressive residual u_q; Fernández specifies a random walk; Litterman allows persistent changes in the residual. The fitted residual covariance governs both coefficient estimation and the allocation of discrepancies relative to observed GDP. Coefficient estimation approximates log annual GDP by the average of quarterly log GDP. Final levels satisfy exact arithmetic annual accounting.

Production regression with Denton allocation retains each of these twelve preliminary relationships and changes the allocation step. Proportional Denton chooses the completed path whose ratio to p_q changes as smoothly as possible:

$$\widehat{Q} = \arg \min_{Q:\, CQ=b} \sum_{q=2}^{T} \left(\frac{Q_q}{p_q} - \frac{Q_{q-1}}{p_{q-1}} \right)^2 . \tag{3}$$

The rows of C impose annual means and retained quarterly levels b. The initial ratio is free. This distinction between preliminary prediction and allocation is standard in temporal disaggregation (Sax & Steiner, 2013). In a production regression using Litterman residuals followed by Denton allocation, Litterman determines the regression coefficients; Denton determines the final allocation. The paired specifications isolate the effect of changing this allocation while retaining the same preliminary GDP relationship.

Component reconstruction estimates expenditure items separately before combining them into GDP. Each positive component uses indicators suited to that item and its annual component accounts; signed inventory investment is handled separately. The same two functional forms and three residual processes give six specifications. Final aggregate GDP is reconciled with annual GDP and retained BEA quarters. Appendix B gives the component construction.

Principal-component regression summarises either the broad or activity panel before estimating its relationship with GDP. Each component is a weighted combination of all indicators in that panel, calculated without GDP. The 24 specifications combine two panels, one to three components and four estimators. Cumulated components enter log-level GDP regressions with the three residual processes; a fourth formulation estimates GDP growth using quarterly and annual-growth equations. A larger indicator panel need not improve factor-based prediction (Boivin & Ng, 2006). Appendix B explains these regressions and their allocation rules.

The joint Bayesian factor model estimates the common activity signal and its GDP relationship together under annual accounting constraints. This differs from principal-component regression, which constructs components without GDP before estimating their GDP relationship. The one-factor specification enters the common comparison; its equations, estimation and supplementary uncertainty results are in Appendix C.

The three simple Denton benchmarks allocate annual GDP directly using a constant, IP, or IP multiplied by the producer price index (PPI). They estimate no GDP relationship and use no quarterly GDP anchors. Their role is to show what annual accounting and an imposed quarterly shape alone imply. IP $\times$ PPI is a proxy for nominal activity, retained as a restrictive real-GDP benchmark: prices affect within-year timing at fixed annual real GDP. It does not estimate separate output and price effects.

Main-sample estimation uses 1919–1963, except that component reconstruction begins in 1929. Indicator standardisation, principal-component weights, model parameters and uncertainty are estimated within the applicable period. Earlier observations in the assembled indicators and annual accounts support only the subsequent series extension.

Admissibility precedes predictive ranking. Each specification must produce finite, positive real GDP throughout its reconstruction period and satisfy annual accounting. Nonpositive predictions and numerical failure are recorded separately from valid reconstructions with large errors.

4 Across-model variation and prediction accuracy

Concealed-quarter prediction provides a basis for comparing reconstructions even though prewar quarterly GDP is unobserved. The historical paths show the quarterly variation that remains at common annual GDP. Concealed postwar quarters then test which specifications recover known quarterly movements most accurately. A separate annual-fit diagnostic distinguishes this timing evidence from the ability to explain annual output.

4.1 Different quarterly histories at common annual GDP

Common annual GDP leaves substantial disagreement about quarterly dynamics. Figure 1 shows four-quarter growth from all 58 specifications. The paths agree on the broad Depression and wartime reversal, but differ in variability, short-lived peaks and contraction timing. Component histories begin in 1929; the others begin in 1919. Quarter-on-quarter growth shows the same underlying comparison (Appendix I).[9]

Different quarterly profiles change both the estimated depth of a contraction and its dates. Section 5 measures those historical differences. The common prediction test first establishes which specifications recover observed quarterly movements most accurately.

[9] Annual BEA growth appears as dots from 1930, the first year for which both annual levels are BEA observations. BEA quarterly GDP begins in 1947, so four-quarter growth begins in 1948.

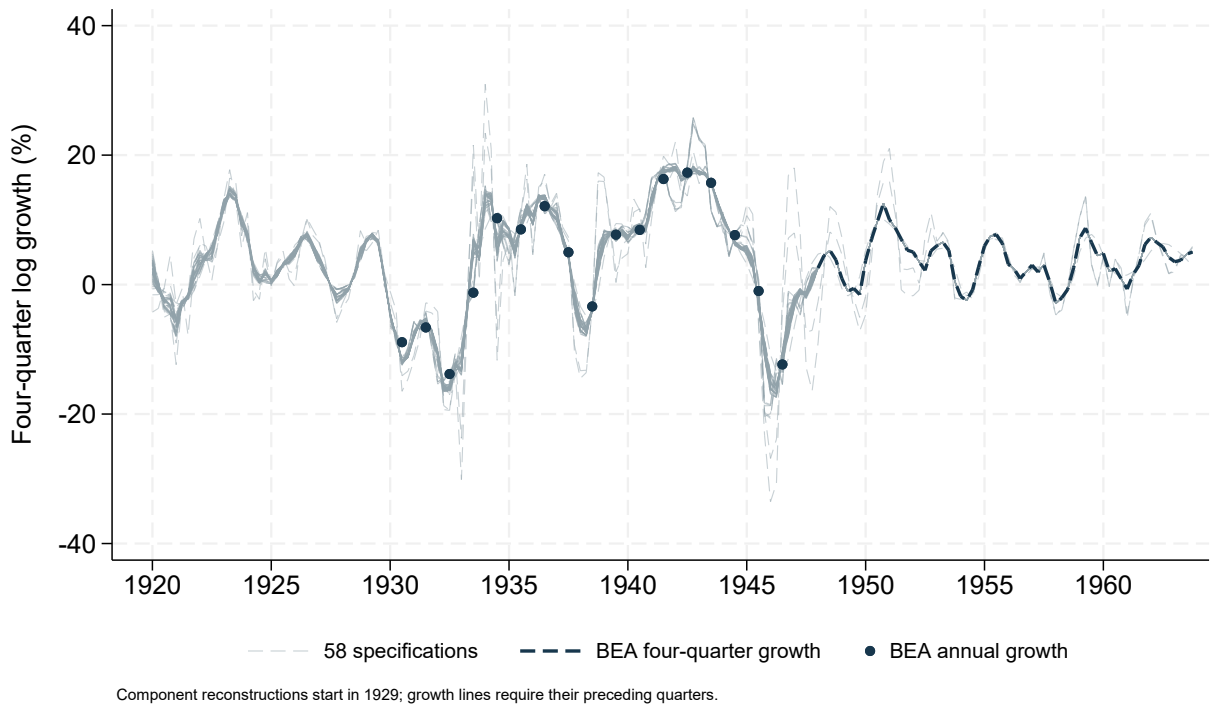


Figure 1: Four-quarter real GDP growth across 58 specifications from Table 3. Thin dashed lines are distinct predictions; the other series are BEA quarterly four-quarter growth and annual-growth dots. The main sample begins in 1919; the six component specifications begin in 1929.

4.2 A common test on concealed BEA quarters

The prediction test recreates the central historical information constraint: annual GDP and indicators are available, but quarterly GDP is withheld. Balke and Gordon (1986) and Ramey and Zubairy (2018) use BEA quarters after 1946, while the reconstruction of Gordon and Krenn (2010) extends through 1951 with different vintages and construction information. The test therefore evaluates adaptations of their methods on identical concealed BEA observations; their published prewar histories remain separate historical comparisons.

Four concealed periods span the observed-GDP overlap: 1947–1950, 1951–1954 and 1955–1958 contain 16 quarters each; 1959–1963 contains 20. Each fitted specification is re-estimated with one period's quarterly values withheld, retaining annual GDP, monthly indicators and quarterly observations outside that period. Concealed values enter neither fitting, state inference nor initialisation. The three simple Denton benchmarks use only annual accounts and their stated indicator, with no estimated GDP relationship or quarterly anchors.

This is retrospective reconstruction rather than real-time forecasting. For an interior concealed period, observations on either side can inform the path. The first period is particularly relevant to backcasting: quarterly relationships are learned from later BEA quarters. The complete overlap contains 68 quarterly levels and 67 quarterly growth observations. Only changes with both levels inside the same concealed period are scored: 15 changes in each four-year period and 19 in the five-year period, or 64 overall. Three boundary-crossing changes are excluded.

For these common dates $\mathcal{H}$, the selection criterion is

$$\text{RMSE} = \left[\frac{1}{|\mathcal{H}|} \sum_{q \in \mathcal{H}} \left(100\Delta \log \widehat{Q}_q - 100\Delta \log Q_q^{BEA} \right)^2 \right]^{1/2}. \tag{4}$$

Growth is not annualised; errors are percentage points. Pooled RMSE determines the best-performing specification, which is then refitted using all available quarterly information. Its postwar fitted values are not further prediction evidence.

These scores rank conditional reconstructions; they do not provide an independent assessment after selection. Section 7 therefore checks both the estimation assumptions and a nested selection procedure that reserves separate periods for ranking and assessment.

4.3 Prediction accuracy and model comparison

Production regression with Denton allocation has the lowest prediction error (Table 4). Its best specification uses log IP and Litterman residuals, with RMSE 0.5633 percentage points. The same production regression with residual-based allocation ranks second, at 0.5719. This is the common-data adaptation of Balke and Gordon (1986), using log IP and Litterman residuals, rather than the published Balke and Gordon (1986) series. These are numerical rankings; they do not establish statistically significant accuracy differences.

Table 4: Quarterly growth prediction on concealed BEA data

Method	Best specification	Count	Best	Mean	Worst
Production regression with Denton allocation	Log IP; Litterman	12	0.5633	0.6108	0.6914
Production regression	Log IP; Litterman	12	0.5719	0.6178	0.6919
Principal-component regression	3 components from 15 activity indicators; Chow–Lin	24	0.5882	0.7062	0.8653
Joint Bayesian factor model	29 indicators; one joint factor	1	0.5931	0.5931	0.5931
Simple Denton benchmarks	Constant indicator	3	0.8503	1.6127	2.3302
Component reconstruction	Level components; Litterman; 1929-1963	6	1.0388	1.0558	1.0777

RMSE in percentage points for the same 64 concealed quarterly changes, with growth defined as $100\Delta \log Q$. Best and worst are the lowest and highest specification RMSEs within each method; mean is their arithmetic average. Methods originate in the studies discussed in Section 3; results use the specifications estimated with this paper's data. Appendix B reports every specification.

The close scores support the shared production relationship, with only a modest further gain from changing its allocation rule. Denton improves RMSE by 0.0086 percentage points while preserving the preliminary log-IP relationship. This supports the production-regression approach of Balke and Gordon (1986), with a modest gain from the allocation used by Ramey and Zubairy (2018). It does not validate the precise quarterly profiles of either published series.

More detailed indicators and more flexible relationships do not improve on the best-performing reconstruction in this sample. Principal-component regression performs best with three activity-panel components and Chow–Lin residuals, at 0.5882 percentage points, about 10% below the best broad-panel error but above the leading production regression. A changing IP response likewise fails to

improve on the leading constant-response specifications. Across its twelve specifications, production regression with Denton allocation has mean RMSE 0.6108. Even the best simple benchmark, which uses annual GDP alone, has RMSE 0.8503. The fitted reconstruction, which also uses retained BEA quarters, predicts better than these annual-only allocation benchmarks; the comparison does not isolate coefficient estimation from the additional quarterly information.

Expenditure detail also carries estimation and measurement demands. The best component reconstruction has RMSE 1.0388 percentage points despite its targeted indicators and annual component accounts. It estimates more relationships and requires component prices and separate inventory treatment. The result concerns this reconstruction from 1929. It does not identify which estimation or measurement requirement causes the higher error, nor rule out better implementations of the approach of Gordon and Krenn (2010).

4.4 A second diagnostic: annual growth before normalisation

Annual fit tests a different aspect of reconstruction from quarterly prediction. Before annual normalisation, the preliminary paths show how much annual output the indicators explain; after normalisation, agreement is imposed. Table 5 compares eighteen annual log growth rates over 1929–1946, with 1928 supplying the first denominator. Coefficients may use annual GDP, but the evaluated predictions exclude normalisation and GDP state updates. Appendix E gives the construction.

The diagnostic covers 52 aggregate specifications. The six component specifications are excluded because annual inventory and deflator information remains embedded in their preliminary paths. They still enter the common quarterly test, where annual accounts are deliberately available.

Table 5: Annual growth fit before normalisation, 1929–1946

Method	Best specification	Count	Best	Mean	Worst
Production regression with Denton allocation	Log IP; Chow–Lin; changing response	12	5.25	5.70	6.42
Production regression	Log IP; Chow–Lin; changing response	12	5.25	5.70	6.42
Principal-component regression	3 components from 15 activity indicators; Chow–Lin	24	4.68	5.95	7.06
Joint Bayesian factor model	29 indicators; one joint factor	1	5.92	5.92	5.92
Simple Denton benchmarks	IP	3	9.70	11.83	15.63
Component reconstruction	Excluded	0	–	–	–

RMSE in percentage points across eighteen annual log growth observations. Best, mean and worst summarise eligible specifications within each method. These annual fit diagnostics use indicator-only predictions at fitted coefficients, before annual normalisation. Annual GDP can inform the coefficients. Production regressions with and without Denton share raw predictions. Six component specifications are excluded because annual deflators and inventory values enter their raw paths.

Annual fit and quarterly timing favour different specifications. The best-performing quarterly reconstruction has raw annual-growth RMSE 5.94 percentage points. Annual fit instead favours activity-panel principal-component regression with three components and Chow–Lin residuals; within production regression it favours log IP with a changing response and Chow–Lin residuals. Substantial discrepancies remain before reconciliation. Because paired production regressions share raw predictions, annual fit cannot distinguish their allocation rules. Quarterly prediction therefore remains the criterion for choosing a quarterly history.

5 Historical implications of the reconstructions

Within the central half of specifications, the estimated Great Depression decline is less sensitive to reconstruction choices than the 1937–1938 decline. The Depression's interquartile range is narrow relative to its depth. The 1937–1938 contraction varies more, yet the specifications favoured by prediction consistently make it milder than Balke and Gordon (1986) and Ramey and Zubairy (2018). All contraction depths below use a peak followed by a trough within the stated episode; demobilisation is measured only through the 1946 sample boundary.

5.1 Contraction depths across methods

Interquartile ranges show that reconstruction sensitivity differs across episodes. The interquartile range is 30.9–31.6% for the Depression and 6.6–7.8% for 1937–1938 (Table 6). Dispersion is greater for 1937–1938 both in percentage points and relative to contraction depth. These ranges summarise equally weighted specifications; they are not confidence intervals or probabilities assigned to methods.

The full ranges are much wider: 28.7–41.3% for the Depression and 4.8–16.4% for 1937–1938. Simple allocation benchmarks determine the latter extremes. Direct allocation with IP gives a 15.3% decline; IP multiplied by PPI gives 16.4%; the constant-indicator benchmark supplies the lower bound. None estimates GDP's response to its indicator. Among the 55 specifications that do, the 1937–1938 range narrows to 6.1–8.4%. For demobilisation, the full range is 15.7–28.5% and the interquartile range is 16.2–16.6%. The prediction criterion identifies the best-performing specifications within the comparison.

Published histories provide a distinct comparison at the same annual GDP. Each is rescaled within each year while preserving its relative quarterly levels.[10] Figure 2 places them alongside the catalogue. Table 6 reports each method's lowest-RMSE specification as well as the ranges.

[10] For published P_{yr}, the comparison is $P^*_{yr} = P_{yr} A_y / (\frac{1}{4} \sum_j P_{yj})$. This can change growth at year boundaries and does not recover original raw predictions. GDP/GNP and source-content differences remain. Published versions are preserved: these are comparisons between reconstructions, not against observed prewar quarterly GDP.

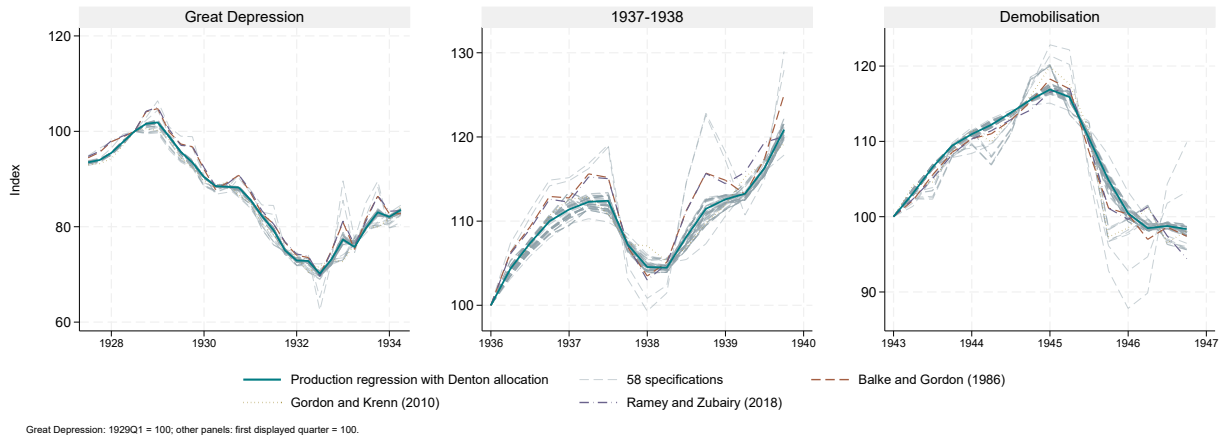


Figure 2: GDP paths across models in three historical episodes. Thin dashed lines show 58 specifications. The solid line is production regression with Denton allocation; comparison lines use the published Balke and Gordon (1986), Gordon and Krenn (2010) and Ramey and Zubairy (2018) series at common annual GDP. Paths are indexed to 100 in 1929Q1 for the Great Depression and in the first displayed quarter for the other episodes.

Table 6: Contraction depths across reconstruction methods

Method (best specification)	RMSE	1929–1933	1937–1938	1944–1946
Production regression with Denton allocation	0.5633	31.14	7.07	15.86
Production regression	0.5719	31.36	7.07	16.03
Principal-component regression	0.5882	31.10	6.66	16.29
Joint Bayesian factor model	0.5931	31.13	6.60	16.16
Simple Denton benchmarks	0.8503	28.66	4.78	16.18
Component reconstruction	1.0388	30.61	6.43	20.15
Range across all 58 specifications	–	28.66–41.28	4.78–16.40	15.73–28.50
Interquartile range across specifications	–	30.87–31.60	6.60–7.80	16.15–16.56

Method rows use the lowest-quarterly-RMSE specifications identified in Table 4. Declines are the largest chronological peak-to-subsequent-trough fall within each episode, in per cent; RMSE is in percentage points. The final two rows report the full range and the empirical 25th–75th percentile range across equally weighted specifications, not confidence intervals. Demobilisation ends at the 1946 sample boundary.

The best-performing specifications agree on a milder 1937–1938 contraction, although their ranking uses only postwar prediction errors. Every method's lowest-RMSE specification implies a smaller decline than Balke and Gordon (1986) and Ramey and Zubairy (2018) at common annual GDP. The common criterion is concealed postwar growth, not the historical magnitude under comparison.

5.2 Historical implications of the best-performing reconstruction

The best-performing reconstruction implies milder 1937–1938 and demobilisation declines than the widely used Balke and Gordon (1986) and Ramey and Zubairy (2018) histories. At common annual GDP, its 1937–1938 decline is 7.07%, compared with 10.50% and 10.62%, respectively (Table 7). It

is close to the 6.77% estimate of Gordon and Krenn (2010).[11][12] Its peak is 1937Q3 and its trough 1938Q2.

Table 7: Historical properties of the best-performing reconstruction and published series

Series	1929–1933	1937–1938	1944–1946	Volatility	Persistence
Production regression with Denton allocation	31.14	7.07	15.86	2.60	0.64
Balke and Gordon (1986)	33.25	10.50	18.00	3.62	0.24
Gordon and Krenn (2010)	29.98	6.77	19.50	3.31	0.45
Ramey and Zubairy (2018)	33.75	10.62	19.31	3.42	0.33

All paths use common annual real GDP. Contraction depths are percentage declines within 1929–1933, 1937–1938 and 1944–1946. Growth volatility is the standard deviation of 111 non-annualised quarterly log changes in 1919–1946, in percentage points; persistence is the lag-one growth correlation. Statistics are calculated separately from each point prediction.

The Depression remains severe, whereas the scale of demobilisation is more sensitive to expenditure disaggregation. The best-performing reconstruction gives a 31.14% Depression decline from 1929Q3 to 1933Q1, between Gordon and Krenn (2010) and the deeper Balke and Gordon (1986) and Ramey and Zubairy (2018) estimates. Its 15.86% demobilisation decline is smaller than in all three published series. This runs from 1945Q1 to 1946Q4 and ends at the sample boundary, rather than at a confirmed trough. Component reconstruction implies a larger decline, so the estimated scale of demobilisation remains sensitive to the method. That scale matters for interpreting the small postwar rise in unemployment studied by Fujita et al. (2024).

Lower reconstructed volatility is not, by itself, evidence of greater economic stability. The best-performing path has a quarterly growth standard deviation of 2.60 percentage points and a lag-one correlation of 0.64. The series of Balke and Gordon (1986), Gordon and Krenn (2010) and Ramey and Zubairy (2018) have standard deviations of 3.62, 3.31 and 3.42, and correlations of 0.24, 0.45 and 0.33. Yet the best-performing reconstruction also smooths observed GDP in every concealed period (Table 14). Smoothing is a property of the reconstruction as well as a difference between historical series.

5.3 Broad recession episodes survive; some quarterly dates differ

The broad sequence of recessions is more stable than their exact quarterly dates. The best-performing reconstruction matches all six NBER recessions without an additional contraction. One turning-point rule is applied to every GDP path: two quarters on each side of a local extremum, alternating peaks and troughs, phases of at least two quarters and cycles of at least five quarters. Figure 3 and Table 8 report the comparison; Appendix F defines matching and boundary treatment.

[11] These are adaptations rather than exact replications. For 1919–1946, Balke and Gordon (1986, p. 809) use Chow–Lin interpolation of annual GNP, with Persons through 1930 linked to the 1976 revision of Federal Reserve IP and benchmark detrending. Here, Federal Reserve IP enters a log production regression estimated over 1919–1963 with Litterman residuals, followed by Denton allocation. Ramey and Zubairy (2018, pp. 894–895) apply Denton to published Balke and Gordon (1986) output before 1939 and nominal GNP deflated by CPI in 1939–1946; here the preliminary path comes from the estimated production regression. Common annual GDP removes differences in annual totals while preserving each published series' relative quarterly profile.

[12] The smaller 1937–1938 decline relative to Balke and Gordon (1986) and Ramey and Zubairy (2018) also holds at the published series' original annual totals. The best-performing reconstruction's lower volatility and higher persistence likewise hold before placing the published series on common annual GDP.

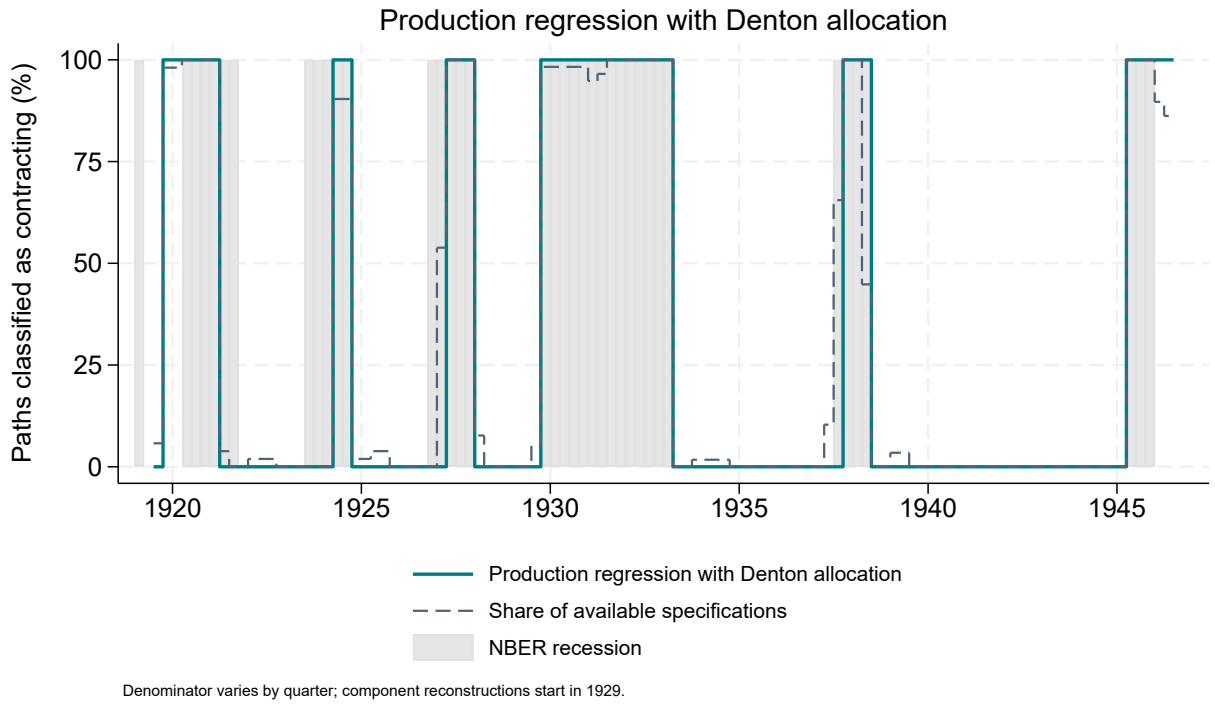


Figure 3: Recession classification across reconstruction methods. The dashed line gives the share of available specifications classifying each quarter as contracting. The solid line gives the classification from production regression with Denton allocation; shading denotes NBER recessions. Denominators vary with coverage; component reconstruction begins in 1929.

Table 8: GDP-based dating and the NBER chronology

Series	Matched	Additional	Agreement (%)	Date error
Production regression with Denton allocation	6	0	88.9	0.91
Balke and Gordon (1986)	6	3	84.3	1.50
Gordon and Krenn (2010)	6	1	88.9	0.83
Ramey and Zubairy (2018)	6	1	84.3	1.82

The same dating rule is applied to all point predictions. Matched episodes share at least one contraction quarter; additional episodes have no NBER match. Calendar agreement uses 108 quarters with complete dating windows. Date error is the mean absolute distance between matched GDP and NBER turning points, in quarters. Initial and final incomplete phases are censored.

The matched episodes differ in timing and duration. The best-performing reconstruction dates the first contraction from 1919Q3 to 1921Q1, both two quarters before NBER's 1920Q1–1921Q3 dates. The two-quarter dating window makes 1919Q3 the earliest admissible peak, which qualifies interpretation near the sample boundary. The 1923–1924 peak falls in 1924Q1, three quarters after NBER's 1923Q2; the 1926–1927 peak falls in 1927Q1, two quarters after NBER's 1926Q3. Their troughs coincide with NBER in 1924Q3 and 1927Q4, respectively, shortening both reconstructed contractions. The 1929Q3 Depression peak and 1933Q1 trough match NBER.

The best-performing reconstruction agrees with NBER's recession classification in 88.9% of the 108 quarters with complete dating windows. Under the same rule, the series of Balke and Gordon (1986) generates three additional contractions; those of Gordon and Krenn (2010) and Ramey and Zubairy (2018) generate one each. NBER provides complementary activity evidence, not observed quarterly GDP, and its wider information set overlaps some reconstruction indicators.[13]

Across the catalogue, recession classification is uniform in 74 of 108 quarters. At least one specification differs in the remaining 34. Each quarter uses the specifications with adequate coverage and dating windows; component histories are unavailable before 1929. These counts locate methodological disagreement without assigning a probability to any chronology or equal credibility to all specifications.

6 Within-model uncertainty

The best-performing specification remains subject to uncertainty in its estimated GDP–indicator relationship. Varying the coefficients shows whether its historical conclusions survive that uncertainty, separately from the reconstruction choices examined above. Each of 10000 joint coefficient draws produces a complete GDP history; the 0.5th and 99.5th percentiles define central 99% coefficient intervals.

The experiment holds annual accounts, indicators, retained BEA quarters, the specification, dynamics and innovation variances fixed. It therefore measures conditional coefficient precision, excluding additional quarterly GDP innovations, model selection, source revisions and historical instability beyond the specification. The intervals are not prediction intervals for unobserved GDP. Appendix J uses the Bayesian model to show how retaining uncertainty about missing paths changes the interpretation.

6.1 Repeating the reconstruction at coefficient draws

Joint coefficient draws propagate estimation uncertainty through the entire reconstruction. Let $\theta = (\alpha, \delta, \beta)'$ collect the intercept, trend and log-IP response in equation (2). Draw

$$\theta^{(s)} \sim N(\widehat{\theta}, \widehat{\Sigma}_\theta), \qquad p_q^{(s)} = \exp(x_q' \theta^{(s)}), \quad s = 1, \ldots, 10{,}000, \tag{5}$$

where $x_q = (1, t_q, \log IP_q)'$ and $\widehat{\Sigma}_\theta$ is the full generalised-least-squares covariance. Joint draws retain coefficient correlations. Normality approximates coefficient estimation uncertainty, not the

[13] The present Business Cycle Dating Committee began in 1978. It considers several indicators without fixed weights, and quarterly turns need not follow by rounding monthly dates. Sources: NBER, *Business cycle dating procedure: Frequently asked questions*, https://www.nber.org/research/business-cycle-dating/business-cycle-dating-procedure-frequently-asked-questions; NBER, *US business cycle expansions and contractions*, updated 14 March 2023, https://www.nber.org/research/data/us-business-cycle-expansions-and-contractions. Both accessed 8 September 2026. Current procedures should not be projected onto every historical date. Romer (1994) shows why changes in historical dating criteria matter.

distribution of GDP. Propagating joint parameter draws into quantities of interest follows the general simulation approach of King et al. (2000); the Denton mapping is specific to this reconstruction.

Each coefficient vector changes the preliminary path; equation (3) is then solved again under the same accounting constraints. The experiment thus measures how coefficient variation changes the completed history, rather than attaching coefficient bands to a fixed allocation.

Annual accounting absorbs coefficient changes that only rescale the preliminary path. Pure intercept variation is exactly offset by proportional Denton; variation in the trend or IP response can change relative quarterly movements. Repeating the allocation is therefore essential to measuring uncertainty in the completed GDP path. Denton is a deterministic mapping. Narrow coefficient intervals indicate precision conditional on this mapping and its accounting restrictions.

The released point prediction remains the reconstruction at $\widehat{\theta}$. Its quarterly standard error is the standard deviation across $Q_q^{(s)}$; the point prediction need not equal their mean. Appendix A gives the covariance, initial conditions and numerical checks. Concealed-quarter errors contain variation excluded from coefficient-only intervals, so their empirical coverage is not used to calibrate these intervals.

6.2 Contraction depths and recession dating

The milder 1937–1938 contraction survives coefficient uncertainty in the best-performing reconstruction. Its 99% interval is 6.34–7.96%, including the 6.77% estimate of Gordon and Krenn (2010) and lying below the approximately 10.5–10.6% declines in Balke and Gordon (1986) and Ramey and Zubairy (2018) (Table 9). Figure 4 shows the corresponding GDP paths. Comparisons with published point series remain descriptive because their corresponding uncertainty distributions are unavailable.

Each statistic is calculated within a complete GDP history before its distribution is summarised. This preserves quarterly dependence and annual accounting: a contraction is a peak followed by a trough in the same history, not a difference between unrelated pointwise bounds. Since extrema and ratios are nonlinear, the decline in the best-performing point prediction need not equal the average decline across histories.

Table 9: Contraction depths and 99% coefficient intervals for the best-performing reconstruction

Episode	Point estimate	99% coefficient interval
Great Depression	31.14	30.38–31.89
1937-1938	7.07	6.34–7.96
Demobilisation	15.86	15.84–16.38

Percentage peak-to-subsequent-trough declines, calculated within each complete history. Intervals use joint coefficient draws and repeated Denton allocation, holding data, dynamics and innovation variances fixed. Demobilisation ends at the sample boundary.

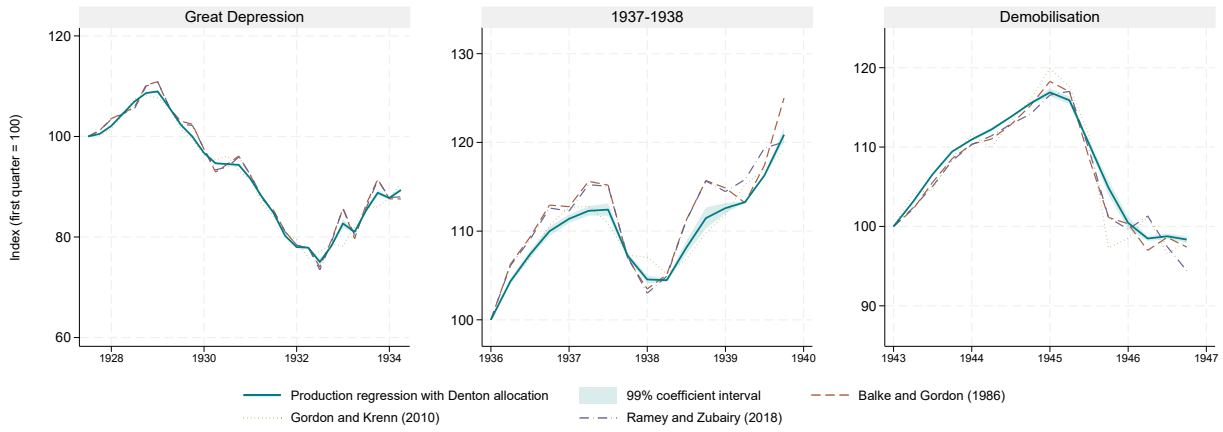


Figure 4: Coefficient uncertainty in the best-performing historical GDP paths. Bands are pointwise 99% coefficient intervals. Each history is indexed to 100 in its own first displayed quarter; the bands therefore measure uncertainty in cumulative GDP movements. Published comparison series use common annual GDP.

The Depression's peak and trough remain unchanged across coefficient draws. All histories retain the 1929Q3 peak and 1933Q1 trough. The 1937–1938 trough is less precise: 80.6% of histories date it in 1938Q2 and the remainder in 1938Q1. Demobilisation remains subject to the 1946 endpoint.



Figure 5: Recession dating under coefficient uncertainty in the best-performing reconstruction. The dashed line gives the share of coefficient histories classifying each quarter as contracting. The solid line is the best-performing point chronology; shading denotes NBER recessions.

Coefficient draws disagree over recession classification in 3 of 108 quarters, compared with 34 across specifications. These counts record any disagreement, irrespective of frequency, and do not decompose a common probability distribution. The 99% coefficient interval for growth volatility also lies below the three published point estimates (Appendix I). This establishes stability to coefficient estimation, not the accuracy of reconstructed volatility.

7 Robustness of model choice and historical conclusions

The milder 1937–1938 contraction survives changes that sometimes alter the best-performing method. The checks vary the estimation period, component information and factor specification set, then repeat model selection on common concealed quarters. This tests the historical conclusion against changes in research assumptions, beyond coefficient variation within one fitted model.

7.1 Alternative assumptions

The main threats are unstable GDP relationships and sensitivity to the information available for selection. A nested comparison also separates ranking from assessment, because the main prediction scores perform both roles.

Restricting the estimation period assesses sensitivity to wartime observations and the historical stability of GDP relationships. One restriction excludes 1942–1946; another uses 1947–1963 only. Each restriction covers indicator means and scales, the IP detrending regression, principal-component weights, regression and factor coefficients, and disturbance parameters. Those fitted quantities are then applied to the full 1919–1963 indicator history, with historical annual GDP retained. The restriction changes the years used to estimate the model, while retaining the full reconstruction period.[14]

A third alternative omits federal spending from the government-component predictor set, retaining annual government output, the trend and residual model. It tests whether this imperfect cash-spending proxy improves quarterly timing. An expanded factor comparison tests additional specifications defined in Appendix C. All use the same concealed scoring periods.

Under each assumption, models are ranked on the same concealed-quarter growth observations. Historical statistics then use the best-performing specification under that assumption. Compatible production-regression alternatives also receive separate coefficient simulations. Numerical non-convergence remains distinct from nonpositive GDP predictions.

The production-regression result survives most, but not all, changes in estimation assumptions. Production regression with Denton allocation remains best after excluding 1942–1946, omitting the federal-spending predictor and expanding the factor candidates (Table 10). Postwar-only estimation instead favours the one-factor model, at RMSE 0.5418 percentage points. All primary specifications are admissible. One specification excluding wartime years and fifteen postwar-only specifications produce nonpositive historical GDP or expenditure components; they are economically inadmissible, not numerical non-convergence. All retained estimates pass their numerical requirements.

[14] Annual component prices remain declared construction inputs. The restriction concerns fitted relationships rather than withholding all historical annual information.

Table 10: Repeat model selection under alternative assumptions

Assumption	Usable/attempted	Lowest-RMSE specification	RMSE
Main comparison	58/58	Log IP; Litterman; Denton	0.5633
Exclude 1942–1946 from estimation	57/58	Log IP; Litterman; Denton	0.5627
Estimate on 1947–1963 only	43/58	29 indicators; one joint factor	0.5418
Omit federal-spending indicator	58/58	Log IP; Litterman; Denton	0.5633
Expand factor alternatives	62/62	Log IP; Litterman; Denton	0.5633

Under each assumption, models are re-estimated and ranked on the same 64 concealed quarterly growth changes. The usable count includes economically admissible, numerically resolved specifications. Table 25 records every attempt and its status.

Production regression with Denton allocation usually remains best when model selection and assessment use separate observations. The nested diagnostic reserves one outer period for assessment and uses the other three for inner model selection. Production regression with Denton allocation wins in three outer periods; activity-panel principal-component regression with three components and Litterman residuals wins for 1959–1963. Pooled outer RMSE is 0.647 percentage points. Inner fits have only eight or nine years of BEA quarters, so this assesses selection with less information than the final reconstruction.

The historical conclusion is more stable than the model ranking. The winners under the alternative assumptions imply 1937–1938 declines of 7.07–7.58% (Table 11). Their Depression declines span 31.14–31.72%, and demobilisation declines span 15.86–16.27%. The supplementary Bayesian comparisons also support the milder 1937–1938 contraction while allowing greater uncertainty in quarterly timing (Appendices C and J).

Table 11: Historical contractions after repeating model selection

Assumption	1929–1933	1937–1938	1944–1946	Volatility	NBER (%)
Main comparison	31.14	7.07	15.86	3.03	95.6
Exclude 1942–1946 from estimation	31.21	7.14	15.86	3.05	95.6
Estimate on 1947–1963 only	31.72	7.58	16.27	3.19	95.6
Omit federal-spending indicator	31.14	7.07	15.86	3.03	95.6
Expand factor alternatives	31.14	7.07	15.86	3.03	95.6

Percentage declines in each scenario's central quarterly path, using the same episode windows and chronological peak-to-trough definition. Volatility is the standard deviation of quarterly log growth in percentage points; NBER reports quarterly calendar agreement. Both use the common 1929–1946 window, whereas Table 7 uses 1919–1946. Annual GDP remains fixed. Demobilisation is subject to the 1946 endpoint. Variation between rows describes sensitivity to assumptions.

Table 12: Coefficient uncertainty under alternative assumptions

Specification	1929–1933	1937–1938	1944–1946
Production regression with Denton allocation	31.14 [30.38–31.89]	7.07 [6.34–7.96]	15.86 [15.84–16.38]
Same method, excluding 1942–1946	31.21 [30.47–31.95]	7.14 [6.42–8.02]	15.86 [15.84–16.42]
Production regression with residual allocation	31.36 [30.61–32.10]	7.07 [6.46–8.06]	16.03 [15.97–16.09]

Each cell gives the point estimate of the episode's peak-to-trough decline in per cent, followed by its 99% coefficient interval in brackets. Each production-regression reconstruction is repeated at joint coefficient draws. The production regression following Balke and Gordon (1986) retains its own residual-based allocation. Annual GDP, indicators and each fitted residual law remain fixed.

The milder 1937–1938 result also survives coefficient variation under alternative production specifications. The 99% intervals remain below the Balke and Gordon (1986) and Ramey and Zubairy (2018) point declines after excluding wartime estimation years or retaining residual-based allocation (Table 12). The conclusion therefore does not depend solely on Denton allocation or wartime observations. Appendix H reports all specifications and their eligibility.

8 The data release and extensions

The release combines one best-performing reconstruction with separate across-specification ranges and coefficient intervals. Extensions provide earlier quarters, nominal GDP and monthly timing, subject to the limits of their data and calibration.

8.1 The best-performing reconstruction and its uncertainty

The main series is real quarterly GDP for 1919–1946 from production regression with Denton allocation, evaluated at fitted coefficients. Separate files provide coefficient standard deviations and central 99% intervals for levels and growth. The reproduction also generates complete coefficient histories. Growth and historical statistics are computed within each history before summarising uncertainty, preserving the dependence and accounting constraints used in the analysis.

Interquartile ranges describe heterogeneity across the primary specifications. Each quarter's GDP levels, quarter-on-quarter growth and four-quarter growth have separate 25th and 75th percentiles, calculated directly from the available paths with equal weights per specification. Counts accompany each measure because component reconstruction begins in 1929 and growth requires earlier observations. The endpoints are not confidence bounds or coherent alternative GDP histories; growth percentiles are not calculated from changes in the level endpoints. Episode declines are likewise calculated within each complete reconstruction before taking their quantiles.

The main prediction test does not validate the additional periods or frequencies covered by the extensions. Earlier real quarters have their own calibration and coefficient intervals; nominal and monthly series are point estimates (Table 13). Supplementary Bayesian paths retain separate coefficient and full-posterior measures, providing an additional uncertainty comparison.

Table 13: Coverage of the released predictions

Output	Coverage	Construction
Real quarterly GDP	1919Q1–1946Q4	Production regression with Denton allocation; separate coefficient intervals and across-specification interquartile ranges
Nominal quarterly GDP	1919Q1–1946Q4	Separate nominal relationships
Earlier real quarters	1909Q1–1918Q4	Separate annual-only calibration of the best-performing specification using Persons; coefficient intervals
Real monthly GDP	Jan 1909–Jun 2010	Denton allocation; Stock–Watson shape from 1959
Nominal monthly GDP	Jan 1919–Dec 1963	Denton allocation with IP multiplied by PPI

Production regression with Denton allocation supplies the best-performing series. Bayesian comparisons are supplementary. Real quarterly predictions have coefficient intervals; across-specification ranges cover 1919–1946. Early intervals condition additionally on the estimated annual GDP trend. Nominal and monthly series are point estimates. Quarterly estimates match annual accounts, and monthly estimates match their quarterly anchors. Interquartile endpoints do not separately preserve annual GDP.

8.2 Nominal GDP and the earlier quarterly extension

Nominal GDP uses a separately estimated PPI deflator equation alongside the production regression. These point estimates do not enter real-GDP model selection. Separate real and nominal fits also do not define joint uncertainty for an implicit deflator. Appendix I shows nominal predictions across the catalogue.

The 1909–1918 extension adapts the best-performing specification to the Persons activity index, with a separate early calibration. The constant-response log regression uses Litterman residuals and Denton allocation. It relates detrended annual real GDP to Persons and restores the log-linear annual GDP trend before allocation. Main-period coefficients and a 1919 quarterly observation do not constrain this fit. The supplementary early factor reconstruction uses the ten-indicator panel (Appendix C). Ten annual benchmarks limit identification, and the postwar prediction test does not validate early timing (Section G.3.3).

Early coefficient intervals quantify uncertainty in this separately estimated relationship. The calculation draws 10,000 joint coefficient vectors from the fitted normal approximation, restores the annual GDP trend and applies Denton allocation to each history. The 99% intervals hold the estimated annual GDP trend, annual accounts, Persons observations and fitted residual parameters fixed. Early residual persistence reaches the lower search bound of -0.85; the intervals condition on that estimate. They exclude uncertainty in trend estimation and changes in Persons' composition, as well as unobserved quarterly disturbances. Their nominal coverage is not established for this small calibration sample.

8.3 Monthly allocation

Monthly estimates provide finer timing for applications, conditional on the quarterly predictions. Proportional Denton allocates each model's quarterly levels using monthly Persons activity before 1919 and IP thereafter for real GDP. Nominal allocations use IP multiplied by PPI from 1919. Monthly annual-rate levels average exactly to their quarterly anchors. After 1946, monthly allocation uses BEA quarterly GDP. From January 1959 the real monthly series follows Stock–Watson

monthly GDP, rebenchmarked to common quarterly GDP, through June 2010 (Stock & Watson, 2010). The nominal monthly series ends in 1963. Stock–Watson is itself estimated, so the link extends an estimated monthly history without providing observed monthly GDP against which to test it. Quarterly validation does not establish the precision of within-quarter timing.

9 Conclusion

Annual GDP does not uniquely determine the quarterly business cycle. Comparing 58 specifications shows that the central range of estimated Great Depression declines is narrow, while 1937–1938 is more sensitive to reconstruction choices. The interquartile ranges are 30.9–31.6% and 6.6–7.8%, respectively. Simple allocation benchmarks widen both full ranges. Historical robustness is therefore a property of a particular conclusion, not of a GDP series as a whole.

Concealed-quarter prediction provides an empirical basis for choosing among quarterly histories. Concealed postwar quarters favour the production-regression approach of Balke and Gordon (1986), with a modest further gain from the Denton allocation used by Ramey and Zubairy (2018). The best-performing combination implies a 7.07% decline in 1937–1938, below Balke and Gordon (1986) and Ramey and Zubairy (2018) and close to Gordon and Krenn (2010). Coefficient uncertainty and alternative estimation assumptions preserve that comparison, even when the best-performing method changes.

The same evidence limits stronger claims about timing and stability. All six NBER recessions have matching episodes, but some quarterly dates differ. Lower reconstructed volatility and higher persistence also appear when the methods recover concealed observed GDP.

The released series, across-specification interquartile ranges and separate coefficient intervals allow applications to distinguish a point estimate from conclusions that survive alternative reconstructions. Supplementary Bayesian comparisons show why coefficient precision should not be mistaken for certainty about the missing GDP path.

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Appendix

A Simulating coefficient uncertainty

The coefficient covariance determines how uncertainty in the estimated GDP–IP relationship enters the reconstruction. For the production regression with Denton allocation in Section 6, generalised least squares estimates the intercept, trend and log-IP coefficient from annual GDP in 1919–1946 and all 68 BEA quarterly levels in 1947–1963. Annual equations redundant with four observed quarters are removed. The 96 retained equations comprise 28 annual and 68 quarterly observations, with 93 residual degrees of freedom after estimating three coefficients. The fitted coefficients determine the released prediction; their covariance determines the simulation distribution.

Let H map quarterly log output into the retained observation equations, X contain quarterly regressors and y contain observed GDP. The annual log equations use the approximation described in Section 3. Let $V(\widehat{\rho})$ be the quarterly residual covariance shape under fitted Litterman persistence, and let $W = HV(\widehat{\rho})H'$. With n linearly independent observation equations and k regression coefficients, the estimated covariance is

$$\widehat{\Sigma}_\theta = s^2 \left(X'H'W^{-1}HX \right)^{-1}, \tag{6}$$

$$s^2 = \frac{(y - HX\widehat{\theta})'W^{-1}(y - HX\widehat{\theta})}{n - k}. \tag{7}$$

Joint coefficient draws preserve the estimated dependence between the intercept, trend and IP response. Predictor centring and scaling are retained from estimation, and the full covariance matrix is transformed consistently with those regressors. The residual degrees-of-freedom adjustment treats fitted persistence as fixed.

In the natural units of equation (2), the fitted coefficients and standard errors are:

Coefficient	Estimate	Standard error
Intercept	6.312192	0.049593
Time trend (years)	0.022764	0.009726
Log industrial production	0.281716	0.030140

The time trend starts at zero in 1919Q1 and increases by one quarter of a year per observation. Fitted Litterman persistence is $\widehat{\rho} = 0.678531$. The covariance, ordered as intercept, trend and log IP, is

$$\widehat{\Sigma}_\theta = 10^{-4} \begin{pmatrix} 24.594760 & 0.512743 & -13.838480 \\ 0.512743 & 0.945995 & -0.382029 \\ -13.838480 & -0.382029 & 9.084093 \end{pmatrix}.$$

Each joint coefficient draw generates a complete GDP history. Choose a matrix L with $LL' = \widehat{\Sigma}_\theta$. For each of 10000 draws, generate $z^{(b)} \sim N(0, I_k)$ and set

$$\theta^{(b)} = \widehat{\theta} + Lz^{(b)}, \qquad p^{(b)} = \exp(X\theta^{(b)}), \qquad Q^{(b)} = \mathcal{D}(p^{(b)}; C, b), \tag{8}$$

where $\mathcal{D}$ is the complete proportional Denton solution in equation (3). The same coefficient vector governs every quarter of that history. Annual GDP and the reconciled BEA anchors remain fixed.

The fitted residual scale informs $\widehat{\Sigma}_\theta$ but is not redrawn; neither are persistence or residual innovations. This is a multivariate normal approximation to coefficient estimation uncertainty, not a posterior distribution over unobserved quarterly shocks.

For every coefficient vector, the complete allocation in equation (3) is repeated:

$$Q^{(s)} = \arg\min_{Q:\, CQ=b} \sum_{q=2}^{T} \left(\frac{Q_q}{p_q^{(s)}} - \frac{Q_{q-1}}{p_{q-1}^{(s)}} \right)^2 . \tag{9}$$

Annual accounting removes pure intercept variation from the completed path. Multiplying p by a positive constant multiplies the objective in equation (3) by a constant without changing its minimiser. Trend and IP-response variation can instead alter relative quarterly predictions and hence the constrained GDP path.

The simulated histories measure coefficient uncertainty while preserving the accounting restrictions. Quarterly standard errors are sample standard deviations across $Q_q^{(b)}$, and intervals use empirical quantiles. Every history preserves annual GDP and retained BEA quarters, apart from the common rounding reconciliation; its annual differences from the released prediction therefore sum to zero. Checks require finite, positive simulated levels. Any inadmissible draw is reported as a failure, without clipping or silent removal. Numerical simulation error is assessed separately from coefficient estimation uncertainty.

Each robustness calculation propagates coefficient uncertainty through its own reconstruction rule. The production regression following Balke and Gordon (1986) retains residual allocation: each coefficient vector changes the preliminary log path, and the fitted residual covariance allocates the discrepancy relative to the same observations. Exponentiated GDP is then reconciled to exact arithmetic annual means (Denton does not replace this allocation). Estimation-period robustness holds each scenario's transformation, persistence and scale fixed while drawing from its coefficient covariance. The factor coefficient experiment in Appendix D conditions on fitted dynamics and variances and integrates latent GDP before reporting coefficient intervals.

B Methods and complete specification results

The 58 real-GDP specifications link distinct reconstruction choices to a common quarterly prediction criterion. The equations below complete the methods in Section 3; the tables identify every specification and its prediction error. Tables are grouped by method. Nominal counterparts are separate outputs and add no specifications to this comparison.

B.1 Production regression and residual allocation

Production regression uses the residual covariance both to estimate the GDP–IP relationship and to allocate discrepancies relative to observed GDP. The regression relates output to IP and a trend. Generalised least squares uses linearly independent annual and retained quarterly observation equations. Let H collect those equations, X the quarterly regressors and V their residual covariance. The coefficient estimator and residual-adjusted path are

$$\widehat{\beta} = [X'H'(HVH')^{-1}HX]^{-1}X'H'(HVH')^{-1}y, \tag{10}$$

$$\widehat{Y} = X\widehat{\beta} + VH'(HVH')^{-1}(y - HX\widehat{\beta}). \tag{11}$$

Redundant annual equations are removed when all four quarterly observations are retained. For log-level specifications, annual coefficient equations approximate log annual output by average quarterly logs. The path is exponentiated and reconciled to arithmetic annual means; this does not remove the approximation used for coefficients.

The residual processes differ in how deviations from the fitted GDP relationship persist. Chow–Lin assumes $u_q = \rho u_{q-1} + \epsilon_q$, a mean-reverting residual. Fernández assumes $u_q = u_{q-1} + \epsilon_q$, so a shock has a permanent effect on the residual. Litterman assumes $u_q = u_{q-1} + v_q$ and $v_q = \rho v_{q-1} + \epsilon_q$, allowing persistence in changes of the residual. These assumptions change the covariance matrix while retaining the predictor set. The implementations use a stationary Chow–Lin residual, a zero initial Fernández residual, and a zero initial Litterman innovation state before accumulation. Initial conditions matter for temporal disaggregation (Proietti, 2005).

The paired Denton specifications isolate a change in final allocation while retaining the same preliminary prediction. Equation (3) uses the modified proportional first-difference form, commonly called Denton–Cholette, with a free initial GDP-to-indicator ratio. Three simple benchmarks instead use a constant, IP, or IP multiplied by PPI directly; their annual allocation does not receive quarterly GDP anchors.

Production regression allows GDP's response to IP to change with economic composition. Following the motivation in Romer (1989), the changing-response equation interacts time with detrended production:

$$y_q = \alpha + \delta\tau_q + (\beta + \gamma\tau_q)z_q + u_q. \tag{12}$$

Here y_q is GDP in levels or logarithms, z_q is IP in the corresponding form after removing a linear trend, and τ_q measures decades centred at the sample midpoint. The IP trend is estimated from IP alone in the permitted calibration years. The GDP trend and response coefficients are estimated jointly by generalised least squares. Setting $\gamma = 0$ gives the constant-response model under a change of basis. The interaction allows changing sensitivity to production fluctuations without freely adding a quadratic GDP trend. This adapts Romer's argument to quarterly IP; it does not replicate her annual commodity-output specification.

B.2 Component reconstruction

Component reconstruction matches timing indicators to expenditure categories before aggregating them into GDP. BEA annual expenditure accounts cover 1929–1963. Nine positive components are fitted in levels or logs using Chow–Lin, Fernández or Litterman residual dynamics; imports enter aggregate GDP negatively. Durable-manufactures production indicates durable consumption and equipment investment. Department-store sales indicate combined nondurable consumption and services. Private construction and public works contracts indicate residential and non-residential structures. Merchandise trade indicates exports and imports, and documented budget expenditures indicate government purchases. Intellectual-property investment uses its annual account, trend and residual process, without a monthly proxy. Signed inventory investment receives a separate smooth annual allocation.

All six component specifications enter the common quarterly evaluation, but their annual inputs preclude the separate raw annual-fit diagnostic. They reconstruct 1929–1946 and are evaluated on concealed quarters in 1947–1963. Final aggregate output is reconciled to annual GDP and retained BEA quarters. Annual deflators and interpolated annual inventory remain embedded in the raw paths, so these are not indicator-only annual predictions. The diagnostic exclusion reflects this information set.

B.3 Principal components and growth regression

Principal components summarise shared indicator movements without using GDP to choose their weights. For standardised quarterly indicator changes x_q, component j is $h_{jq} = w_j' x_q$, where w_j is an eigenvector of the sample covariance matrix. The regressions use the one, two or three largest-variance components from either the broad or activity panel in Table 2. Cumulated components enter log-level GDP regressions with a trend. Component growth itself enters direct growth regressions.

Direct growth regression estimates quarterly responses from retained quarterly growth and triangular annual-growth equations. With quarterly predictor growth d_q,

$$G_y = 4\alpha + \beta' \sum_{j=0}^{6} w_j d_{q_y - j} + e_y, \qquad \widehat{g}_q^{raw} = \widehat{\alpha} + \widehat{\beta}' d_q,$$

where $w = (\frac{1}{4}, \frac{1}{2}, \frac{3}{4}, 1, \frac{3}{4}, \frac{1}{2}, \frac{1}{4})$. A single scale puts cumulated raw levels in GDP units; Denton subsequently matches the final annual totals and retained quarterly levels. Appendix E derives the triangle and the arithmetic-aggregation distinction.

B.4 Business-cycle statistics in concealed periods

Reconstruction smooths observed quarterly movements, but does not uniformly reduce contraction depths. Production regression with Denton allocation and the joint Bayesian factor model both have lower growth volatility and higher persistence than BEA GDP in all four concealed periods (Table 14). Both produce larger declines in 1947–1950 and smaller declines in the other three periods. These diagnostics reuse the selection observations and are not an independent assessment after selection.

Table 14: Business-cycle statistics in concealed postwar periods

Concealed period	Observed BEA	Production regression with Denton allocation	Joint Bayesian factor model
Growth standard deviation (percentage points)			
1947–1950	1.56	1.37	1.33
1951–1954	1.18	1.00	1.03
1955–1958	1.26	1.06	1.03
1959–1963	0.95	0.81	0.70
Lag-one growth correlation			
1947–1950	0.44	0.75	0.72
1951–1954	0.49	0.50	0.56
1955–1958	0.31	0.51	0.55
1959–1963	0.05	0.15	0.35
Largest peak-to-subsequent-trough decline (per cent)			
1947–1950	1.71	2.00	2.02
1951–1954	2.54	2.30	2.29
1955–1958	3.60	2.80	2.75
1959–1963	1.33	0.56	0.37

Growth is $100\Delta \log Q$, without annualisation. Standard deviations use divisor n, as in the historical comparisons. The first three periods contain 15 growth observations and 14 adjacent-growth pairs each; the last contains 19 and 18. Declines use the largest percentage fall from a peak to a later trough within the period, allowing dates to differ across paths. BEA observations are the original scoring targets. The best-performing production specification and the one-factor Bayesian specification are held fixed across the four comparisons. These diagnostics reuse the selection observations; they provide neither an independent assessment after selection nor a correction for prewar GDP.

B.5 Individual specification results

Every primary specification produces admissible output and receives a quarterly score, including those with large errors. All use the common concealment periods and pass the positive-output requirement. Component reconstruction begins in 1929. Appendix H separately records nonpositive extrapolations under restricted estimation.

Production regression with Denton allocation

Industrial production enters in levels or logarithms, with a constant or linearly changing response. Each combination uses one of three residual processes before Denton allocation.

Table 15.1: Production regression with Denton allocation: complete specification results.

No.	Specification	Quarterly rank	Quarterly RMSE	Annual RMSE
1	IP in levels; Chow–Lin	23	0.6300	5.68
2	IP in levels; Chow–Lin; changing response	19	0.6239	5.40
3	Log IP; Chow–Lin	5	0.5759	5.32
4	Log IP; Chow–Lin; changing response	38	0.6914	5.25
5	IP in levels; Fernández	18	0.6104	5.94
6	IP in levels; Fernández; changing response	17	0.6083	5.69
7	Log IP; Fernández	3	0.5728	5.37
8	Log IP; Fernández; changing response	35	0.6873	5.29
9	IP in levels; Litterman	7	0.5849	6.42
10	IP in levels; Litterman; changing response	8	0.5871	5.97
11	Log IP; Litterman	1	0.5633	5.94
12	Log IP; Litterman; changing response	13	0.5944	6.11

Production regression

The twelve industrial-production regressions combine levels or logarithms, constant or changing responses, and three residual processes. Their fitted residual covariance allocates annual discrepancies.

Table 15.2: Production regression: complete specification results.

No.	Specification	Quarterly rank	Quarterly RMSE	Annual RMSE
13	IP in levels; Chow–Lin	24	0.6347	5.68
14	IP in levels; Chow–Lin; changing response	21	0.6282	5.40
15	Log IP; Chow–Lin	6	0.5773	5.32
16	Log IP; Chow–Lin; changing response	39	0.6919	5.25
17	IP in levels; Fernández	22	0.6284	5.94
18	IP in levels; Fernández; changing response	20	0.6252	5.69
19	Log IP; Fernández	4	0.5741	5.37
20	Log IP; Fernández; changing response	36	0.6877	5.29
21	IP in levels; Litterman	14	0.5955	6.42
22	IP in levels; Litterman; changing response	15	0.5975	5.97
23	Log IP; Litterman	2	0.5719	5.94
24	Log IP; Litterman; changing response	16	0.6016	6.11

Principal-component regression

The broad (29 indicators) and activity (15 indicators) panels each supply one, two or three principal components. Four estimators are applied to each combination, giving 24 specifications.

Table 15.3: Principal-component regression: complete specification results.

No.	Specification	Quarterly rank	Quarterly RMSE	Annual RMSE
25	1 component from 29 indicators; Chow–Lin	28	0.6548	6.27
26	1 component from 29 indicators; Fernández	29	0.6551	6.30
27	1 component from 29 indicators; Litterman	37	0.6897	6.73
28	1 component from 29 indicators; annual-growth equation	27	0.6546	6.30
29	2 components from 29 indicators; Chow–Lin	32	0.6765	6.11
30	2 components from 29 indicators; Fernández	30	0.6741	6.17
31	2 components from 29 indicators; Litterman	40	0.6936	6.67
32	2 components from 29 indicators; annual-growth equation	31	0.6743	6.17
33	3 components from 29 indicators; Chow–Lin	44	0.8010	5.93
34	3 components from 29 indicators; Fernández	45	0.8063	5.99
35	3 components from 29 indicators; Litterman	42	0.7227	7.06
36	3 components from 29 indicators; annual-growth equation	46	0.8066	5.99
37	1 component from 15 activity indicators; Chow–Lin	41	0.6975	5.72
38	1 component from 15 activity indicators; Fernández	34	0.6829	5.79
39	1 component from 15 activity indicators; Litterman	25	0.6409	6.61
40	1 component from 15 activity indicators; annual-growth equation	33	0.6823	5.79
41	2 components from 15 activity indicators; Chow–Lin	48	0.8642	5.58
42	2 components from 15 activity indicators; Fernández	49	0.8648	5.63
43	2 components from 15 activity indicators; Litterman	43	0.7323	6.68
44	2 components from 15 activity indicators; annual-growth equation	50	0.8653	5.63
45	3 components from 15 activity indicators; Chow–Lin	9	0.5882	4.68
46	3 components from 15 activity indicators; Fernández	11	0.5892	4.78
47	3 components from 15 activity indicators; Litterman	26	0.6429	5.50
48	3 components from 15 activity indicators; annual-growth equation	10	0.5890	4.78

Joint Bayesian factor model

A single latent factor is estimated jointly with quarterly GDP, using the 29-indicator panel.

Table 15.4: Joint Bayesian factor model: complete specification results.

No.	Specification	Quarterly rank	Quarterly RMSE	Annual RMSE
49	29 indicators; one joint factor	12	0.5931	5.92

Simple Denton benchmarks

These benchmarks allocate annual GDP directly, without an estimated production regression.

Table 15.5: Simple Denton benchmarks: complete specification results.

No.	Specification	Quarterly rank	Quarterly RMSE	Annual RMSE
50	Constant indicator	47	0.8503	10.17
51	IP	57	1.6578	9.70
52	IP multiplied by PPI	58	2.3302	15.63

Component reconstruction

The six designs combine level or log component equations with three residual specifications. Their indicator-only annual diagnostic is excluded because observed annual component information enters the reconstruction.

Table 15.6: Component reconstruction: complete specification results.

No.	Specification	Quarterly rank	Quarterly RMSE	Annual RMSE
53	Level components; Chow–Lin; 1929-1963	52	1.0514	–
54	Log components; Chow–Lin; 1929-1963	53	1.0526	–
55	Level components; Fernández; 1929-1963	55	1.0577	–
56	Log components; Fernández; 1929-1963	56	1.0777	–
57	Level components; Litterman; 1929-1963	51	1.0388	–
58	Log components; Litterman; 1929-1963	54	1.0564	–

C Joint factor candidates and restricted estimation

The joint factor model estimates shared activity, its relationship with GDP and missing quarterly output together under annual accounting constraints. It draws on historical activity-factor methods and Bayesian mixed-frequency GDP estimation (Koop et al., 2023; Ritschl et al., 2016). Ritschl et al. (2016) estimate a historical activity index; Koop et al. (2023) reconstruct monthly GDP with a Bayesian mixed-frequency vector autoregression.

GDP can depart from the common activity signal. This differs from first estimating principal components without GDP and then fitting a GDP regression. For standardised quarterly indicator changes x_{iq}, factor f_q and GDP growth $g_q = 100\Delta \log Q_q$,

$$x_{iq} = \lambda_i f_q + e_{iq}, \qquad e_{iq} = \rho_i e_{i,q-1} + \epsilon_{iq}, \tag{13}$$

$$f_q = \phi f_{q-1} + \eta_q, \tag{14}$$

$$g_q = \mu + \beta f_q + u_q, \qquad u_q = \rho_u u_{q-1} + \nu_q. \tag{15}$$

Gaussian innovations are independent across equations and time; residuals remain serially dependent through their first-order dynamics. Positive quantity, nominal-value and price indicators enter as log differences; interest rates and the corporate yield spread enter as percentage-point differences. Unit factor innovation variance identifies scale and a positive IP loading identifies sign. Initial factors and residuals have stationary Gaussian distributions.

The main specification has one factor and 29 indicators. It uses 1919–1963 for indicator standardisation, parameter estimation and quarterly reconstruction, matching the conventional candidates. The broader factor sensitivity adds two factors, weaker coefficient priors, a separate prewar GDP loading and a separate wartime GDP residual variance. In the two-factor model, IP loads positively on factor one with a zero loading on factor two; manufacturing employment identifies factor two's sign.

Priors regularise the factor loadings, GDP relationship and dynamics. Main loadings have independent $N(0, 1.5^2)$ priors. The GDP intercept and loadings have $N(0, 2^2)$ priors. Indicator, factor and GDP autoregressive parameters have zero-centred normal priors with standard deviations 0.30, 0.50 and 0.35, truncated to $(-0.95, 0.95)$ for indicator and GDP residuals and $(-0.98, 0.98)$ for factors. The additional prewar GDP loading has a $N(0, 0.5^2)$ prior. Innovation variances have inverse-gamma priors with shape 2.5 and scale 1. Weaker-prior candidates change the stated coefficient scales. These regularising assumptions apply to factor candidates; production-regression coefficient intervals use the estimated covariance in Appendix A.

The parameterisation preserves annual GDP exactly while allowing quarterly shares to vary. It uses three log ratios within each unknown year, $z_{yr} = \log(Q_{yr}/Q_{y4})$, with $z_{y4} = 0$:

$$Q_{yr} = 4A_y \frac{\exp(z_{yr})}{\sum_{j=1}^{4} \exp(z_{yj})}.$$

The GDP likelihood is evaluated on the resulting complete path. Retained BEA quarters are fixed; concealed quarters are unknown from initialisation onward. Joint Gaussian proposals for log ratios receive a Metropolis–Hastings correction for the exact nonlinear likelihood. Independently initialised chains are checked for split-chain agreement and effective sample sizes; retained results require $\widehat{R} < 1.01$ and effective sample size above 400 for monitored parameters and latent GDP. Numerical convergence is separate from reconstruction accuracy.

Restricted estimation prevents omitted years from influencing estimated relationships while retaining them in the reconstructed history. Indicator means and scales and model parameters are fitted only on allowed year segments, with stationary restarts across omitted periods. Full-history inference then conditions on 1919–1963 indicators and annual accounts at those parameter draws; excluded estimation years cannot update parameters. The factor model uses 1919–1941 and 1947–1963 for the no-war exercise, and 1947–1963 for the postwar-only exercise.

Numerical checks control the approximation used to infer the full history under those restrictions. Integrating Gaussian factors yields a GDP-growth likelihood; conditional share proposals are corrected for the nonlinear accounting transformation. For each retained parameter draw, importance

sampling uses at least 64 conditional proposals and increases that number if fewer than 32 are effective. Comparing the full and first-half proposal sets must change conditional mean growth by less than 0.03 percentage points; otherwise the calculation is repeated with more proposals. Conditional paths also receive the nonlinear likelihood correction. These are numerical approximations with checked error, not independent exact draws.

C.1 Prediction accuracy and historical comparisons

Allowing two factors improves quarterly prediction without surpassing the best-performing production reconstruction. The one-factor model ranks 12 among the 58 primary specifications, with quarterly growth RMSE 0.5931 percentage points and raw annual-growth RMSE 5.92. The two-factor model has RMSE 0.5736 and ranks fourth in the expanded catalogue. Weaker priors and a separate prewar GDP loading make smaller changes to prediction errors. The one-factor specification from the primary catalogue supplies the supplementary uncertainty calculations, although it is not the most accurate factor specification considered.

The factor point path also implies a milder 1937–1938 contraction (Table 16). Its decline is 6.60%, compared with 7.07% in the best-performing series and 10.50–10.62% in Balke and Gordon (1986) and Ramey and Zubairy (2018) at common annual GDP. Its peak and trough, 1937Q2 and 1938Q1, precede the production reconstruction by one quarter. Both imply Depression declines near 31% from 1929Q3 to 1933Q1 and demobilisation declines near 16% through 1946Q4. Both are smoother and more persistent than the published histories, including at their original annual totals.

Table 16: Historical properties including the Bayesian comparison

Series	1929–1933	1937–1938	1944–1946	Volatility	Persistence
Production regression with Denton allocation	31.14	7.07	15.86	2.60	0.64
Joint Bayesian factor model	31.13	6.60	16.16	2.49	0.76
Balke and Gordon (1986)	33.25	10.50	18.00	3.62	0.24
Gordon and Krenn (2010)	29.98	6.77	19.50	3.31	0.45
Ramey and Zubairy (2018)	33.75	10.62	19.31	3.42	0.33

All paths use common annual real GDP. Contraction depths are percentage declines within the stated episode windows. Volatility is the standard deviation of 111 non-annualised quarterly log changes in 1919–1946; persistence is their lag-one correlation. The factor point path is the posterior mean of GDP levels.

Table 17: GDP-based dating including the Bayesian comparison

Series	Matched	Additional	Agreement (%)	Date error
Production regression with Denton allocation	6	0	88.9	0.91
Joint Bayesian factor model	5	0	88.9	0.56
Balke and Gordon (1986)	6	3	84.3	1.50
Gordon and Krenn (2010)	6	1	88.9	0.83
Ramey and Zubairy (2018)	6	1	84.3	1.82

The common dating rule, episode matching and boundary treatment are defined in Appendix F. Calendar agreement uses 108 quarters; date error is the mean absolute distance between matched GDP and NBER turning points, in quarters.

The Bayesian chronology's unmatched first episode reflects boundary censoring, rather than the absence of a downturn. It matches five NBER episodes rather than the best-performing reconstruction's six (Table 17). Its initial path contracts continuously from the 1919 sample boundary through 1921Q1. Without an identified initial peak, this phase is left-censored and the 1920–1921 episode is excluded from matching. Both point paths agree with NBER's quarterly classification in 88.9% of the evaluated quarters and generate no additional episodes.

C.2 Supplementary nominal and early reconstructions

The nominal and early factor reconstructions estimate separate GDP relationships. The nominal reconstruction estimates a nominal-GDP equation in the same specification; it is a point comparison and does not define joint uncertainty for an implicit deflator. The early model estimates loadings from ten indicators and detrended annual real GDP over 1909–1918. It neither transfers main-period coefficients nor imposes a 1919 quarterly observation. All early posterior diagnostics pass, but ten annual benchmarks provide limited calibration information and postwar prediction cannot validate early timing. This supplementary posterior is distinct from the coefficient intervals for the early production regression.

D Coefficient uncertainty in the joint factor model

The factor coefficient experiment measures how estimated relationships affect a conditional mean GDP history. With p indicators, let b contain the p indicator loadings, the GDP intercept and its factor response. Let ψ contain $p+2$ persistence parameters and $p+1$ innovation variances. Holding ψ at the full-posterior means $\widehat{\psi}$, the experiment draws

$$b^{(s)} \sim p(b \mid D, \widehat{\psi}), \qquad m_q^{(s)} = E[Q_q \mid D, b^{(s)}, \widehat{\psi}], \tag{16}$$

where D contains the indicators, annual accounts and retained BEA quarters. Latent activity and GDP are integrated out in levels before calculating growth, contraction depths or dates. This excludes variation of missing GDP around its coefficient-specific mean. The economic target is comparable to the production coefficient experiment, although one uses a conditional Bayesian posterior and the other an approximate normal coefficient distribution.

D.1 Simulation and numerical checks

The conditional experiment varies estimated relationships while fixing the dynamics and variance parameters. With p indicators, the full fit jointly estimates $3p + 5$ parameters and unobserved GDP; its GDP-level posterior mean supplies the Bayesian comparison. Equation (16) instead varies p indicator loadings and two GDP coefficients, fixing $p + 2$ persistence parameters and $p + 1$ innovation variances at their full-posterior means. Factor innovation variance remains one, and the normal loading and GDP-coefficient priors in Appendix C remain unchanged. Unobserved GDP is integrated out before measuring coefficient uncertainty.

At fixed residual dynamics, each coefficient block has a Gaussian conditional distribution. Whiten its response and regressors using the fixed residual persistence: $\widetilde{y}_q = y_q - \rho y_{q-1}$, with stationary first observation $\sqrt{1-\rho^2}\, y_1$, and the same transformation for X. For prior $b \sim N(0, D_0)$ and innovation covariance Σ,

$$V_b = (\widetilde{X}'\Sigma^{-1}\widetilde{X} + D_0^{-1})^{-1}, \qquad m_b = V_b \widetilde{X}'\Sigma^{-1}\widetilde{y}.$$

Conditional on the latent states, $b \sim N(m_b, V_b)$. The GDP intercept and factor response are updated jointly, and indicator loadings one at a time, as factor and GDP states change. Retained vectors preserve posterior dependence among all $p + 2$ coefficients. Four independently initialised chains discard 1,000 warm-up iterations each and retain 2,500 vectors each.

Numerical integration estimates a conditional mean GDP history for each coefficient vector. Each vector yields $E[Q_q \mid D, b, \widehat{\psi}]$, with Gaussian factors integrated analytically. Quarterly GDP uses the 84 annual log-ratio coordinates for the 28 historical years in Appendix C. Integration averages GDP levels with exact nonlinear likelihood weights, using 4,096 common scrambled, antithetic Sobol integration points per vector and analytical control variates. The points estimate a mean; their dispersion does not enter the coefficient intervals.

A high-precision anchor reduces the common numerical offset in the estimated mean histories. Let $I_N(b)$ denote that numerical mean and b_0 the conditional coefficient-posterior mean. The correction is

$$\widehat{m}(b) = I_N(b) - I_N(b_0) + I_{\text{high}}(b_0),$$

where the high-precision anchor uses 524,288 integration points. This corrects integration error, not differences from the supplementary full-posterior GDP mean. The conditional mean histories are not recentred on that point path.

Independent checks assess integration accuracy, chain convergence and accounting for the conditional-mean histories. Targeted coefficient vectors use two scrambled sets of 32,768 points. Release requires monitored coefficients and conditional-mean quantities to have $\widehat{R} < 1.01$ and effective sample size above 400; derived statistics and interval tails receive separate checks. Every mean path must remain positive and preserve annual means and retained BEA quarters.

All numerical requirements pass. The maximum coefficient-chain $\widehat{R}$ is 1.0026 and the minimum bulk effective sample size is 1495. Across 44 independently checked coefficient vectors, the largest quarterly growth integration error is 0.000395 percentage points, or 1.31% of its coefficient standard deviation; the largest level error is 2.85% of its coefficient standard deviation. The minimum importance effective sample size is 4,094 out of 4,096 proposals. The 10,000 conditional-mean histories are positive and preserve annual means and observed quarterly anchors to numerical precision. Derived historical statistics and interval tails also pass their separate convergence requirements.

D.2 Historical implications of coefficient uncertainty

The factor coefficient interval supports the milder 1937–1938 contraction (Table 18). Its central 99% range is 6.10–7.30%, compared with 6.34–7.96% for the best-performing reconstruction. Both include the estimate of Gordon and Krenn (2010) and lie below the Balke and Gordon (1986) and Ramey and Zubairy (2018) point declines at common annual GDP. The average factor GDP path across coefficient draws differs from its full-posterior point path by at most 0.028% in levels.

Table 18: Coefficient uncertainty in the best-performing and Bayesian reconstructions

	Production regression with Denton allocation		Joint Bayesian factor model	
Episode	Point	99% interval	Point	99% interval
Great Depression	31.14	30.38–31.89	31.13	30.43–31.83
1937-1938	7.07	6.34–7.96	6.60	6.10–7.30
Demobilisation	15.86	15.84–16.38	16.16	16.07–16.28

Percentage peak-to-subsequent-trough declines, calculated within each complete history before taking central 99% quantiles. Production histories repeat Denton allocation at joint coefficient draws. Factor histories average latent GDP in levels at joint coefficient draws. Data, dynamics and innovation variances remain fixed.

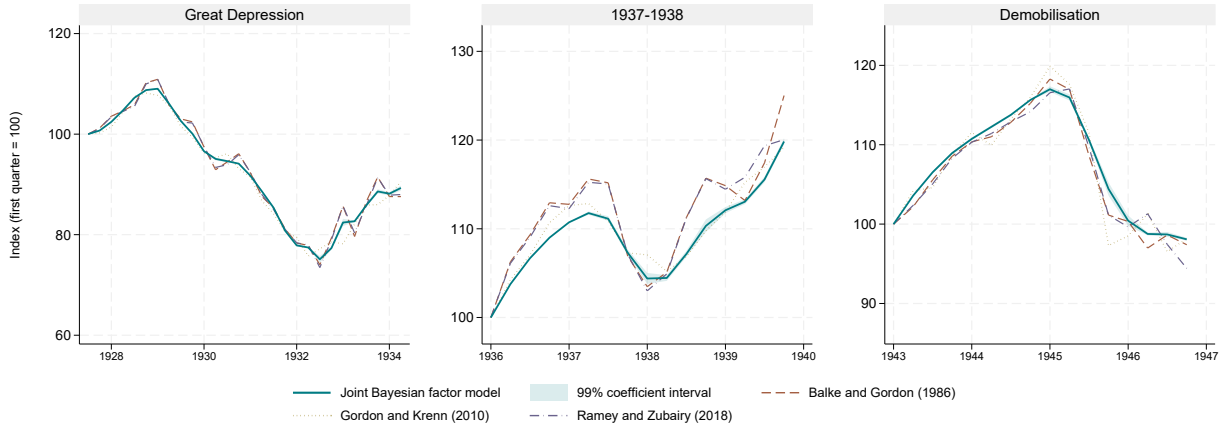


Figure 6: Coefficient uncertainty in the Bayesian historical GDP comparison. Bands are pointwise 99% intervals across conditional mean histories, each indexed to 100 in its first displayed quarter. Data, dynamics and innovation variances remain fixed.

Most turning points remain stable under factor coefficient variation. All histories retain the Depression trough in 1933Q1; the peak is 1929Q3 in 99.63% of histories and 1929Q2 otherwise. The 1937–1938 trough is 1938Q2 in 34.63% of histories and 1938Q1 otherwise. Recession classification differs across histories in 3 of 108 quarters, the same count as in the production coefficient experiment. These counts include rare alternatives and depend on the number of retained histories.

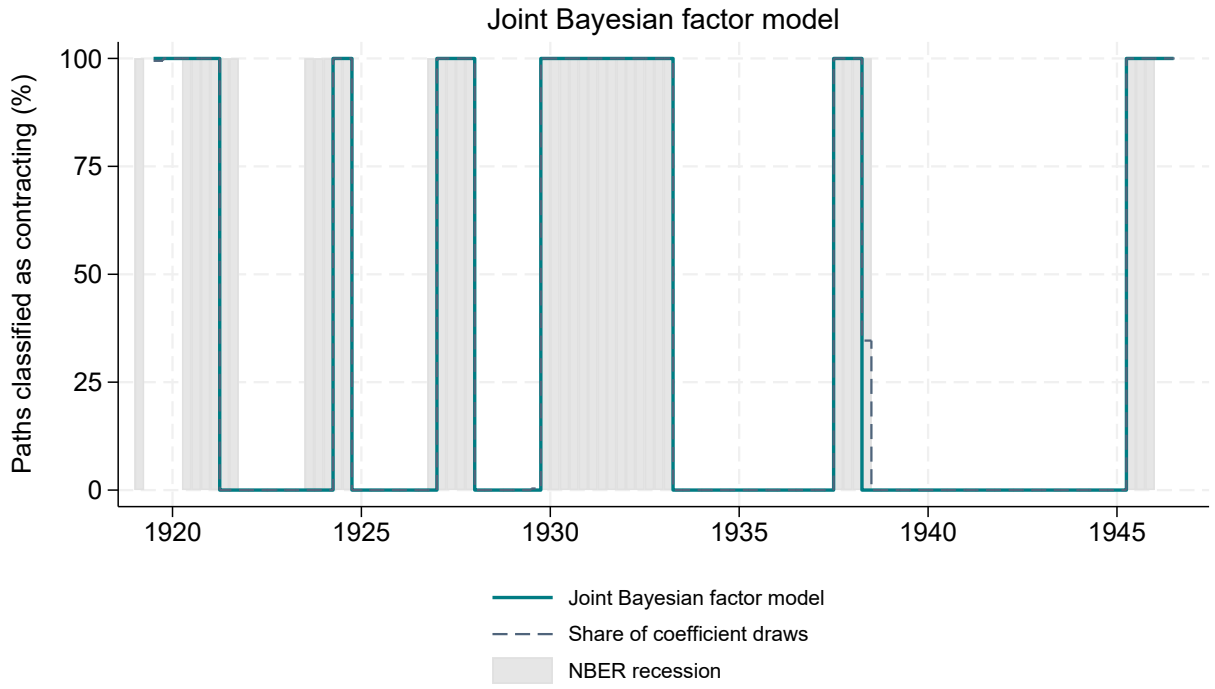


Figure 7: Recession dating under coefficient uncertainty in the Bayesian comparison. The dashed line gives contraction shares across conditional mean histories; the solid line gives the posterior-mean GDP chronology. Shading denotes NBER recessions.

E Annual aggregation and the raw-fit diagnostic

The triangular equation is exact for growth in average quarterly log GDP, but arithmetic annual GDP requires a correction. This distinction governs the annual relation used in Sections 3 and 4.4. Let $\ell_{yr} = \log Q_{yr}$, $g_{yr} = 100(\ell_{yr} - \ell_{yr-1})$, crossing year boundaries as needed, and $\bar{\ell}_y = \frac{1}{4}\sum_r \ell_{yr}$. Then

$$\begin{aligned} 100\Delta\bar{\ell}_y = {} & \tfrac{1}{4}g_{y-1,2} + \tfrac{1}{2}g_{y-1,3} + \tfrac{3}{4}g_{y-1,4} \\ & + g_{y,1} + \tfrac{3}{4}g_{y,2} + \tfrac{1}{2}g_{y,3} + \tfrac{1}{4}g_{y,4}. \end{aligned}$$

Earlier current-year changes affect more output levels; preceding-year changes create carry-over. Weights sum to four, so a quarterly intercept enters four times (Mariano & Murasawa, 2003; Tödter, 2010).

The relation is exact for changes in average log levels. Define

$$J_y = \log\left(\tfrac{1}{4}\sum_r e^{\ell_{yr}}\right) - \bar{\ell}_y.$$

Growth in arithmetic annual GDP equals the triangle plus $100\Delta J_y$. The correction depends on changes in within-year dispersion. Scoring therefore uses exact arithmetic annual means in equation (17), even when coefficient estimation uses the triangle.

Exact annual agreement cannot validate quarterly timing, because it is imposed by construction. The annual diagnostic instead asks how well the indicators explain historical annual growth before

reconciliation. In the linear analogy $A_y = \alpha + \beta \overline{X}_y + e_y$, the fitted relationship leaves an annual discrepancy; benchmarking distributes it across quarters. Inspecting that discrepancy measures the explanatory content of the preliminary relationship, not the accuracy of its within-year allocation.[15]

Annual GDP may inform coefficient estimation, but raw predictions at those coefficients exclude annual normalisation and GDP state updates. For factor methods this requires indicator-only inference and initialisation. The diagnostic uses eighteen annual growth observations over 1929–1946, with 1928 supplying the initial GDP level:

$$\widehat{A}_y^{raw} = \frac{1}{4} \sum_r \widehat{Q}_{yr}^{raw}, \qquad \widehat{G}_y^{raw} = 100 \log \left(\widehat{A}_y^{raw} / \widehat{A}_{y-1}^{raw} \right). \tag{17}$$

The annual diagnostic covers the 52 aggregate specifications. The six component specifications are excluded because observed annual inventory investment and annual component deflators enter their raw predictions directly. Removing final normalisation would therefore retain information from the annual accounts being assessed. All 58 specifications enter the quarterly comparison, where annual accounts are deliberately available.

F Business-cycle statistics and dating

Common statistical definitions isolate differences between GDP paths from differences in how business cycles are measured. The statistics in Section 5 apply identically to published reconstructions, model predictions and GDP paths from coefficient draws. For episode window W, chronological drawdown is

$$D_W(Q) = 100 \max \left\{ 0, \max_{p<t,\ p,t \in W} \left(1 - \frac{Q_t}{Q_p} \right) \right\}.$$

The maximising pair determines a peak and subsequent trough. Recovery is the first later quarter regaining that path's own peak. Windows are 1929–1933, 1937–1938 and 1944–1946; recovery is sought through 1946Q4. End-window troughs and unrecovered peaks remain censored.

Each contraction must be measured within a complete GDP history before summarising its uncertainty. $D_W(\widehat{Q})$ describes a given point estimate. Applying D_W to coefficient paths from production regression with Denton allocation measures coefficient uncertainty; applying it to the factor model's conditional mean histories measures its coefficient uncertainty. Because extrema and ratios are nonlinear, a contraction calculated from a mean GDP path need not equal the mean contraction across histories. Growth volatility and lag-one correlation are likewise computed within each path, over 111 quarterly growth observations.

The primary chronology uses local extrema with two quarters on each side. Peaks and troughs alternate, phases last at least two quarters and cycles at least five quarters. If consecutive extrema are both peaks or both troughs, the rule retains the more extreme value. This explicit rule is related to the classical dating literature (Harding & Pagan, 2002), not a replication of NBER judgement. Reference and reconstructed episodes are matched one-to-one by positive overlap. Missed and additional contractions are retained. Initial and final incomplete phases are censored; boundary quarters without a complete local window are excluded from calendar agreement. One- and three-quarter windows provide dating sensitivity without selecting a convention to maximise NBER agreement.

[15] In a consistently aggregated linear level regression, this discrepancy is the estimation residual. The diagnostic here uses annual growth in a historical subperiod, so its ranking need not match level RMSE or full-sample R^2. For nonlinear and state-space methods, removing a final proportional adjustment is insufficient if GDP has already updated intermediate predictions.

G Historical data sources and construction

G.1 GDP sources and published reconstructions

Table 19: Accounts and timing information in the principal studies

Study	Period covered	Annual GDP or GNP and indicators
Balke and Gordon (1986)	Quarterly GNP: 1875Q1–1983Q4 (109 years). Historical reconstruction: 1875Q1–1946Q4; official NIPA data thereafter. Annual GNP: 1869–1983.	Annual GNP; the Persons activity index linked to Federal Reserve IP; wholesale prices for the GNP deflator.
Gordon and Krenn (2010)	Monthly and quarterly reconstruction: 1919–1951 (33 years). Main reconstruction: 1919–1941; extension through 1951. BEA overlap: 1947–1951.	Nine expenditure components use annual accounts and monthly production, employment, retail, construction, trade and federal-spending indicators. Inventories are smoothed from annual accounts; components are aggregated at 1937 prices.
Ramey and Zubairy (2018)	Quarterly GDP: 1889Q1–2015Q4 (127 years). Historical reconstruction: 1889–1946; BEA quarterly GDP thereafter.	Balke and Gordon (1986) quarterly GNP before 1939; historical nominal GNP and CPI in 1939–1946; proportional Denton allocation to annual GDP; BEA quarterly GDP from 1947.

Periods refer to the reconstructed or released GDP/GNP series, rather than every estimation sample used in each study. The annual GNP series of Balke and Gordon (1986) begins before their quarterly GNP. Gordon and Krenn (2010) estimate the 1942–1951 extension separately from the 1919–1941 reconstruction. NIPA denotes the National Income and Product Accounts. Sources: Balke and Gordon (1986, pp. 781, 790, 809); Gordon and Krenn (2010, pp. 36–38); Ramey and Zubairy (2018, pp. 894–895).

Annual national accounts draw on broader evidence than the monthly indicators. BEA combines income and expenditure information from surveys, tax and business records and government accounts (Bureau of Economic Analysis, 2024; Marcuss & Kane, 2007). Quarterly source evidence is generally less comprehensive than annual evidence. The distinction matters for interpretation: fixing annual GDP does not remove historical measurement error, but separates uncertainty in quarterly allocation from uncertainty in the annual benchmark.[16]

Published reconstructions differ in accounting concepts, sources and coverage. The NBER tables for *The American Business Cycle* provide historical GNP, prices, money, rates and component information. Their quarterly table spans 1875–1983, but individual columns have shorter histories. Monthly manufacturing production, shipments and inventories cover 1929–1942. GNP and GDP differ, as do price bases, seasonal treatment and vintages.[17] The distributed workbook of Gordon and Krenn (2010) and the replication data of Ramey and Zubairy (2018) provide completed reconstructions as well as supporting information.[18] Reproducing the original studies requires their

[16] The commodity-output extrapolations criticised by Romer (1989) concern earlier historical estimates; her comparison uses standard Commerce GNP from 1929 (p. 17).

[17] Source: NBER, *Tables from The American Business Cycle*, `https://www.nber.org/research/data/tables-american-business-cycle`, accessed 15 October 2026.

[18] The NBER *American Business Cycle* tables include the quarterly file `abcq`. The workbook of Gordon and Krenn (2010), with *Read Me*, *Monthly Data* and *Quarterly Data* sheets, is available at `https://www.nber.org/data-appendix/w16380`. The `RZDAT.xlsx` file of Ramey and Zubairy (2018), sheet `rzdat`, is available through `https://econweb.ucsd.edu/~vramey/research.html`. Source pages accessed 15 October 2026.

accounts, indicator vintages and transformations. The distributed workbook of Gordon and Krenn (2010) is dated September 2009 and contains completed monthly components, whereas the paper cited here is revised February 2014. The dates alone do not establish correspondence between the workbook and that revision. The nominal GNP input of Ramey and Zubairy (2018) for 1939–1946 is seasonally adjusted; the unadjusted NBER series `q08260b` is not an interchangeable input. Removing the final Denton allocation from a published series does not remove annual information already embedded in its preliminary path.

Component reconstruction follows Gordon and Krenn (2010). It uses annual expenditure components, quantities and component prices, which are separate from the factor-model panel. The historical component tables cover 1919–1941 and 1947–1983; modern BEA annual components are available from 1929. Historical GNP components and modern GDP components differ in definition. The reconstruction uses the modern annual accounts and independently observed timing indicators. Monthly federal budget expenditures supply government-spending information, with the source reconciliation in Section G.3.2. They include transfers and interest, omit part of state and local activity and therefore remain a proxy for government purchases. A separate sensitivity exercise omits this indicator.

The timing indicators measure the activity most closely related to each expenditure category. Durable-manufactures production supplies timing for durable consumption and equipment investment; department-store sales supply timing for combined nondurable consumption and services. The latter is an indirect proxy for services. Private construction contracts and public works and utility contracts jointly inform construction investment, but are not added as expenditure quantities. Merchandise exports and imports are proxies for the corresponding goods-and-services accounts. Inventories use annual information.

Component reconstruction begins in 1929, when the modern BEA expenditure accounts provide the required categories. Intellectual-property investment uses its annual account, a trend and residual allocation without a monthly proxy; it is not assigned equipment growth. Nondurable consumption and services are combined using Fisher quantity links because their chain-type quantity indices are not additive. These accounting choices are separate from the monthly indicators that supply timing information.

Source construction respects the evaluation information set. Annual GDP and permitted indicators remain available, but concealed quarterly observations enter neither indicator construction nor fitting. This keeps the source preparation consistent with the conditional-reconstruction test in Section 4.

G.2 Indicator availability and source register

The source search separates missing coverage from deliberate limits on indicator detail. It covers aggregates, industry series and products in the NBER chapter catalogues and complementary official histories across production, labour, expenditure, goods movement, prices and finance. Annual agricultural output and shorter monthly agricultural and service histories do not provide a balanced set of monthly quantity indicators for 1919–1963. Tables 22 and 23 record coverage and source-quality restrictions. Among the remaining histories, Table 20 explains how broad measures and distinct economic roles determine the detail retained.[19]

Table 20: Economic rationale for the 29-indicator panel

Economic role	Indicators retained	Limit on further detail
Industrial output (2)	IP measures aggregate industrial activity; durable-manufactures production distinguishes durable consumption and investment goods.	Total manufacturing is an intermediate aggregate within IP. Retaining IP and its durable component limits overlapping aggregates; they do not algebraically recover total manufacturing.
Basic materials (4)	Pig iron and steel distinguish primary iron production and steelmaking. Lumber and stone, clay and glass distinguish construction-material industries.	Cement, oak flooring and individual capital goods such as freight-car shipments add finer product detail within these broad economic roles.
Labour (3)	Manufacturing employment measures jobs; payrolls reflect employment, hours and pay. Help-wanted advertising measures recruitment demand beyond manufacturing.	Weekly earnings further decomposes labour income. More occupation and industry series add detail to employment and earnings already represented.
Construction (2)	Private construction contracts and public works and utility contracts distinguish private building and infrastructure commitments.	Building types and alternative value or floor-space measures add subdivisions. The retained series overlap in privately owned utilities; they are predictors, not additive private and public expenditure categories.
Sales, transport and trade (4)	Department-store sales, freight carloadings, merchandise exports and merchandise imports distinguish retail demand, domestic goods movement and the two external flows.	The trade balance is determined by exports and imports. The shorter retail and transport histories listed in Table 22 fail the coverage or comparability checks.

[19]The Standard and Poor's production index and the AT&T and Axe–Houghton activity indices are not included in the main panel. Their available NBER online histories end in 1889, 1961 and 1930, respectively, and therefore do not provide complete monthly coverage over 1919–1963. NBER's printed catalogue lists longer histories, including an Axe–Houghton series without trend adjustment, but the additional observations are not supplied in its online database. AT&T and the trend-adjusted Axe–Houghton series both cover 1909–1918; the early extension uses Persons without comparing these alternatives. Sources: NBER, *Macrohistory Database*, individual series records; and *Catalog of business cycle series* (revised September 1967), https://www.nber.org/sites/default/files/2020-01/macrohis.pdf, accessed 22 October 2026.

Table 20: Economic rationale for the 29-indicator panel (continued)

Economic role	Indicators retained	Limit on further detail
Prices (7)	CPI and PPI anchor consumer and producer prices. Wholesale farm-product prices, prices received by farmers, wholesale food prices, retail food prices and wholesale prices excluding food/farm products distinguish sectors and stages.	Crop and meat-animal prices add agricultural subdivisions; individual commodity and manufactured-goods price indices add detail within the retained price groups. The seven indices distinguish farm-gate, wholesale and retail pricing.
Equity markets (2)	The stock price index measures valuation; NYSE shares traded measures trading activity.	Dow Jones prices add a narrower valuation index. Dividend yields add a payout dimension beyond the valuation and trading-activity roles retained here.
Long-term credit (2)	The AAA corporate yield measures private borrowing costs; the corporate yield spread measures the BAA–AAA risk premium.	The BAA yield is recovered from these two variables. Railway, utility and industrial yields add issuer detail. Municipal yields concern public financing rather than the private credit conditions represented here.
Short-term credit (2)	The bankers' acceptance and commercial-paper rates represent two private financing markets.	Additional private rates add contract detail; the Federal Reserve discount rate is an administered policy instrument. The commercial-paper history changes instrument and maturity, as documented below.
Money (1)	Broad money measures liquid balances held by the public.	Currency and deposits split the aggregate; alternative definitions add further monetary measures. Bank reserves, vault cash and gold measure monetary institutions or mechanisms beyond this public-liquidity role.

Numbers in parentheses indicate the number of indicators in each group. Selection limits the detail within stated economic roles; it does not establish that omitted series lack predictive information. Boivin and Ng (2006) motivate attention to indicator composition, not this particular panel size. Cement also requires attention to changes in territorial coverage, including Puerto Rico and Hawaii. The source documentation and observations for exclusions are preserved separately from estimation inputs.

The register identifies each selected source and distinguishes its full available history from the common sample. Dates below are the first and last nonmissing numerical observations in the preserved files. The main-window audit checks every month separately. A slash between NBER suffixes denotes source segments of one concept. BLS and Federal Reserve data use the FRED identifiers shown. All 29 selected variables have complete numerical support in 1919M1–1963M12 after the stated joins.

NBER's missing-value code, `1E-37`, is recoded as missing. Published seasonal adjustment is abbreviated SA; unadjusted or unlabelled source histories are marked U. The accompanying audit files retain source URLs, checksums and exact local paths.

Two additional inputs serve specific reconstruction methods. The Persons activity index supplies early activity information from NBER m12004a (January 1875-December 1915) and m12004b (January 1915-December 1919). Federal budget expenditures supply component-specific information from NBER m15005b-f (November 1914-December 1962 collectively), continued through 1963 with the matching Treasury budget subtotal. Sections G.3.2–G.3.3 document these qualifications; Table 21 lists the 29 indicators in the main factor-model panel.

Table 21: Sources for the factor-model panel

Indicator	Source identifier(s)	Numerical source history	Unit; seasonal status
Industrial production	INDPRO	1919M1–2026M7	Index; SA
Durable-manufactures production	m01234b	1919M1–1968M6	1957–1959=100; SA
Steel production	m01135a / m01135b	1899M1–1939M12 / 1932M1–1965M9	Thousand long tons/working day; thousand short tons/calendar day; U
Pig iron production	m01130a / m01130b	1877M1–1941M12 / 1941M1–1964M12	Thousand long/short tons per day; U
Lumber production	m02119a / m02119b	1919M1–1947M12 / 1947M1–1963M12	Different index bases; U, working-day adjusted
Stone, clay and glass production	m02158a / m02158b	1919M1–1947M12 / 1947M1–1963M12	Different index bases; U
Manufacturing employment	m08010b	1919M1–1969M3	Thousands of production workers; U
Manufacturing payrolls	m08069b	1919M1–1968M12	Nominal weekly payroll index; U
Help-wanted advertising	m08082a / m08082b	1919M1–1960M8 / 1951M1–1966M1	Different index bases; U
Private construction contracts	m02116f	1919M1–1963M12	Million current dollars; SA
Public works and utility contracts	m02111e	1919M1–1963M12	Million current dollars; SA
Department-store sales	m06002b	1919M1–1963M12	Nominal sales index; U
Freight carloadings	m03002	1918M1–1973M12	Thousands of cars per week; U
Merchandise exports	m07023	1866M7–1969M10	Million current dollars; U
Merchandise imports	m07028	1866M7–1969M10	Million current dollars; U
Consumer prices, all items	CPIAUCNS	1913M1–2026M7	1982–1984=100; U
Producer prices, all commodities	PPIACO	1913M1–2026M7	1982=100; U
Wholesale farm-product prices	m04058	1890M1–1967M1	1957–1959=100; U
Prices received by farmers	m04060a	1910M1–1967M1	1900–1914=100; U
Wholesale food prices	m04061	1890M1–1967M2	1957–1959=100; U
Retail food prices	m04071	1913M1–1968M2	1957–1959=100; U
Wholesale prices excl. food/farm products	m04193	1890M1–1970M12	1957–1959=100; U
Stock price index	m11025a / m11025b	1871M1–1956M12 / 1945M1–1968M12	Different index bases; U
NYSE shares traded	m11002	1875M1–1966M8	Millions of shares; U

Table 21: Sources for the factor-model panel (continued)

Indicator	Source identifier(s)	Numerical source history	Unit; seasonal status
Prime 90-day bankers' acceptance rate	m13007	1917M8–1965M12	Per cent; U
Commercial-paper rate	m13002	1857M1–1971M12	Per cent; U
AAA corporate yield	m13035	1919M1–1968M12	Per cent; U
Corporate yield spread	m13036 minus m13035	BAA: 1919M1–1968M5	Percentage points; U
Broad money	m14144a / m14144c	1907M5–1946M12 / 1947M1–1969M9	Billion dollars; SA

Sources: Federal Reserve, BLS and NBER, individual series documentation (footnote 7). Full histories are retained; the balanced panel covers 1919–1963. The modern endpoint refers to the preserved download, not the latest available release. NBER freight metadata advertise July 1974, but the preserved numeric history ends in December 1973. Wholesale farm-product price metadata advertise December 1967, but the last nonmissing value is January 1967. The stock price index lacks August-November 1914, outside the main sample.

G.3 Source reconciliation and quarterly preparation

G.3.1 Unit conversions and source joins

Physical unit conversions are distinguished from statistical links. A long ton equals 1.12 short tons. The early steel series is measured per working day, whereas the later series is measured per calendar day. The historical working-day convention subtracts Sundays, Independence Day and Christmas. Early steel is converted using the actual monthly calendar before combining it with the later history. Pig iron requires the ton conversion but not the working-day conversion. Later steel observations are used from January 1932 and later pig-iron observations from January 1941. Multiplying daily rates by calendar days produces monthly output totals.

Overlapping index histories are linked on a stated scale. For the stock price index, lumber production, stone, clay and glass production, and help-wanted advertising, the earlier index is multiplied by the geometric mean of the later-to-earlier ratio over all common main-sample months. Later observations then take precedence. The overlap is 1945–1956 for the stock price index, 1947 for the two materials indices, and January 1951-August 1960 for help-wanted advertising. This preserves source movements within each segment but cannot remove differences in weights or coverage. The reported intervals hold these links fixed and do not quantify sensitivity to alternative link dates.

The steel calendar convention is documented in the NBER historical series notes (series 01135, printed p. 613). Index-link diagnostics are saved in the accompanying Stata audit.

G.3.2 Published harmonisations and remaining measurement changes

The construction indicators use published harmonisations rather than a new splice of geographically inconsistent raw totals. NBER series m02111e and m02116f raise earlier contract values to a 48-state basis and apply seasonal adjustment. Their historical observations remain estimates of national coverage. Private construction also changes from a project-type classification to an ownership classification in 1932. NBER extends the ownership concept backwards using the earlier classification and a link based on the 1932 annual totals (which is an approximation). Both documentation files state that the originals were missing and had not been proofread. The reconstruction therefore conditions on these source estimates and documentation limitations. Private construction contracts

and public works and utility contracts overlap in privately owned utilities and are not additive expenditure components.

The raw residential and non-residential contract series are not equivalent substitutes for these harmonised histories. Their geographical coverage expands from 27 to 37 and then 48 states. The 1956 residential change also alters collection procedures; the source describes the earlier monthly values as unrevised, even where revised annual totals are listed. A single ratio cannot recover the omitted regional movements. Component reconstruction therefore uses the published harmonised construction indicators listed in Table 2.

Monetary and interest-rate histories preserve their economic roles while changing observation conventions. Broad money combines currency with adjusted demand and time deposits at commercial banks. Before 1947 it records the Wednesday nearest month-end; thereafter it uses monthly averages, including averages of semimonthly observations in 1947–1954. The segments share the same units and are joined without rescaling. The prime 90-day bankers' acceptance rate changes from averages of weekly quotations to daily quotations in 1951. The commercial-paper rate also changes in instrument maturity and quotation. The money timing break coincides with the start of quarterly GDP; its effect is not isolated by a separate omission of broad money. The AAA corporate yield and the corporate yield spread enter the panel; the BAA corporate yield does not enter separately.

Complete numerical coverage can include source estimates and changes in measurement. Help-wanted advertising links the Metropolitan Life and National Industrial Conference Board indices. The latter source estimates December 1962-March 1963 during the newspaper strike. Prices received by farmers include selected production payments during October 1943-June 1946. BLS's early all-item CPI is reconstructed retrospectively, while CPI excluding food relies heavily on interpolation and is excluded as an additional timing signal.[20] The number of NYSE shares traded is affected by share issuance and splits. Manufacturing employment and manufacturing payrolls cover production workers.

Trade and transport are indicators of goods movements with their own timing conventions. Exports exclude military grant-aid shipments from July 1950. Import coverage changes for small shipments and informal entries in the 1950s, while dock strikes affect shipment timing. Freight carloadings are monthly averages of weekly counts, with source-specific assignment of reporting weeks. Department-store sales cover a particular retail channel. These histories add information beyond factory output without providing complete expenditure or transport accounts.

The reconstructions condition on the selected indicator definitions, source joins and measurement conventions. Sensitivity to these choices is distinct from within-model uncertainty, which holds the supplied indicators fixed. A larger panel also adds factor-model loadings and indicator-specific parameters, so convergence and the limited estimation information remain relevant.

Federal budget expenditures require a documented chain of spending sources. The NBER segments cover November 1914-June 1933 (m15005b), January 1932-December 1938 (m15005c), July 1937-June 1940 (m15005d), July 1939-June 1947 (m15005e) and July 1945-December 1962 (m15005f). Later segments take precedence from their starting dates, following Gordon and Krenn (2010, p. 40); geometric mean overlap ratios rescale the earlier histories. Overlapping values differ, and rescaling cannot remove changes in definitions or vintages.[21]

[20] Sources: BLS, *Consumer Price Index: History*, https://www.bls.gov/opub/hom/cpi/history.htm; NBER, documentation for series m04052 (consumer prices excluding food), https://www.nber.org/databases/macrohistory/rectdata/04/docs/m04052.txt. Both accessed 15 October 2026.

[21] Source: NBER, *Macrohistory Database, Chapter XV: Government Finance*, https://www.nber.org/research/data/nber-macrohistory-xv-government-finance, series m15005b-f; accessed 15 October 2026.

The 1963 continuation uses the Treasury budget subtotal before interfund deductions, matching the convention in m15005f. Published monthly values enter directly in millions of current dollars, without a fitted scale factor. Six common months in 1962 provide a vintage-comparability check.[22] The broader federal cash-payments series m15033 has a different concept and is not used. Following Gordon and Krenn (2010, p. 40), December 1931, January 1934, June 1936 and June 1937 are replaced by the mean of their two unmodified neighbours after real deflation and Census X-11. Budget expenditure remains a timing proxy: it includes transfers and interest and omits parts of state and local purchases.

G.3.3 Aggregation, seasonal adjustment and transformations

Quarterly aggregation follows the economic unit of each series. Monthly trade, contract values, NYSE shares traded and physical output totals are summed. Price and production indices, employment, payroll indices, freight weekly rates, market yields and money observations are averaged over all three months. Steel and pig-iron daily rates are first converted to monthly tonnage. A quarterly value is accepted only when all required monthly observations are present. The result is a balanced quarterly factor-model panel.

Published seasonal adjustment is retained for total IP, durable-manufactures production, the two harmonised contract series and broad money. The remaining positive activity, price, turnover and help-wanted histories use a common multiplicative Census X-11 specification with a log transformation over 1919–1963. No ARIMA extension or automatic outlier correction is imposed. The stock price index and interest rates are kept in observed form. Shared indicators receive the same preparation across methods; seasonal adjustment uses no GDP observations.

Transformations distinguish quantities, nominal values, prices and interest rates. Positive activity, nominal-value, monetary and price variables enter growth-based factor specifications as log differences. Interest rates and the corporate yield spread enter as percentage-point differences, not logarithms. Standardisation is fitted on the permitted estimation observations and held fixed for each concealed-period prediction. Level-based reconstruction methods retain the corresponding levels. The differenced panel spans 1919Q2–1963Q4, giving 179 quarterly observations. Sales, construction contracts and trade enter in nominal terms, alongside price indicators.

Nine indicators from the main panel also have complete numerical coverage over the early extension. Steel production, pig iron production, merchandise exports, merchandise imports, broad money, the commercial-paper rate, wholesale farm-product prices, wholesale food prices and wholesale prices excluding food/farm products each have 120 monthly values in 1909–1918. NYSE shares traded also has 120 values, but its August-November 1914 values interpolate the exchange closure and are excluded from the early panel. The stock price index lacks those four months.

The Persons activity index is available throughout 1909–1918 and can supply cyclical timing information. NBER m12004a covers January 1875-December 1915 and m12004b January 1915-December 1919; together they provide all 120 months of the extension. Balke and Gordon (1986, p. 809) use Persons to interpolate detrended annual real GNP, then restore its trend. A level rescaling to IP would not reproduce this treatment. Their early regression uses 1875–1918. Its calibration depends on that longer estimation window; ten annual observations over 1909–1918 provide much less in-

[22] Source: United States Treasury Department, *Treasury Bulletin*, February 1963, August 1963 and February 1964, Table 3, printed p. 5; FRASER scans accessed 15 October 2026. June 1963 uses final net budget expenditure from February 1964, p. 1, plus interfund deductions from August 1963, p. 6. The reproduction includes transcriptions, source records and overlap checks; the scans are available at the FRASER URLs recorded in the source documentation.

formation about the GDP relationship. The trend and loading assumptions therefore matter for interpretation of the early extension.

Changes in the composition of the Persons activity index limit comparability over time. In 1905–1914, it combines pig iron, bank clearings outside New York, merchandise imports, railway earnings and employment. In 1915–1918, it combines seasonally adjusted deviations from linear trends in pig iron, cotton consumption, employment and freight ton-miles, with weights of 1, 1, 2 and 2 (Persons, 1931, pp. 131–132). The 1915 and 1919 changes are changes in measurement, not just index bases. Including Persons brings the early panel to ten indicators. Its overlap with pig iron and imports limits the independence of its information in factor models. Its changing coverage also makes the assumed trend and source joins consequential (Zarnowitz, 1992, p. 87); their sensitivity is not quantified by the early coefficient intervals. It lacks a comparable history through 1963 and is therefore absent from the main panel. Recession dating uses reconstructed GDP levels: dating deviations from trend answers a different question (Romer, 1994).

An earlier wholesale-price history could extend PPI before 1913. NBER m04048b covers January 1890-December 1914 and overlaps with the BLS series in 1913–1914. The ten-indicator early panel excludes this continuation because its change in definitions requires a separate linking assumption.

G.4 Excluded indicators

Table 22: Activity histories outside the balanced panel

Source or concept	Availability or source issue	Decision
Coal; electricity; cotton	Selected coal history ends December 1958; electric power January 1957; cotton consumption December 1961.	Excluded for insufficient comparable coverage. Electricity-plus-gas differs in scope from electricity.
Flour; corn grindings; slaughter	Flour ends April 1952; corn grindings May 1953; cattle February 1956, hogs January 1957, sheep/lambs August 1956.	Potential shorter-window agricultural or food-production checks; not a balanced set of quantity indicators for 1919–1963.
Crop production; fertiliser	Broad crop histories are annual; the cited fertiliser history spans 1922–1943.	Annual crops supply annual evidence only. Fertiliser lacks the main start and benchmark overlap.
Farm income and employment	Selected farm cash income: 1935–1949. Farm-employment history starts in 1940.	Insufficient common coverage; prices are not treated as substitute quantities.
Housing starts; construction put in place	Long annual histories exist, but the relevant monthly housing and expenditure histories begin in 1939.	Annual histories do not supply monthly timing. Contracts and materials provide earlier indicators.
ENR construction contracts	Selected history: 1913–1962.	The harmonised NBER contract histories preserve the full common sample.

Table 22: Activity histories outside the balanced panel (continued)

Source or concept	Availability or source issue	Decision
Durable employment; manufactured food	Durable employment ends September 1963; food-production history ends July 1956.	Complete manufacturing employment and durable-manufactures production supply the retained measures; no final-quarter extrapolation.
Mail-order sales; composite wage index	Mail-order sales: 1919–1944. Selected wage index: 1919-July 1946.	No modern quarterly GDP overlap in these histories.
Rail ton-miles; passenger-miles	Selected freight-ton-mile history ends August 1943 and has wartime gaps; passenger-miles end September 1956.	Freight carloadings provide a transport quantity indicator with complete coverage.
Railway revenue	Monthly through 1961; later file contains only February, May, August and November entries for 1962–1963.	Exclude from the balanced monthly panel; the later entries require a separate quarterly reporting interpretation.
Telephone; postal receipts; advertising	Telephone revenue ends 1961; postal receipts March 1942; magazine advertising July 1958, with a noncomparable 1948 change.	Insufficient comparable common coverage. These omissions limit direct service measurement.
Wage and salary disbursements	Distribution, services and government: monthly history begins in 1929.	An income proxy, not a direct service-output measure; insufficient coverage before 1929.

A continuation measuring a different concept would require an additional reconstruction assumption. Relevant NBER chapters are I-III, VI and VIII. Detailed individual IDs for the excluded series are given in Table 24.

Table 23: Exclusions based on source construction or comparability

Source or concept	Reason	Treatment
CPI excluding food (m04052)	Many early monthly values are interpolated between sparse priced dates; constructed from other price indices.	Exclude as additional independent timing information.
Bank debits (m12016a/b, m12017a/b)	March 1933 missing; account definitions change in 1943. Outside New York, the number of reporting centres also changes.	Excluded: interpolation would fill the bank-holiday month, while scaling would not harmonise the account populations.
Bank clearings (m12014)	Reporting cities expand substantially; no verified constant-population bridge.	Exclude from the common panel on comparability grounds.
Business failures (m09029a/b/c, m09033a/b/c)	Coverage changes in 1933 and 1939. Intermediate b segments can resolve the apparent late-1938 numerical gap.	Exclude because the underlying population changes; the 1938 gap is not an archive-wide absence.

Table 23: Exclusions based on source construction or comparability (continued)

Source or concept	Reason	Treatment
Manufacturing labour turnover	Early quit, layoff and accession rates are unweighted company medians and exclude seasonal industries. Coverage expands to all employees in 1943; total accessions and separations include within-firm transfers from 1959.	Excluded because weighting and worker coverage change across the sample.
Dividend payments	Early payments are adjusted to annual dividend estimates. Coverage of financial corporations changes in 1934; later series differ in seasonal treatment.	Excluded because the populations and adjustments differ across periods.
Ayres activity index (m12003)	Monthly index relative to trend, 1855–1970. A 1933 description identifies Federal Reserve industrial production as its basis at that date.	Excluded because earlier composition and trend adjustment remain uncertain.
Call-money rate (m13001)	Quotation changes in 1956; February 1963 records 45% rather than the surrounding 4.5%, requiring source verification.	The prime 90-day bankers' acceptance rate and the commercial-paper rate represent short-term financing; the anomalous observation is not corrected without source verification.
Government expenditure and debt	Budget expenditure ends in 1962; the cash-payments continuation changes scope and uses annual-rate units. Debt is a financing stock.	No general-government output proxy in the common panel. Cash spending requires separate component-specific treatment.
Treasury yields	Available histories change tax and callability characteristics.	Retain private borrowing costs and the corporate yield spread.
Paper; passenger-car production	Paper coverage expands to building paper; civilian vehicle production is interrupted during the war.	Exclude from the balanced panel because definitions and wartime shutdowns require separate treatment. A wartime shutdown is not a routine missing observation.
Published GDP/GNP reconstructions	Share annual-account constraints and combine underlying indicators.	Use for historical comparison, not as independent timing information. Persons enters the early extension under the separate conditions in Section G.3.3.

Published harmonisation can justify a source change, as for construction. The Ayres source is the Cleveland Trust Company *Business Bulletin*, 15 September 1933, reprinted in the *Commercial and Financial Chronicle*, 16 September 1933, p. 1996; https://fraser.stlouisfed.org/title/commercial-financial-chronicle-1339/september-16-1933-518570/fulltext, accessed 22 October 2026. Sensitivity to the turnover, dividend and Ayres exclusions has not been estimated.

Table 24: Additional source identifiers for reproduction

Concept	NBER identifiers
Coal; electric power; cotton	m01118; m01128/m01128a; m01089
Flour; corn grindings; cattle/hogs/sheep	m01058a/b/c; m01060; m01042/m01039/m01047
Annual crops; fertiliser; farm income	a01005a/b; m01029; m12031b
Farm employment: hired / unpaid family	m08338 / m08339
Housing starts; ENR construction	m02161a/b; m02107
Durable employment; food production	m08146a/c; m01260b/c
Mail-order sales; wage index	m06003ab; m08061c
Rail freight ton-miles; revenue	m03003/m03001; m03016
Telephone; passenger-miles; postal receipts	m03018a/b/c/d; m03010; m15006
Magazine advertising; wage and salary disbursements in distribution, services and government	m06057; m08274a/b
Manufacturing quits; layoffs; separations	m08251a/b; m08252a/b; m08254a/b
Manufacturing gross/net accessions; dividends	m08255a/b; m08256a/b; m08238a/b/c
Residential contracts: value / floor space	m02011a/c/d; m02012a/c/d
Non-residential contracts: value / floor space	m02177a/c/d; m02178a/c/d
Cement; total manufacturing; paper; cars	m02122; m01175; m01105a/b; m01107a/b
Currency; bank deposits	m14125a/b; m14145a/b
Federal budget spending; cash payments	m15005b/c/d/e/f; m15033 (FRED M15033USM027NNBR)

G.5 Source documentation and reproducibility

Source notes record definitions, units, published estimates and changes in coverage. The reproduction materials identify the observations used and document the unit conversions, source links and seasonal adjustments. No missing monthly observations are interpolated to complete the panel. Appendix K describes these materials.

H Complete robustness results

Robustness requires both predictive comparisons and economically admissible historical paths. Models are re-estimated, ranked and reconstructed under each set of assumptions. Removing federal spending changes the government-component predictor while retaining annual government accounts. Estimation-period restrictions change the years used to fit indicator transformations, coefficients and disturbance parameters; historical annual GDP still constrains the reconstructed path. The factor sensitivity exercise expands the candidate set. Restricted factor estimation prevents excluded periods from updating fitted parameters, following the general logic of separating specified information blocks (Plummer, 2015).

Restricting estimation can produce inadmissible historical extrapolations even when the estimates satisfy the numerical requirements. All 58 primary specifications are eligible in the main comparison. Excluding 1942–1946 makes one component specification economically inadmissible. Postwar-only

estimation makes fifteen level specifications inadmissible: three component reconstructions and twelve production regressions with or without Denton allocation. Their historical extrapolations produce nonpositive GDP or a nonpositive expenditure component. All restricted Bayesian fits converge, so none of these exclusions represents unresolved numerical non-convergence. Scores for eligible specifications use the same 64 concealed quarterly growth observations.

Table 25: Every specification under each robustness assumption.

No.	Specification	Main	No war	Postwar	No fiscal	Factors
1	IP in levels; Chow–Lin; Denton	0.630	0.606	I	0.630	0.630
2	IP in levels; Chow–Lin; changing response; Denton	0.624	0.606	I	0.624	0.624
3	Log IP; Chow–Lin; Denton	0.576	0.567	0.599	0.576	0.576
4	Log IP; Chow–Lin; changing response; Denton	0.691	0.658	0.616	0.691	0.691
5	IP in levels; Fernández; Denton	0.610	0.596	I	0.610	0.610
6	IP in levels; Fernández; changing response; Denton	0.608	0.597	I	0.608	0.608
7	Log IP; Fernández; Denton	0.573	0.566	0.592	0.573	0.573
8	Log IP; Fernández; changing response; Denton	0.687	0.655	0.607	0.687	0.687
9	IP in levels; Litterman; Denton	0.585	0.593	I	0.585	0.585
10	IP in levels; Litterman; changing response; Denton	0.587	0.594	I	0.587	0.587
11	Log IP; Litterman; Denton	0.563	0.563	0.595	0.563	0.563
12	Log IP; Litterman; changing response; Denton	0.594	0.601	0.608	0.594	0.594
13	IP in levels; Chow–Lin	0.635	0.613	I	0.635	0.635
14	IP in levels; Chow–Lin; changing response	0.628	0.612	I	0.628	0.628
15	Log IP; Chow–Lin	0.577	0.569	0.600	0.577	0.577
16	Log IP; Chow–Lin; changing response	0.692	0.659	0.616	0.692	0.692
17	IP in levels; Fernández	0.628	0.611	I	0.628	0.628
18	IP in levels; Fernández; changing response	0.625	0.610	I	0.625	0.625
19	Log IP; Fernández	0.574	0.567	0.593	0.574	0.574
20	Log IP; Fernández; changing response	0.688	0.656	0.608	0.688	0.688
21	IP in levels; Litterman	0.596	0.608	I	0.596	0.596
22	IP in levels; Litterman; changing response	0.598	0.607	I	0.598	0.598
23	Log IP; Litterman	0.572	0.570	0.597	0.572	0.572
24	Log IP; Litterman; changing response	0.602	0.607	0.609	0.602	0.602
25	1 component from 29 indicators; Chow–Lin	0.655	0.664	0.634	0.655	0.655
26	1 component from 29 indicators; Fernández	0.655	0.663	0.634	0.655	0.655
27	1 component from 29 indicators; Litterman	0.690	0.690	0.634	0.690	0.690
28	1 component from 29 indicators; annual-growth equation	0.655	0.663	0.631	0.655	0.655
29	2 components from 29 indicators; Chow–Lin	0.677	0.673	0.580	0.677	0.677
30	2 components from 29 indicators; Fernández	0.674	0.673	0.578	0.674	0.674
31	2 components from 29 indicators; Litterman	0.694	0.693	0.580	0.694	0.694

No.	Specification	Main	No war	Postwar	No fiscal	Factors
32	2 components from 29 indicators; annual-growth equation	0.674	0.671	0.577	0.674	0.674
33	3 components from 29 indicators; Chow–Lin	0.801	0.718	0.586	0.801	0.801
34	3 components from 29 indicators; Fernández	0.806	0.725	0.581	0.806	0.806
35	3 components from 29 indicators; Litterman	0.723	0.723	0.582	0.723	0.723
36	3 components from 29 indicators; annual-growth equation	0.807	0.730	0.580	0.807	0.807
37	1 component from 15 activity indicators; Chow–Lin	0.698	0.682	0.601	0.698	0.698
38	1 component from 15 activity indicators; Fernández	0.683	0.666	0.595	0.683	0.683
39	1 component from 15 activity indicators; Litterman	0.641	0.651	0.596	0.641	0.641
40	1 component from 15 activity indicators; annual-growth equation	0.682	0.666	0.594	0.682	0.682
41	2 components from 15 activity indicators; Chow–Lin	0.864	0.859	0.674	0.864	0.864
42	2 components from 15 activity indicators; Fernández	0.865	0.733	0.667	0.865	0.865
43	2 components from 15 activity indicators; Litterman	0.732	0.765	0.666	0.732	0.732
44	2 components from 15 activity indicators; annual-growth equation	0.865	0.737	0.666	0.865	0.865
45	3 components from 15 activity indicators; Chow–Lin	0.588	0.898	0.667	0.588	0.588
46	3 components from 15 activity indicators; Fernández	0.589	0.722	0.657	0.589	0.589
47	3 components from 15 activity indicators; Litterman	0.643	0.675	0.660	0.643	0.643
48	3 components from 15 activity indicators; annual-growth equation	0.589	0.714	0.656	0.589	0.589
49	29 indicators; one joint factor	0.593	0.601	0.542	0.593	0.593
50	Constant indicator	0.850	0.850	0.850	0.850	0.850
51	IP	1.658	1.658	1.658	1.658	1.658
52	IP multiplied by PPI	2.330	2.330	2.330	2.330	2.330
53	Level components; Chow–Lin; 1929-1963	1.051	I	I	1.003	1.051
54	Log components; Chow–Lin; 1929-1963	1.053	0.950	4.155	1.023	1.053
55	Level components; Fernández; 1929-1963	1.058	0.900	I	1.006	1.058
56	Log components; Fernández; 1929-1963	1.078	0.970	0.783	1.031	1.078
57	Level components; Litterman; 1929-1963	1.039	0.797	I	0.973	1.039
58	Log components; Litterman; 1929-1963	1.056	0.934	0.752	0.961	1.056
59	29 indicators; two factors	–	–	–	–	0.574
60	29 indicators; separate prewar GDP loading	–	–	–	–	0.592
61	29 indicators; separate wartime GDP variance	–	–	–	–	0.593
62	29 indicators; wider coefficient priors	–	–	–	–	0.592

I Additional historical results

Coefficient uncertainty in complete GDP histories carries through to growth volatility and persistence. Table 26 reports these statistics, and Figure 9 shows the corresponding four-quarter growth intervals. Each statistic is calculated within a complete history before taking quantiles. Figure 8 reports quarter-on-quarter growth across methods, complementing the four-quarter growth comparison in Figure 1. Component paths begin in 1929; the best-performing and supplementary Bayesian real reconstructions cover 1919–1946.

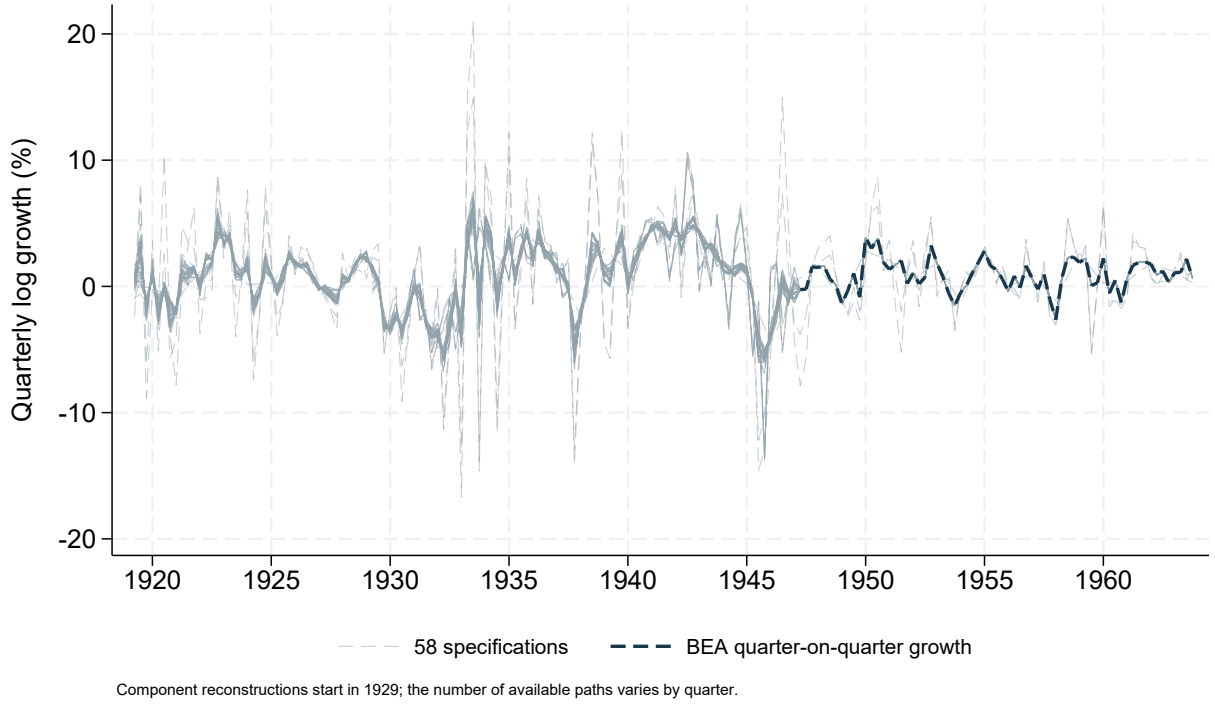


Figure 8: Quarter-on-quarter real GDP growth across the same 58 specifications, measured as $100\Delta \log Q$. Thin grey lines give individual predictions; the dark dashed line gives BEA quarterly growth.

Table 26: Coefficient uncertainty in volatility and persistence

	Production regression with Denton allocation		Joint Bayesian factor model	
Statistic	Point	99% interval	Point	99% interval
Growth volatility (pp)	2.60	2.43–2.82	2.49	2.37–2.64
Growth persistence	0.64	0.52–0.76	0.76	0.67–0.84

Volatility is the standard deviation of 111 quarterly changes in $100 \log Q$, in percentage points. Persistence is their lag-one correlation. Central 99% coefficient intervals summarise each statistic calculated within each complete history.

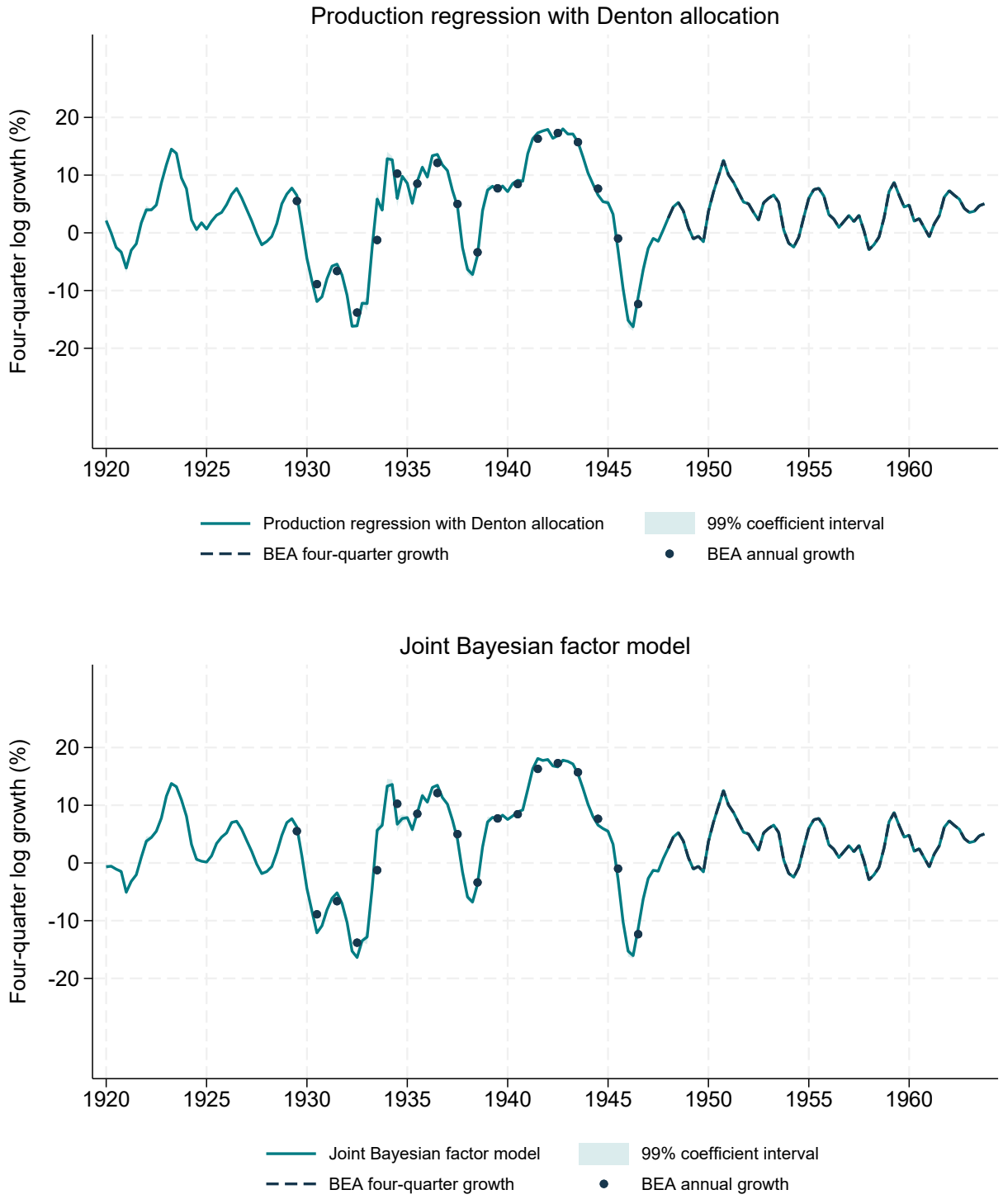


Figure 9: Four-quarter growth and pointwise 99% coefficient intervals. Upper: production regression with Denton allocation. Lower: joint Bayesian factor model. The bands summarise growth calculated separately for each coefficient draw, conditional on the same annual accounts and BEA quarters.

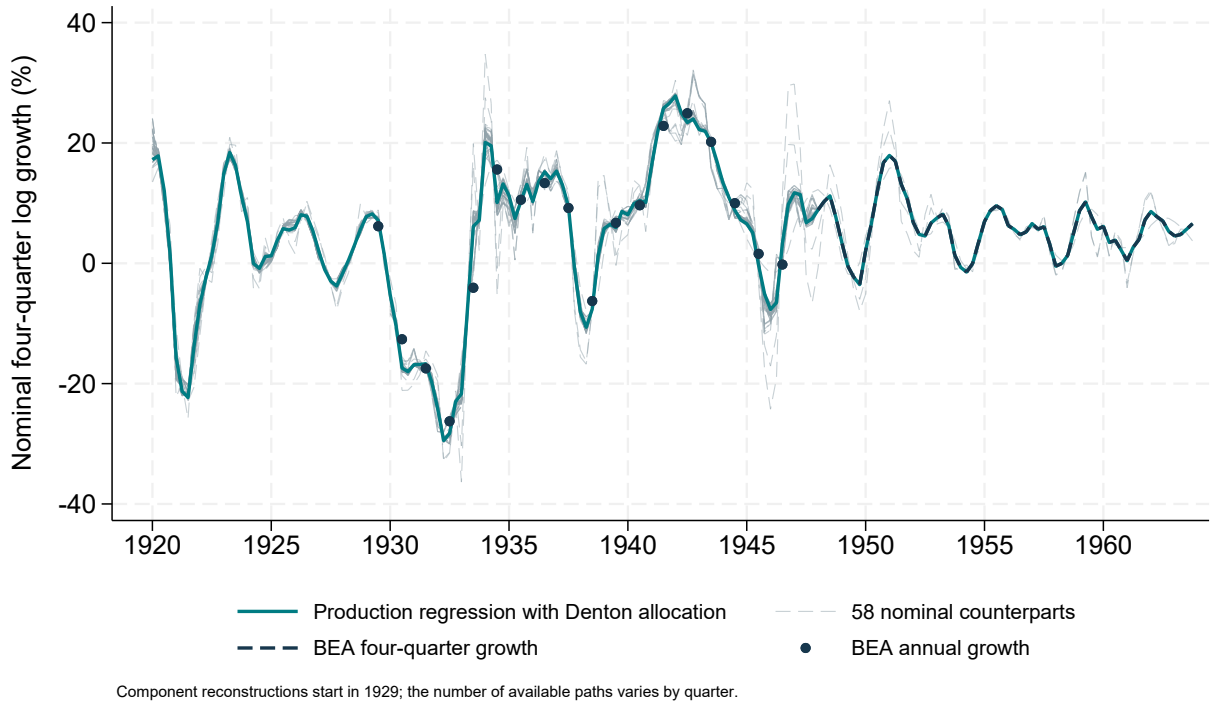


Figure 10: Four-quarter nominal GDP growth from the 58 specifications applied to nominal GDP. Thin dashed lines show individual predictions; the solid line shows production regression with Denton allocation. Dark dashed lines show BEA four-quarter growth, and dots show annual growth.

J What the uncertainty measures establish

Limited variation across coefficient draws need not imply a precisely known quarterly history. The experiments in Section 6 and Appendix D vary estimated relationships while holding dynamics, innovation variances, data and model structure fixed. Production regression repeats Denton allocation at each coefficient vector. The factor experiment reports the conditional mean GDP history in equation (16), integrating out latent activity and missing GDP before measuring its variation across coefficients.

J.1 The full factor posterior

The full factor posterior treats missing quarterly GDP as uncertain even at given parameters. It draws

$$(Q^{(s)}, b^{(s)}, \psi^{(s)}) \sim p(Q, b, \psi \mid D),$$

with latent activity integrated out in this notation. All $3p + 5$ estimated parameters vary, and every GDP path preserves observed annual accounts and BEA quarters. Historical statistics are calculated within each sampled path, rather than within coefficient-specific conditional means. The supplementary point series is the posterior mean of GDP levels; coefficient histories are not recentred on it.

The milder 1937–1938 contraction survives this broader uncertainty target. Its central 99% posterior interval is 5.11–9.69%, wider than the 6.10–7.30% coefficient interval but still below the Balke and Gordon (1986) and Ramey and Zubairy (2018) point declines at common annual GDP. The decline is calculated within every complete GDP path before taking quantiles. Its split-chain diagnostic satisfies $\widehat{R} < 1.01$; bulk and interval-tail effective sample sizes exceed 400. These checks establish numerical precision, not historical accuracy.

J.2 Recession-classification uncertainty

Recession classification is less stable under the full posterior than across coefficient-specific mean histories (Table 27). At least one classification differs in 84 of 108 quarters under the full factor posterior, compared with 3 for factor coefficients and 3 for production coefficients. Requiring at least 5% support for each classification reduces the factor counts to 23 and 1. Figure 11 compares their contraction shares.

Table 27: Uncertainty targets and recession-classification disagreement

GDP histories	Quantities varied	Any disagreement	5–95% share
Production regression: coefficient histories	Regression coefficients	3	2
Factor model: conditional mean histories	Relationship coefficients	3	1
Factor model: full posterior GDP paths	All model parameters and unobserved GDP paths	84	23

The coefficient experiments use 10000 complete histories; the full posterior supplies 10000 GDP paths. All use fixed observed data, the same turning-point rule and the same 108 quarters. "Any disagreement" counts quarters classified both ways across retained histories. "5–95% share" counts quarters where 5–95% of histories classify a contraction, including the endpoints. This second count excludes disagreements confined to fewer than 5% of histories. Both are descriptive counts, not statistical tests or interval widths.

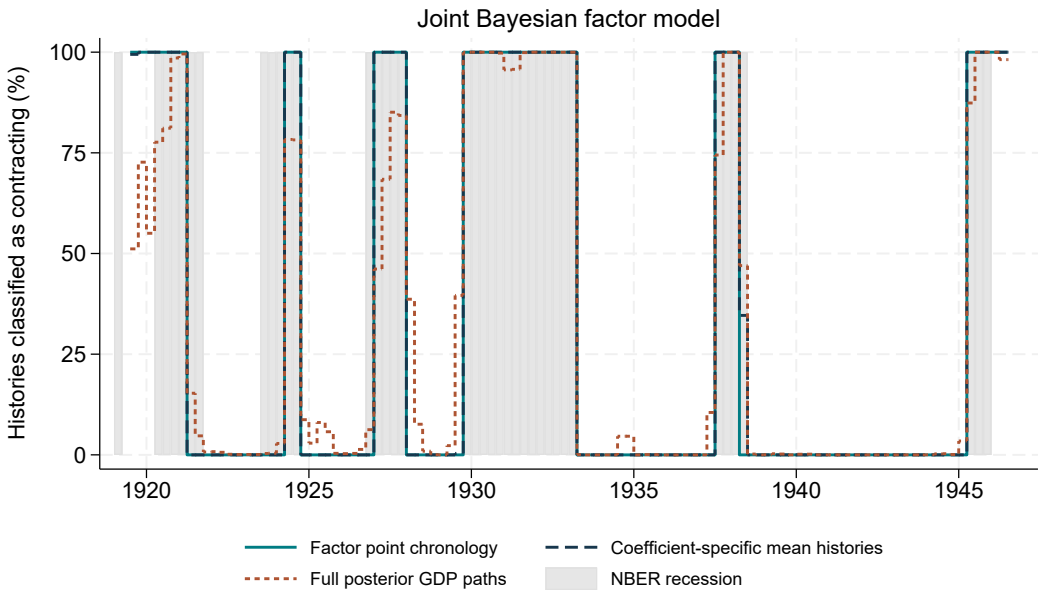


Figure 11: Contraction shares under coefficient uncertainty and the full factor posterior. Each share is the fraction of histories classifying a quarter as contracting under the common dating rule. Coefficient histories average latent GDP in levels at fixed dynamics and innovation variances; full posterior paths vary all parameters and unobserved GDP jointly. The point chronology uses the posterior-mean GDP prediction; shading denotes NBER recessions.

Counting any disagreement identifies where timing can change, but treats rare and common alternatives alike. A contraction share of 0.001 counts in the same way as a share of 0.5, and additional draws can reveal further rare alternatives. The count thus measures neither the probability nor the magnitude of disagreement. The 5–95% rule is also descriptive. Full factor-posterior shares estimate conditional posterior contraction probabilities; coefficient shares describe classifications of mean reconstructions.

These comparisons do not decompose total historical uncertainty. The full factor posterior changes both the parameter distribution and whether latent GDP dispersion is retained. Its difference from the coefficient experiment cannot be attributed solely to quarterly disturbances, persistence or innovation variances. A matching full distribution is unavailable for production regression with Denton allocation. Across-specification variation, coefficient uncertainty and the full factor posterior therefore remain separate measures.

All distributions condition on the supplied annual accounts, indicator vintages and maintained specification. The factor model allows idiosyncratic indicator disturbances, but does not integrate uncertainty about revisions to the observed sources. Model selection and historical instability beyond the fitted specification also remain outside the distributions. Exact annual accounting fixes yearly means; quarterly timing still depends on the indicators and relationships.

K Reproduction and the released data

The release pairs one best-performing GDP path with separate measures of model dispersion and coefficient uncertainty. The main real quarterly series covers 1919–1946 and uses production regression with Denton allocation. Its coefficient uncertainty summaries remain separate from interquartile ranges across the primary specifications. The range file includes the available-specification count for levels and each growth measure. The 1909–1918 quarterly extension has separate coefficient intervals conditional on its early calibration. Supplementary files retain Bayesian point paths and coefficient summaries; the broader factor posterior remains separately labelled. Nominal GDP and monthly allocations are point predictions only.

Three separate packages accompany the paper. The website package contains the paper, presentations, released data and their documentation. The journal reproduction package contains the inputs, code and accepted Bayesian estimation results needed to reproduce the numerical analysis. The full reproduction package adds the LaTeX sources, formatted tables, figures and publication-building scripts.

The numerical workflow in both reproduction packages is contained in `full_reproduction/`. Its entry point is `full_reproduction/master.do`; `full_reproduction/README.md` gives the requirements and execution steps. The default run prepares the source data, re-estimates the conventional models and verifies and imports the exact accepted Bayesian estimation results before regenerating outputs. The preserved Bayesian results retain the simulations used in the paper. MATLAB is required only for new Bayesian estimation. The reusable GDP series and uncertainty summaries are in `full_reproduction/results/final_dataset/`; the output index maps numerical files and graphs to this paper.

Source documentation in `full_reproduction/data/sources.md` identifies the input maps, acquisition inventories and required-file list. These record source definitions, URLs, available acquisition dates and checksums. The maps specify panel membership and transformations; preparation checks monthly coverage, source joins and quarterly aggregation. The workflow also checks source hashes, annual accounting, quarterly anchors and Bayesian diagnostics. Section G.2 explains the systematic search and exclusions; supporting source records remain distinct from the estimation inputs.

Data-use policy. The dataset accompanying this paper may be used for research, teaching and policy analysis, provided that the BIS, this paper and the applicable dataset version are cited. All use, reproduction and redistribution remain subject to the BIS Terms and Conditions: https://www.bis.org/about/terms-conditions. In particular, incorporation of the released series, including rebased, rescaled or frequency-converted versions, into a database, repository or data service intended for reuse across multiple research projects may fall outside the permissions granted by the BIS Terms and Conditions. Users considering such incorporation should contact the BIS in advance to confirm whether permission is required.

Tables K1.1–K1.4 report the quarterly estimates, with the separately calibrated early extension in its own table. Tables K.2–K.5 report coefficient uncertainty, across-specification ranges and monthly allocations (data version 2026-10-20). Table notes explain their construction and limits. Values are rounded for presentation; the electronic release retains full precision. The data-use policy above applies to these tables.

Table K1.1: Early quarterly real GDP extension and growth, 1909–1918

Notes: Real GDP is in billions of 2017 dollars, at seasonally adjusted annual rates; average quarters to obtain annual GDP. Growth is 100 times the log change in unrounded real GDP, without annualisation. This extension uses a separate annual-only Persons calibration with ten annual GDP benchmarks and Denton allocation. Postwar tests do not validate early timing. Nominal estimates are unavailable; blank growth cells indicate unavailable lags.

Quarter	Real GDP	Quarterly growth (%)	Four-quarter growth (%)
1909Q1	628.217		
1909Q2	637.645	1.49	
1909Q3	653.098	2.39	
1909Q4	665.352	1.86	
1910Q1	664.264	−0.16	5.58
1910Q2	652.291	−1.82	2.27
1910Q3	645.275	−1.08	−1.21
1910Q4	650.307	0.78	−2.29
1911Q1	665.303	2.28	0.16
1911Q2	672.994	1.15	3.12
1911Q3	679.858	1.01	5.22
1911Q4	678.612	−0.18	4.26
1912Q1	686.129	1.10	3.08
1912Q2	697.071	1.58	3.52
1912Q3	710.497	1.91	4.41
1912Q4	729.421	2.63	7.22
1913Q1	735.925	0.89	7.01
1913Q2	735.530	−0.05	5.37
1913Q3	742.374	0.93	4.39
1913Q4	720.730	−2.96	−1.20
1914Q1	700.717	−2.82	−4.90
1914Q2	696.758	−0.57	−5.42
1914Q3	674.770	−3.21	−9.55
1914Q4	637.629	−5.66	−12.25
1915Q1	653.723	2.49	−6.94
1915Q2	670.197	2.49	−3.89
1915Q3	703.562	4.86	4.18
1915Q4	756.270	7.22	17.06
1916Q1	788.977	4.23	18.81
1916Q2	790.459	0.19	16.50
1916Q3	795.967	0.69	12.34
1916Q4	794.361	−0.20	4.91
1917Q1	764.380	−3.85	−3.17
1917Q2	781.604	2.23	−1.13
1917Q3	768.687	−1.67	−3.49
1917Q4	776.691	1.04	−2.25
1918Q1	787.478	1.38	2.98
1918Q2	853.517	8.05	8.80
1918Q3	880.294	3.09	13.56
1918Q4	848.887	−3.63	8.89

Table K1.2: Quarterly GDP and real GDP growth, 1919–1930

Notes: GDP levels are seasonally adjusted annual rates in billions of 2017 dollars (real) or current dollars (nominal). Growth is 100 times the log change in unrounded real GDP, without annualisation. Production regression with Denton allocation supplies the best-performing real path; nominal relationships are estimated separately. Blank growth cells prevent comparisons across the separate 1918/1919 calibrations.

Quarter	Real GDP	Nominal GDP	Quarterly growth (%)	Four-quarter growth (%)
1919Q1	840.271	75.622		
1919Q2	842.713	76.592	0.29	
1919Q3	864.194	80.953	2.52	
1919Q4	850.039	83.193	−1.65	
1920Q1	858.352	89.840	0.97	2.13
1920Q2	842.510	91.575	−1.86	−0.02
1920Q3	842.432	91.307	−0.01	−2.55
1920Q4	822.174	84.262	−2.43	−3.33
1921Q1	807.566	76.778	−1.79	−6.10
1921Q2	817.487	74.030	1.22	−3.02
1921Q3	826.574	73.051	1.11	−1.90
1921Q4	836.687	73.397	1.22	1.75
1922Q1	840.500	71.703	0.45	4.00
1922Q2	850.654	72.284	1.20	3.98
1922Q3	867.497	74.014	1.96	4.83
1922Q4	912.263	78.559	5.03	8.65
1923Q1	945.758	83.190	3.61	11.80
1923Q2	983.405	86.914	3.90	14.50
1923Q3	995.541	87.050	1.23	13.77
1923Q4	1003.239	87.798	0.77	9.51
1924Q1	1020.967	89.137	1.75	7.65
1924Q2	1005.781	86.889	−1.50	2.25
1924Q3	1001.213	86.320	−0.46	0.57
1924Q4	1020.929	88.797	1.95	1.75
1925Q1	1027.691	90.249	0.66	0.66
1925Q2	1026.336	90.250	−0.13	2.02
1925Q3	1032.328	91.443	0.58	3.06
1925Q4	1057.641	93.854	2.42	3.53
1926Q1	1079.192	95.747	2.02	4.89
1926Q2	1097.045	97.837	1.64	6.66
1926Q3	1114.905	98.888	1.61	7.70
1926Q4	1123.639	99.067	0.78	6.05
1927Q1	1123.932	97.633	0.03	4.06
1927Q2	1120.043	96.827	−0.35	2.07
1927Q3	1112.758	96.001	−0.65	−0.19
1927Q4	1100.684	95.402	−1.09	−2.06
1928Q1	1107.231	96.002	0.59	−1.50
1928Q2	1113.066	97.353	0.53	−0.62
1928Q3	1130.678	98.938	1.57	1.60
1928Q4	1157.528	100.927	2.35	5.04
1929Q1	1184.219	103.764	2.28	6.72
1929Q2	1202.885	105.680	1.56	7.76
1929Q3	1206.412	106.259	0.29	6.48
1929Q4	1170.979	102.521	−2.98	1.16
1930Q1	1133.077	98.538	−3.29	−4.41
1930Q2	1106.817	95.197	−2.34	−8.32
1930Q3	1071.023	89.283	−3.29	−11.90
1930Q4	1048.223	85.623	−2.15	−11.07

Table K1.3: Quarterly GDP and real GDP growth, 1931–1938

Notes: GDP levels are seasonally adjusted annual rates in billions of 2017 dollars (real) or current dollars (nominal). Growth is 100 times the log change in unrounded real GDP, without annualisation. Production regression with Denton allocation supplies the best-performing real path; nominal relationships are estimated separately.

Quarter	Real GDP	Nominal GDP	Quarterly growth (%)	Four-quarter growth (%)
1931Q1	1046.451	83.253	−0.17	−7.95
1931Q2	1044.728	80.473	−0.16	−5.77
1931Q3	1014.489	75.550	−2.94	−5.42
1931Q4	974.240	70.289	−4.05	−7.32
1932Q1	939.085	65.380	−3.68	−10.83
1932Q2	888.600	59.941	−5.53	−16.19
1932Q3	863.552	56.931	−2.86	−16.11
1932Q4	862.419	55.836	−0.13	−12.19
1933Q1	830.759	52.632	−3.74	−12.26
1933Q2	866.273	55.459	4.19	−2.54
1933Q3	915.590	60.542	5.54	5.85
1933Q4	897.102	59.982	−2.04	3.94
1934Q1	944.673	64.342	5.17	12.85
1934Q2	983.233	67.431	4.00	12.66
1934Q3	971.788	66.974	−1.17	5.96
1934Q4	989.358	68.453	1.79	9.79
1935Q1	1029.297	72.024	3.96	8.58
1935Q2	1034.923	72.642	0.55	5.12
1935Q3	1062.666	74.246	2.65	8.94
1935Q4	1108.459	78.052	4.22	11.37
1936Q1	1133.747	79.813	2.26	9.67
1936Q2	1182.953	83.228	4.25	13.37
1936Q3	1217.324	86.439	2.86	13.59
1936Q4	1246.981	89.840	2.41	11.78
1937Q1	1262.801	93.029	1.26	10.78
1937Q2	1273.047	94.786	0.81	7.34
1937Q3	1274.573	94.978	0.12	4.60
1937Q4	1215.591	89.219	−4.74	−2.55
1938Q1	1185.336	85.787	−2.52	−6.33
1938Q2	1184.416	85.221	−0.08	−7.22
1938Q3	1226.015	88.034	3.45	−3.88
1938Q4	1263.709	90.366	3.03	3.88

Table K1.4: Quarterly GDP and real GDP growth, 1939–1946

Notes: GDP levels are seasonally adjusted annual rates in billions of 2017 dollars (real) or current dollars (nominal). Growth is 100 times the log change in unrounded real GDP, without annualisation. Production regression with Denton allocation supplies the best-performing real path; nominal relationships are estimated separately.

Quarter	Real GDP	Nominal GDP	Quarterly growth (%)	Four-quarter growth (%)
1939Q1	1276.455	90.893	1.00	7.41
1939Q2	1284.103	90.928	0.60	8.08
1939Q3	1318.503	93.423	2.64	7.27
1939Q4	1370.399	98.503	3.86	8.11
1940Q1	1370.870	98.525	0.03	7.14
1940Q2	1398.574	100.389	2.00	8.54
1940Q3	1444.275	103.695	3.22	9.11
1940Q4	1498.581	108.987	3.69	8.94
1941Q1	1572.355	115.993	4.81	13.71
1941Q2	1646.440	124.798	4.60	16.32
1941Q3	1717.323	134.203	4.22	17.32
1941Q4	1788.078	142.243	4.04	17.66
1942Q1	1880.999	153.208	5.07	17.92
1942Q2	1939.439	160.208	3.06	16.38
1942Q3	2032.628	169.589	4.69	16.86
1942Q4	2141.102	180.804	5.20	18.02
1943Q1	2231.997	191.333	4.16	17.11
1943Q2	2301.736	199.538	3.08	17.13
1943Q3	2378.721	207.375	3.29	15.72
1943Q4	2442.589	214.090	2.65	13.17
1944Q1	2476.574	218.655	1.38	10.40
1944Q2	2504.424	222.611	1.12	8.44
1944Q3	2540.084	226.450	1.41	6.56
1944Q4	2577.926	230.072	1.48	5.39
1945Q1	2609.023	233.512	1.20	5.21
1945Q2	2586.615	234.231	−0.86	3.23
1945Q3	2464.203	225.679	−4.85	−3.03
1945Q4	2340.386	218.605	−5.16	−9.67
1946Q1	2242.118	216.289	−4.29	−15.16
1946Q2	2198.007	219.404	−1.99	−16.28
1946Q3	2204.318	233.278	0.29	−11.15
1946Q4	2195.201	241.169	−0.41	−6.40

Table K.2: Coefficient uncertainty in real quarterly GDP levels and growth, 1909–1946

Notes: SD is the standard deviation across 10,000 coefficient histories. Lower and upper 99% bounds are their 0.5th and 99.5th percentiles. GDP levels are annual rates in billions of 2017 dollars; growth bounds are in per cent and growth standard deviations in percentage points. Growth is 100 times the log change, without annualisation. Tables K1.1–K1.4 report the point estimates at fitted coefficients; these need not equal the draw means. The calculation holds annual GDP, indicators, the specification and fitted residual parameters fixed, then repeats the complete reconstruction at each coefficient vector. Early intervals additionally hold the estimated annual GDP trend fixed and condition on residual persistence at its lower search bound (−0.85), using only ten annual benchmarks. Their small-sample coverage is not established. These are coefficient intervals, not prediction intervals for unobserved GDP: quarterly disturbances, source revisions, model selection and uncertainty in fixed inputs are excluded. Growth intervals are calculated within each history and do not bridge the separate 1918/1919 calibrations. Blank cells indicate unavailable growth measures.

	Real GDP level			Quarterly real GDP growth			Four-quarter real GDP growth		
Quarter	SD	Lower 99%	Upper 99%	SD	Lower 99%	Upper 99%	SD	Lower 99%	Upper 99%
Early extension: separate calibration, 1909–1918									
1909Q1	5.230	614.870	641.852						
1909Q2	2.936	630.081	645.226	0.372	0.524	2.444			
1909Q3	1.995	647.840	658.135	0.766	0.404	4.356			
1909Q4	6.171	649.394	681.226	0.622	0.239	3.448			
1910Q1	5.644	649.575	678.689	0.078	−0.373	0.028	1.682	1.196	9.875
1910Q2	0.525	650.807	653.517	0.769	−3.780	0.190	0.541	0.861	3.652
1910Q3	3.182	637.173	653.586	0.573	−2.533	0.426	0.799	−3.237	0.883
1910Q4	2.987	642.757	658.168	0.034	0.699	0.873	1.387	−5.813	1.342
1911Q1	0.290	664.531	666.027	0.503	0.962	3.556	0.806	−1.883	2.276
1911Q2	0.786	670.884	674.940	0.073	0.951	1.329	0.036	3.038	3.226
1911Q3	0.927	677.421	682.202	0.020	0.970	1.070	0.629	3.582	6.828
1911Q4	2.002	673.598	683.931	0.431	−1.269	0.956	0.164	3.840	4.687
1912Q1	1.766	681.808	690.923	0.038	1.017	1.212	0.301	2.342	3.895
1912Q2	0.954	694.724	699.646	0.120	1.255	1.877	0.254	2.889	4.198
1912Q3	0.119	710.109	710.719	0.153	1.484	2.276	0.120	4.095	4.713
1912Q4	2.602	722.439	735.865	0.340	1.722	3.477	0.652	5.478	8.841
1913Q1	0.216	735.095	736.156	0.385	−0.105	1.880	0.230	6.341	7.525
1913Q2	2.038	730.179	740.685	0.249	−0.671	0.614	0.140	4.978	5.700
1913Q3	2.399	736.230	748.607	0.600	−0.603	2.492	0.307	3.612	5.194
1913Q4	0.172	720.616	721.493	0.345	−3.802	−2.022	0.379	−2.085	−0.131
1914Q1	1.545	697.126	705.058	0.242	−3.436	−2.191	0.249	−5.447	−4.172
1914Q2	6.620	679.822	713.948	0.730	−2.514	1.253	1.227	−8.574	−2.248
1914Q3	2.154	668.761	679.867	0.631	−4.891	−1.641	0.016	−9.636	−9.548
1914Q4	10.316	611.002	664.165	1.938	−10.680	−0.690	1.597	−16.509	−8.279

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Table K.2 (continued)

	Real GDP level			Quarterly real GDP growth			Four-quarter real GDP growth		
Quarter	SD	Lower 99%	Upper 99%	SD	Lower 99%	Upper 99%	SD	Lower 99%	Upper 99%
1915Q1	5.956	637.653	668.281	0.707	0.618	4.269	1.132	−10.049	−4.226
1915Q2	4.254	658.758	680.673	0.277	1.837	3.256	1.585	−8.045	0.125
1915Q3	0.643	702.060	705.322	0.727	3.094	6.830	0.228	3.676	4.859
1915Q4	9.566	732.738	782.018	1.173	4.277	10.322	2.883	9.826	24.678
1916Q1	6.990	771.821	807.856	0.379	3.251	5.196	1.797	14.404	23.659
1916Q2	1.870	785.880	795.519	1.122	−2.758	3.024	0.399	15.591	17.645
1916Q3	3.442	786.729	804.470	0.197	0.108	1.119	0.524	10.923	13.617
1916Q4	1.685	789.299	797.953	0.221	−0.813	0.326	1.476	0.927	8.526
1917Q1	4.155	753.494	774.928	0.333	−4.642	−2.928	1.429	−6.966	0.402
1917Q2	6.224	765.485	797.588	1.340	−1.226	5.687	1.033	−3.849	1.479
1917Q3	0.425	767.663	769.855	0.741	−3.539	0.284	0.488	−4.683	−2.168
1917Q4	2.494	770.424	783.287	0.376	0.074	2.015	0.112	−2.420	−1.855
1918Q1	9.365	763.832	812.149	0.868	−0.859	3.618	0.645	1.363	4.691
1918Q2	6.267	837.111	869.439	1.923	3.027	12.950	0.062	8.626	8.945
1918Q3	9.642	855.197	904.932	0.361	2.137	4.001	1.040	10.798	16.166
1918Q4	6.545	831.973	865.719	1.867	−8.406	1.223	0.450	7.686	10.006
Main historical reconstruction, 1919–1946									
1919Q1	1.674	835.838	844.473						
1919Q2	0.717	840.862	844.549	0.177	−0.164	0.749			
1919Q3	1.551	860.250	868.169	0.262	1.858	3.187			
1919Q4	1.027	847.403	852.722	0.183	−2.127	−1.181			
1920Q1	1.079	855.618	861.110	0.143	0.586	1.332	0.303	1.367	2.923
1920Q2	0.331	841.602	843.318	0.155	−2.258	−1.471	0.054	−0.160	0.116
1920Q3	0.442	841.306	843.604	0.091	−0.239	0.233	0.164	−2.973	−2.141
1920Q4	1.048	819.515	824.861	0.162	−2.848	−2.013	0.191	−3.841	−2.859
1921Q1	1.674	803.277	811.860	0.088	−2.022	−1.568	0.327	−6.933	−5.256
1921Q2	0.252	816.825	818.105	0.177	0.763	1.673	0.023	−3.072	−2.951
1921Q3	0.669	824.846	828.271	0.111	0.819	1.393	0.057	−2.042	−1.751
1921Q4	1.254	833.488	839.939	0.069	1.042	1.399	0.276	1.041	2.456
1922Q1	0.629	838.932	842.136	0.077	0.261	0.657	0.281	3.274	4.724
1922Q2	0.158	850.258	851.085	0.089	0.970	1.427	0.022	3.925	4.039
1922Q3	0.941	865.059	869.902	0.093	1.717	2.197	0.189	4.345	5.318
1922Q4	0.521	910.889	913.585	0.161	4.610	5.451	0.106	8.367	8.908

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Table K.2 (continued)

	Real GDP level			Quarterly real GDP growth			Four-quarter real GDP growth		
Quarter	SD	Lower 99%	Upper 99%	SD	Lower 99%	Upper 99%	SD	Lower 99%	Upper 99%
1923Q1	0.132	945.422	946.097	0.064	3.443	3.771	0.087	11.572	12.015
1923Q2	0.749	981.463	985.324	0.086	3.684	4.127	0.093	14.255	14.742
1923Q3	0.166	995.121	995.987	0.092	0.988	1.468	0.094	13.529	14.011
1923Q4	0.504	1001.953	1004.566	0.034	0.683	0.860	0.106	9.239	9.787
1924Q1	1.289	1017.667	1024.367	0.176	1.293	2.212	0.136	7.306	8.005
1924Q2	0.563	1004.321	1007.220	0.182	−1.970	−1.029	0.132	1.911	2.593
1924Q3	1.289	997.859	1004.541	0.073	−0.647	−0.266	0.113	0.275	0.858
1924Q4	0.571	1019.472	1022.402	0.184	1.474	2.425	0.105	1.473	2.017
1925Q1	0.986	1025.179	1030.255	0.040	0.558	0.764	0.036	0.556	0.746
1925Q2	0.071	1026.152	1026.515	0.099	−0.388	0.124	0.053	1.888	2.160
1925Q3	0.827	1030.200	1034.461	0.077	0.383	0.777	0.049	2.934	3.189
1925Q4	0.174	1057.183	1058.070	0.070	2.240	2.604	0.069	3.355	3.708
1926Q1	0.406	1078.142	1080.228	0.026	1.950	2.085	0.133	4.545	5.231
1926Q2	0.421	1095.961	1098.126	0.008	1.621	1.660	0.035	6.571	6.752
1926Q3	0.231	1114.315	1115.503	0.059	1.465	1.768	0.101	7.438	7.956
1926Q4	0.592	1122.131	1125.176	0.032	0.698	0.863	0.066	5.887	6.223
1927Q1	0.756	1121.973	1125.885	0.016	−0.018	0.068	0.104	3.796	4.331
1927Q2	0.501	1118.747	1121.349	0.023	−0.406	−0.289	0.083	1.860	2.289
1927Q3	0.093	1112.514	1112.993	0.053	−0.789	−0.516	0.029	−0.268	−0.118
1927Q4	1.165	1097.679	1103.687	0.098	−1.345	−0.838	0.158	−2.472	−1.654
1928Q1	0.222	1106.671	1107.838	0.087	0.369	0.818	0.086	−1.722	−1.273
1928Q2	0.237	1112.463	1113.692	0.004	0.518	0.536	0.066	−0.796	−0.454
1928Q3	0.071	1130.487	1130.859	0.028	1.497	1.640	0.014	1.561	1.635
1928Q4	0.388	1156.488	1158.506	0.027	2.274	2.416	0.138	4.675	5.397
1929Q1	0.416	1183.168	1185.302	0.064	2.112	2.443	0.026	6.662	6.793
1929Q2	0.075	1202.690	1203.079	0.033	1.479	1.647	0.023	7.695	7.815
1929Q3	0.821	1204.314	1208.521	0.070	0.116	0.473	0.062	6.322	6.643
1929Q4	0.458	1169.874	1172.269	0.104	−3.250	−2.704	0.073	0.976	1.357
1930Q1	0.251	1132.440	1133.716	0.054	−3.430	−3.150	0.057	−4.562	−4.271
1930Q2	1.053	1104.130	1109.561	0.078	−2.548	−2.145	0.096	−8.566	−8.072
1930Q3	0.198	1070.500	1071.513	0.113	−3.582	−3.002	0.086	−12.127	−11.684
1930Q4	1.076	1045.411	1050.944	0.085	−2.373	−1.939	0.071	−11.260	−10.895

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Table K.2 (continued)

	Real GDP level			Quarterly real GDP growth			Four-quarter real GDP growth		
Quarter	SD	Lower 99%	Upper 99%	SD	Lower 99%	Upper 99%	SD	Lower 99%	Upper 99%
1931Q1	0.752	1044.465	1048.324	0.031	−0.249	−0.090	0.092	−8.198	−7.725
1931Q2	0.713	1042.842	1046.535	0.139	−0.520	0.197	0.028	−5.849	−5.706
1931Q3	0.235	1013.903	1015.115	0.046	−3.051	−2.811	0.042	−5.526	−5.313
1931Q4	0.214	973.785	974.904	0.043	−4.154	−3.932	0.084	−7.526	−7.093
1932Q1	1.052	936.437	941.910	0.133	−4.018	−3.329	0.183	−11.282	−10.340
1932Q2	0.648	886.929	890.280	0.185	−6.010	−5.054	0.141	−16.547	−15.820
1932Q3	0.806	861.437	865.594	0.021	−2.919	−2.811	0.116	−16.415	−15.818
1932Q4	0.404	861.351	863.457	0.140	−0.493	0.230	0.067	−12.377	−12.028
1933Q1	2.947	823.079	838.422	0.401	−4.781	−2.698	0.467	−13.486	−11.059
1933Q2	0.104	866.004	866.547	0.356	3.266	5.112	0.076	−2.739	−2.348
1933Q3	3.737	905.942	925.289	0.407	4.480	6.599	0.501	4.553	7.150
1933Q4	0.832	894.902	899.174	0.498	−3.325	−0.746	0.139	3.577	4.297
1934Q1	1.002	942.067	947.230	0.194	4.665	5.671	0.460	11.655	14.050
1934Q2	2.234	977.481	989.061	0.123	3.686	4.322	0.226	12.078	13.257
1934Q3	1.527	967.797	975.744	0.384	−2.176	−0.180	0.565	4.487	7.421
1934Q4	1.701	984.941	993.810	0.017	1.747	1.837	0.091	9.554	10.029
1935Q1	1.010	1026.714	1031.918	0.268	3.264	4.648	0.037	8.482	8.672
1935Q2	0.708	1033.070	1036.761	0.165	0.120	0.971	0.295	4.353	5.890
1935Q3	0.738	1060.763	1064.555	0.012	2.613	2.677	0.089	8.711	9.169
1935Q4	0.473	1107.236	1109.677	0.109	3.935	4.505	0.214	10.817	11.918
1936Q1	1.354	1130.246	1137.216	0.159	1.847	2.667	0.218	9.101	10.219
1936Q2	0.066	1182.794	1183.135	0.121	3.938	4.560	0.071	13.186	13.553
1936Q3	0.415	1216.261	1218.398	0.033	2.779	2.949	0.103	13.324	13.855
1936Q4	0.923	1244.622	1249.357	0.040	2.304	2.509	0.043	11.670	11.886
1937Q1	0.563	1261.301	1264.216	0.030	1.181	1.334	0.164	10.356	11.200
1937Q2	0.866	1270.749	1275.220	0.025	0.745	0.875	0.066	7.164	7.507
1937Q3	1.558	1270.563	1278.668	0.055	−0.015	0.267	0.089	4.366	4.828
1937Q4	2.977	1208.044	1223.415	0.367	−5.680	−3.781	0.318	−3.362	−1.715
1938Q1	3.303	1176.892	1193.944	0.034	−2.613	−2.437	0.323	−7.155	−5.487
1938Q2	2.231	1178.606	1190.151	0.090	−0.318	0.149	0.256	−7.876	−6.553
1938Q3	1.799	1221.305	1230.593	0.335	2.584	4.317	0.025	−3.954	−3.823
1938Q4	3.735	1254.076	1273.355	0.149	2.648	3.416	0.540	2.475	5.266

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Table K.2 (continued)

	Real GDP level			Quarterly real GDP growth			Four-quarter real GDP growth		
Quarter	SD	Lower 99%	Upper 99%	SD	Lower 99%	Upper 99%	SD	Lower 99%	Upper 99%
1939Q1	1.012	1273.887	1279.115	0.216	0.450	1.567	0.358	6.481	8.327
1939Q2	1.765	1279.575	1288.713	0.217	0.035	1.157	0.051	7.955	8.220
1939Q3	1.163	1315.488	1321.493	0.049	2.513	2.769	0.235	6.671	7.884
1939Q4	1.917	1365.373	1375.358	0.228	3.266	4.446	0.156	7.697	8.503
1940Q1	0.076	1370.597	1370.994	0.135	−0.318	0.384	0.074	6.935	7.323
1940Q2	0.165	1398.129	1398.982	0.017	1.960	2.046	0.126	8.209	8.861
1940Q3	0.160	1443.871	1444.704	0.023	3.158	3.277	0.099	8.859	9.369
1940Q4	0.069	1498.474	1498.834	0.015	3.654	3.732	0.144	8.573	9.321
1941Q1	0.267	1571.735	1573.115	0.021	4.751	4.860	0.012	13.686	13.753
1941Q2	0.389	1645.460	1647.470	0.007	4.584	4.621	0.035	16.228	16.410
1941Q3	0.036	1717.202	1717.386	0.025	4.147	4.277	0.013	17.280	17.346
1941Q4	0.626	1786.398	1789.634	0.033	3.950	4.122	0.031	17.575	17.735
1942Q1	1.024	1878.308	1883.637	0.089	4.835	5.297	0.038	17.819	18.019
1942Q2	1.494	1935.560	1943.284	0.131	2.719	3.401	0.101	16.117	16.637
1942Q3	0.727	2030.737	2034.519	0.041	4.588	4.801	0.034	16.769	16.946
1942Q4	1.198	2138.059	2144.234	0.092	4.964	5.437	0.091	17.788	18.257
1943Q1	0.677	2230.284	2233.781	0.027	4.088	4.226	0.025	17.050	17.178
1943Q2	0.858	2299.540	2303.946	0.067	2.903	3.249	0.040	17.024	17.233
1943Q3	0.233	2378.101	2379.312	0.028	3.217	3.361	0.026	15.654	15.790
1943Q4	0.449	2441.418	2443.688	0.027	2.579	2.719	0.039	13.068	13.272
1944Q1	0.686	2474.754	2478.300	0.044	1.267	1.495	0.058	10.246	10.544
1944Q2	1.377	2500.805	2507.984	0.029	1.045	1.192	0.020	8.387	8.489
1944Q3	0.218	2539.530	2540.653	0.047	1.293	1.537	0.004	6.554	6.574
1944Q4	2.255	2572.081	2583.823	0.096	1.232	1.729	0.072	5.211	5.581
1945Q1	5.024	2595.967	2622.172	0.105	0.924	1.472	0.220	4.639	5.782
1945Q2	4.980	2573.712	2599.588	0.010	−0.889	−0.838	0.248	2.588	3.875
1945Q3	2.746	2456.985	2471.287	0.304	−5.643	−4.061	0.103	−3.305	−2.767
1945Q4	7.256	2321.448	2359.287	0.199	−5.674	−4.639	0.397	−10.709	−8.639
1946Q1	5.789	2227.007	2257.190	0.052	−4.424	−4.155	0.451	−16.335	−13.988
1946Q2	2.007	2192.778	2203.157	0.167	−2.421	−1.551	0.284	−17.020	−15.545
1946Q3	3.735	2194.647	2214.046	0.261	−0.387	0.965	0.281	−11.873	−10.410
1946Q4	4.060	2184.699	2205.833	0.016	−0.454	−0.372	0.495	−7.688	−5.108

Table K.3: Across-specification ranges for real quarterly GDP levels and growth, 1919–1946

Notes: Interquartile ranges give the 25th–75th percentiles; full ranges give the minimum–maximum. Each available primary specification receives equal weight. The count n is reported separately for each quarter and measure; zero counts have blank ranges. GDP levels are annual rates in billions of 2017 dollars. Growth is 100 times the log change, without annualisation. Growth ranges are calculated directly from growth within each original path, not from changes in level endpoints. These ranges describe dispersion across specifications; they are neither confidence intervals nor coherent alternative GDP paths. Their endpoints need not preserve annual GDP. Component reconstruction starts in 1929, so levels have 52 available specifications before 1929 and 58 thereafter. Growth requires one or four earlier quarters, delaying the additional component contributions. The ranges condition on common annual GDP and the retained sources; they do not measure source uncertainty.

	Real GDP level			Quarterly real GDP growth			Four-quarter real GDP growth		
Quarter	Interquartile range	Full range	n	Interquartile range	Full range	n	Interquartile range	Full range	n
1919Q1	834.535–844.465	829.903–860.344	52			0			0
1919Q2	841.119–847.860	826.824–852.575	52	0.24–0.87	−2.36–1.71	52			0
1919Q3	858.345–867.832	847.378–896.970	52	1.18–3.11	−0.61–8.14	52			0
1919Q4	846.455–851.960	818.538–855.304	52	−2.07–−1.18	−8.85–−0.07	52			0
1920Q1	854.906–861.699	816.662–874.821	52	0.84–1.31	−0.23–3.64	52	1.22–3.33	−4.25–5.27	52
1920Q2	839.855–842.649	802.227–846.429	52	−2.52–−1.57	−5.08–−0.34	52	−0.85–0.08	−3.68–0.64	52
1920Q3	840.528–842.468	838.387–890.200	52	−0.10–0.17	−0.70–10.41	52	−3.05–−2.05	−5.02–−0.46	52
1920Q4	819.583–829.774	806.170–856.379	52	−2.84–−1.32	−5.65–−0.72	52	−3.60–−2.13	−5.05–4.52	52
1921Q1	803.903–811.683	772.999–823.876	52	−2.18–−1.71	−7.83–−1.09	52	−6.81–−5.21	−12.37–−2.86	52
1921Q2	816.857–818.247	797.145–820.494	52	0.68–1.63	−0.53–4.78	52	−3.02–−2.58	−3.92–−0.64	52
1921Q3	824.030–828.095	819.909–839.286	52	0.77–1.34	0.03–3.45	52	−2.04–−1.66	−7.84–−1.31	52
1921Q4	835.299–839.215	824.994–876.188	52	1.14–1.60	0.62–6.25	52	0.71–2.34	−0.96–7.07	52
1922Q1	834.587–840.961	831.194–856.186	52	−0.20–0.45	−3.71–1.18	52	2.89–4.51	1.32–10.22	52
1922Q2	850.185–854.126	846.230–855.756	52	1.06–2.32	−0.89–2.68	52	3.94–4.35	3.67–5.98	52
1922Q3	865.691–873.199	845.004–876.275	52	1.82–2.21	−0.42–2.82	52	4.43–5.82	0.68–6.65	52
1922Q4	909.429–913.863	905.646–929.562	52	4.07–5.40	3.55–8.84	52	8.22–8.85	5.91–9.58	52
1923Q1	945.418–947.370	940.982–962.627	52	3.43–4.07	2.25–4.62	52	11.72–12.82	9.56–13.18	52
1923Q2	981.447–985.135	976.551–1010.688	52	3.68–4.11	3.08–6.00	52	13.88–14.73	13.55–17.76	52
1923Q3	993.538–995.549	971.122–998.650	52	0.94–1.29	−3.99–2.05	52	13.01–13.91	12.62–16.07	52
1923Q4	1002.056–1005.183	983.506–1010.455	52	0.70–1.08	0.08–1.55	52	9.22–10.05	5.64–10.94	52
1924Q1	1019.928–1023.805	1009.158–1061.526	52	1.33–2.16	0.15–7.63	52	7.36–7.98	6.36–11.13	52
1924Q2	1004.672–1008.708	985.982–1011.786	52	−1.89–−1.05	−7.38–0.18	52	1.95–2.59	−2.47–3.47	52
1924Q3	998.533–1002.863	961.540–1013.135	52	−0.74–−0.48	−2.51–0.21	52	0.35–0.76	−2.27–1.63	52
1924Q4	1017.441–1021.887	1012.768–1039.842	52	1.33–2.31	0.24–7.83	52	1.30–1.98	0.24–5.57	52

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Table K.3 (continued)

Quarter	Real GDP level			Quarterly real GDP growth			Four-quarter real GDP growth		
	Interquartile range	Full range	n	Interquartile range	Full range	n	Interquartile range	Full range	n
1925Q1	1025.619–1029.725	1018.418–1061.833	52	0.68–0.89	0.28–2.09	52	0.48–0.66	−0.20–1.04	52
1925Q2	1022.058–1026.247	1021.038–1026.572	52	−0.49–−0.13	−3.92–0.80	52	1.31–2.11	1.17–3.49	52
1925Q3	1030.545–1035.579	1012.301–1040.076	52	0.42–1.26	−1.23–1.57	52	3.06–3.25	2.62–5.14	52
1925Q4	1057.647–1060.581	1048.821–1061.711	52	2.29–2.63	1.80–4.05	52	3.46–4.14	0.86–4.62	52
1926Q1	1077.790–1079.978	1058.401–1083.134	52	1.75–1.99	0.91–2.26	52	4.57–5.21	−0.32–6.16	52
1926Q2	1095.848–1098.254	1087.073–1101.040	52	1.59–1.72	1.43–3.14	52	6.59–7.16	5.84–7.43	52
1926Q3	1115.087–1115.895	1112.280–1121.731	52	1.50–1.79	1.05–3.01	52	7.43–7.91	6.74–10.26	52
1926Q4	1122.039–1125.024	1117.959–1142.500	52	0.58–0.86	0.26–1.83	52	5.59–6.17	5.34–8.56	52
1927Q1	1118.948–1125.910	1115.641–1141.995	52	−0.23–0.06	−0.72–0.38	52	3.66–4.32	2.97–6.93	52
1927Q2	1118.633–1121.215	1115.531–1131.862	52	−0.41–−0.05	−0.89–0.13	52	1.90–2.27	1.31–4.04	52
1927Q3	1112.327–1114.150	1110.219–1114.943	52	−0.79–−0.42	−1.92–−0.10	52	−0.30–−0.12	−1.03–0.15	52
1927Q4	1097.960–1104.707	1073.192–1111.281	52	−1.31–−0.85	−3.41–−0.21	52	−2.43–−1.52	−5.83–−0.60	52
1928Q1	1106.144–1108.413	1102.014–1111.556	52	0.27–0.78	−0.25–2.65	52	−1.74–−0.95	−3.56–−0.45	52
1928Q2	1112.212–1113.333	1107.498–1120.435	52	0.49–0.55	0.31–1.64	52	−0.79–−0.50	−2.18–−0.03	52
1928Q3	1130.341–1130.937	1126.314–1136.136	52	1.54–1.68	0.96–2.23	52	1.44–1.66	1.02–2.31	52
1928Q4	1156.607–1159.000	1149.721–1166.485	52	2.29–2.49	1.19–2.96	52	4.60–5.39	3.60–8.34	52
1929Q1	1183.582–1186.203	1161.472–1205.469	58	2.13–2.40	0.61–2.88	52	6.59–6.91	5.24–7.45	52
1929Q2	1199.459–1203.057	1195.092–1203.713	58	1.21–1.63	−0.53–2.85	58	7.57–7.86	6.45–8.07	52
1929Q3	1205.141–1208.241	1198.364–1235.971	58	0.29–0.58	−0.40–3.36	58	6.44–6.69	5.85–8.42	52
1929Q4	1168.829–1172.429	1158.427–1175.208	58	−3.34–−2.80	−5.32–−2.03	58	0.92–1.40	−0.17–2.01	52
1930Q1	1130.869–1133.389	1127.823–1149.665	58	−3.51–−3.14	−3.86–−1.92	58	−4.64–−4.34	−6.66–−1.02	58
1930Q2	1106.097–1109.317	1097.058–1148.550	58	−2.43–−2.08	−3.03–−0.10	58	−8.32–−7.99	−9.23–−3.97	58
1930Q3	1070.016–1071.608	1048.158–1073.643	58	−3.55–−3.19	−9.15–−2.23	58	−12.13–−11.87	−16.48–−11.06	58
1930Q4	1046.927–1051.680	1012.767–1058.345	58	−2.28–−1.85	−4.41–−1.06	58	−11.17–−10.83	−14.60–−9.64	58
1931Q1	1045.262–1050.362	1022.876–1066.928	58	−0.21–0.03	−0.68–1.41	58	−8.10–−7.52	−11.69–−5.65	58
1931Q2	1040.470–1045.483	1037.486–1058.968	58	−0.89–0.00	−2.69–3.40	58	−6.14–−5.81	−8.42–−5.40	58
1931Q3	1011.707–1015.003	1009.980–1022.083	58	−3.03–−2.68	−3.55–−1.79	58	−5.64–−5.30	−5.97–−2.81	58
1931Q4	973.457–977.523	955.160–983.783	58	−4.13–−3.46	−6.59–−2.63	58	−7.62–−7.02	−9.73–−3.07	58
1932Q1	936.283–942.862	914.881–981.027	58	−3.94–−3.38	−4.89–−0.11	58	−11.37–−10.35	−15.37–−4.18	58
1932Q2	887.901–892.204	873.072–899.395	58	−5.85–−5.23	−11.33–−1.80	58	−16.34–−15.55	−19.30–−14.40	58
1932Q3	861.421–867.039	839.189–892.025	58	−3.61–−2.51	−4.56–−0.73	58	−16.37–−15.67	−19.43–−13.29	58
1932Q4	856.998–862.216	847.568–870.243	58	−0.75–0.07	−5.04–3.29	58	−12.81–−12.17	−14.19–−10.33	58

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Table K.3 (continued)

Quarter	Real GDP level			Quarterly real GDP growth			Four-quarter real GDP growth		
	Interquartile range	Full range	n	Interquartile range	Full range	n	Interquartile range	Full range	n
1933Q1	825.983–833.485	725.766–858.354	58	−4.38–−2.82	−16.68–−0.06	58	−13.26–−11.74	−30.14–−7.96	58
1933Q2	857.418–866.124	843.616–873.219	58	3.12–4.84	0.86–15.05	58	−3.76–−2.66	−4.40–−0.85	58
1933Q3	908.578–921.529	876.674–1041.029	58	5.32–6.79	0.45–21.03	58	4.80–6.77	−1.74–21.55	58
1933Q4	897.102–910.915	875.082–932.614	58	−2.81–0.22	−14.63–6.19	58	4.03–5.75	0.61–9.55	58
1934Q1	946.517–952.694	935.654–989.226	58	4.19–5.31	3.33–9.90	58	12.84–14.12	8.62–30.97	58
1934Q2	978.157–986.992	962.232–1039.962	58	3.04–4.19	−0.16–7.02	58	12.61–13.70	9.71–20.92	58
1934Q3	968.518–974.356	926.185–985.828	58	−1.90–−0.24	−11.59–2.37	58	5.03–7.08	−11.69–11.23	58
1934Q4	984.070–990.956	933.679–1004.784	58	1.45–1.78	0.81–2.37	58	7.82–9.59	3.75–10.52	58
1935Q1	1024.496–1030.656	995.912–1055.669	58	3.49–4.45	0.38–12.28	58	7.27–8.57	3.04–8.86	58
1935Q2	1032.765–1035.965	1018.243–1041.274	58	0.24–1.08	−3.37–4.05	58	4.57–5.78	−1.77–7.84	58
1935Q3	1061.277–1065.463	1032.794–1090.083	58	2.63–3.02	1.05–4.96	58	8.84–9.39	8.16–11.89	58
1935Q4	1108.459–1111.441	1104.770–1124.882	58	4.10–4.45	1.85–8.54	58	11.28–12.20	9.49–18.63	58
1936Q1	1130.954–1139.590	1102.828–1146.646	58	1.91–2.63	−1.44–3.72	58	9.30–10.82	4.61–12.57	58
1936Q2	1182.525–1185.861	1179.280–1188.905	58	3.83–4.51	3.11–7.12	58	13.28–13.69	12.75–15.10	58
1936Q3	1215.060–1218.095	1212.632–1227.133	58	2.50–2.92	2.16–3.81	58	13.12–13.77	10.88–17.07	58
1936Q4	1241.217–1248.740	1237.858–1267.066	58	2.05–2.49	1.92–3.37	58	11.18–11.83	10.65–12.43	58
1937Q1	1260.709–1265.573	1250.488–1281.436	58	1.23–1.58	0.25–2.72	58	10.09–11.18	9.03–14.11	58
1937Q2	1272.470–1275.610	1264.646–1289.802	58	0.75–1.19	−0.93–1.86	58	7.22–7.49	6.49–8.96	58
1937Q3	1267.644–1277.880	1260.169–1318.215	58	−0.29–0.12	−0.67–2.18	58	4.14–4.80	3.79–7.33	58
1937Q4	1209.074–1220.890	1144.174–1243.883	58	−5.52–−3.53	−14.16–−1.30	58	−3.22–−1.63	−10.20–0.46	58
1938Q1	1178.256–1194.142	1102.045–1215.787	58	−2.61–−2.22	−3.75–−1.68	58	−7.05–−5.59	−14.49–−3.36	58
1938Q2	1182.687–1191.327	1125.861–1204.181	58	−0.12–0.12	−0.96–2.14	58	−7.69–−6.58	−13.59–−4.90	58
1938Q3	1218.971–1229.650	1209.066–1271.455	58	2.23–3.92	0.40–12.16	58	−4.00–−3.83	−4.26–−3.61	58
1938Q4	1254.512–1269.980	1230.442–1360.115	58	2.92–3.33	1.75–6.90	58	2.78–5.04	−1.09–17.29	58
1939Q1	1273.479–1278.471	1268.309–1303.860	58	0.65–1.43	−4.44–3.03	58	6.44–8.10	4.23–16.60	58
1939Q2	1280.327–1287.803	1228.574–1301.078	58	0.14–1.11	−5.73–2.55	58	7.81–8.05	7.56–9.79	58
1939Q3	1315.778–1319.495	1275.538–1328.750	58	2.45–2.74	2.10–3.75	58	6.77–7.89	0.32–9.44	58
1939Q4	1368.317–1374.481	1351.324–1444.299	58	3.64–4.36	1.68–12.43	58	7.91–8.53	4.09–9.37	58
1940Q1	1370.977–1377.569	1356.138–1396.957	58	−0.31–0.63	−3.33–1.37	58	7.00–7.58	4.79–8.93	58
1940Q2	1396.400–1399.037	1391.803–1402.360	58	1.50–1.97	0.38–2.82	58	8.27–8.80	7.29–13.22	58
1940Q3	1441.248–1444.475	1430.643–1449.704	58	3.09–3.27	2.01–4.02	58	8.63–9.32	8.28–11.71	58
1940Q4	1496.870–1498.840	1482.464–1520.421	58	3.62–3.90	3.55–5.20	58	8.54–9.03	2.61–11.19	58

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Table K.3 (continued)

Quarter	Real GDP level			Quarterly real GDP growth			Four-quarter real GDP growth		
	Interquartile range	Full range	n	Interquartile range	Full range	n	Interquartile range	Full range	n
1941Q1	1566.300–1572.966	1547.641–1604.110	58	4.55–4.86	4.30–5.47	58	12.85–13.73	10.24–16.56	58
1941Q2	1646.192–1647.738	1641.748–1657.320	58	4.63–4.94	3.11–6.30	58	16.30–16.51	15.76–17.40	58
1941Q3	1717.919–1724.837	1714.505–1744.496	58	4.19–4.53	3.39–5.67	58	17.33–18.04	16.78–19.83	58
1941Q4	1786.228–1789.469	1738.966–1796.552	58	3.67–3.98	0.36–4.44	58	17.58–17.84	13.64–18.75	58
1942Q1	1872.443–1883.621	1795.301–1929.907	58	4.48–5.27	2.97–7.88	58	17.75–18.21	11.26–22.07	58
1942Q2	1934.471–1947.151	1865.382–1952.859	58	2.74–3.85	−0.90–4.30	58	16.05–16.77	11.89–17.27	58
1942Q3	2030.727–2037.836	2000.240–2076.593	58	4.51–4.85	4.18–10.73	58	16.63–16.92	13.68–18.54	58
1942Q4	2136.335–2145.101	2130.969–2255.563	58	4.75–5.51	4.38–8.37	58	17.74–18.29	17.14–26.01	58
1943Q1	2230.897–2236.543	2226.956–2267.150	58	4.08–4.35	−0.46–4.76	58	17.03–17.52	15.59–22.72	58
1943Q2	2299.066–2310.529	2283.169–2321.395	58	2.85–3.39	1.39–3.74	58	17.09–17.31	16.80–21.69	58
1943Q3	2377.660–2382.334	2319.756–2384.510	58	3.05–3.38	−0.03–3.80	58	15.59–15.81	11.18–16.94	58
1943Q4	2432.682–2445.790	2417.542–2464.084	58	2.12–2.80	1.48–5.75	58	12.85–13.14	8.83–13.45	58
1944Q1	2474.003–2479.658	2445.073–2509.708	58	1.26–1.83	0.34–2.06	58	10.17–10.55	8.07–11.19	58
1944Q2	2499.693–2511.443	2419.224–2517.114	58	0.98–1.36	−3.43–1.65	58	8.27–8.46	4.13–8.63	58
1944Q3	2533.149–2539.478	2505.844–2542.157	58	0.91–1.59	0.75–3.82	58	6.25–6.57	5.98–8.10	58
1944Q4	2576.420–2585.118	2557.432–2683.135	58	1.57–1.82	0.60–6.53	58	5.50–5.93	4.79–9.25	58
1945Q1	2604.682–2624.609	2562.940–2770.348	58	1.12–1.50	0.22–4.70	58	5.04–5.84	3.20–12.49	58
1945Q2	2576.895–2598.137	2539.990–2755.260	58	−0.98–−0.84	−5.62–−0.18	58	2.73–3.93	0.90–10.89	58
1945Q3	2456.708–2475.145	2381.317–2527.668	58	−5.59–−4.02	−14.59–−1.18	58	−3.30–−2.40	−6.45–0.86	58
1945Q4	2313.049–2341.615	2093.304–2408.716	58	−5.98–−5.21	−13.89–−3.26	58	−11.18–−9.67	−23.32–−5.99	58
1946Q1	2229.857–2248.576	1980.867–2300.391	58	−4.17–−3.72	−5.52–1.59	58	−16.23–−14.69	−33.54–−10.81	58
1946Q2	2193.502–2207.048	2026.907–2282.150	58	−2.13–−1.57	−3.52–2.30	58	−16.93–−15.54	−30.70–−11.40	58
1946Q3	2200.805–2212.886	2165.226–2353.931	58	−0.16–0.82	−5.25–14.96	58	−11.73–−10.53	−15.48–−1.16	58
1946Q4	2176.072–2203.939	2148.233–2477.939	58	−1.23–−0.36	−1.49–5.13	58	−7.29–−4.96	−11.44–16.87	58

Table K.4: Monthly real GDP, January 1909–June 2010 (billions of 2017 dollars, annual rates)

Notes: Seasonally adjusted annual-rate levels are point allocations without monthly uncertainty intervals. Average the three months within a quarter to recover its quarterly anchor; do not sum them. Proportional Denton allocation uses Persons activity before 1919 and industrial production from 1919 to 1958. Quarterly anchors are the reconstructed real GDP series before 1947 and BEA quarterly GDP thereafter. From January 1959, the Stock–Watson monthly GDP shape is matched to the common BEA quarterly levels (Stock & Watson, 2010). This continuation is itself estimated. Quarterly prediction tests do not establish monthly timing accuracy. The 1909–1918 extension has its own limited annual calibration. The final year ends in June; later months are blank. Values are rounded to three decimal places; accounting holds at the full precision retained in the electronic release.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1909	612.987	631.394	640.269	632.319	633.199	647.417	648.472	654.653	656.168	656.957	675.248	663.852
1910	656.690	655.692	680.409	658.958	644.552	653.363	644.412	642.945	648.468	641.970	655.534	653.417
1911	661.576	660.135	674.197	660.026	681.888	677.067	671.076	685.026	683.472	680.981	676.648	678.208
1912	670.962	703.424	684.001	702.811	705.917	682.484	707.569	723.734	700.186	745.639	721.633	720.991
1913	744.139	745.368	718.269	733.065	741.552	731.973	742.129	727.262	757.731	724.430	712.102	725.657
1914	701.742	690.077	710.332	705.259	690.204	694.810	692.975	662.717	668.619	651.311	628.966	632.610
1915	642.346	660.137	658.686	655.801	662.629	692.162	693.162	697.707	719.816	737.576	753.828	777.405
1916	768.453	791.834	806.644	805.816	776.810	788.752	780.435	814.547	792.919	795.326	804.584	783.172
1917	794.952	749.829	748.360	767.299	790.823	786.689	779.498	770.378	756.187	773.943	793.082	763.048
1918	728.212	784.242	849.979	866.433	851.061	843.056	879.330	884.872	876.681	841.232	843.088	862.342
1919	871.518	834.908	814.386	834.364	831.490	862.284	874.438	867.773	850.371	861.169	847.499	841.448
1920	877.718	856.541	840.796	816.201	849.633	861.696	834.870	849.061	843.365	845.059	814.559	806.903
1921	803.255	814.415	805.027	804.866	827.132	820.464	813.387	835.799	830.537	863.983	835.225	810.852
1922	821.118	836.997	863.386	818.745	849.614	883.603	879.698	849.037	873.756	891.225	911.665	933.899
1923	925.485	942.870	968.920	976.945	986.817	986.451	996.584	997.329	992.712	1005.359	1013.814	990.544
1924	1004.869	1028.484	1029.547	1029.091	1008.814	979.437	972.599	1005.312	1025.729	1022.475	1016.872	1023.439
1925	1037.449	1025.528	1020.094	1030.095	1027.556	1021.358	1052.100	1032.497	1012.386	1040.673	1058.037	1074.213
1926	1067.178	1075.456	1094.942	1098.497	1090.338	1102.299	1102.498	1112.984	1129.234	1128.833	1123.713	1118.371
1927	1112.794	1121.994	1137.009	1112.861	1124.603	1122.666	1111.521	1117.661	1109.093	1099.073	1102.367	1100.611
1928	1107.305	1105.384	1109.003	1104.783	1115.607	1118.809	1123.232	1135.439	1133.362	1143.211	1156.337	1173.036
1929	1189.302	1182.092	1181.264	1195.054	1207.511	1206.091	1211.627	1200.932	1206.678	1211.635	1170.543	1130.760
1930	1137.528	1138.103	1123.599	1116.153	1108.632	1095.668	1070.963	1070.397	1071.709	1060.516	1049.630	1034.522
1931	1035.879	1042.879	1060.595	1058.276	1045.144	1030.766	1034.728	1018.191	990.548	973.049	974.846	974.824
1932	945.106	931.930	940.219	904.294	891.922	869.585	844.645	857.846	888.164	879.090	861.094	847.073
1933	852.459	857.132	782.686	791.344	868.133	939.343	960.161	904.829	881.779	903.411	886.467	901.429
1934	915.453	944.543	974.024	962.008	989.020	998.670	975.838	993.478	946.048	983.818	976.994	1007.261
1935	1037.594	1029.253	1021.043	1022.325	1033.145	1049.300	1041.671	1067.615	1078.710	1088.565	1105.550	1131.261
1936	1142.756	1125.504	1132.980	1177.350	1180.710	1190.799	1208.206	1217.227	1226.538	1227.023	1245.413	1268.506
1937	1250.286	1257.247	1280.871	1280.119	1280.801	1258.221	1257.631	1275.000	1291.087	1278.282	1214.947	1153.544

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Table K.4 (continued)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1938	1164.211	1183.733	1208.064	1204.259	1176.975	1172.014	1203.291	1234.342	1240.412	1243.816	1272.900	1274.411
1939	1269.126	1276.924	1283.316	1283.499	1275.545	1293.266	1311.328	1301.886	1342.294	1360.357	1372.401	1378.439
1940	1395.627	1371.102	1345.880	1365.938	1397.741	1432.043	1438.024	1436.594	1458.207	1472.540	1494.797	1528.406
1941	1543.097	1569.662	1604.307	1599.071	1665.460	1674.789	1695.759	1722.193	1734.018	1767.738	1784.283	1812.213
1942	1838.605	1878.770	1925.621	1915.491	1945.545	1957.282	1993.694	2038.551	2065.638	2108.483	2139.281	2175.543
1943	2189.081	2244.092	2262.819	2298.879	2314.201	2292.130	2343.206	2374.431	2418.526	2439.430	2461.829	2426.508
1944	2456.661	2483.115	2489.947	2504.994	2502.280	2505.997	2512.171	2556.159	2551.922	2573.315	2571.786	2588.676
1945	2594.374	2613.171	2619.523	2591.374	2572.745	2595.727	2644.315	2452.285	2296.010	2253.678	2371.086	2396.395
1946	2258.512	2133.876	2333.967	2259.723	2132.002	2202.296	2197.119	2212.162	2203.672	2211.066	2194.211	2180.327
1947	2182.385	2179.816	2185.842	2170.902	2180.176	2179.598	2164.928	2172.241	2180.127	2188.422	2211.280	2219.654
1948	2238.835	2249.563	2230.648	2241.169	2281.077	2307.824	2300.084	2290.430	2278.796	2307.433	2289.519	2280.141
1949	2270.815	2266.510	2245.095	2258.848	2246.736	2253.800	2253.400	2277.367	2298.505	2208.556	2263.279	2300.222
1950	2337.458	2328.977	2371.877	2401.255	2411.174	2440.617	2481.134	2536.482	2515.765	2545.061	2545.731	2586.850
1951	2582.602	2593.077	2606.222	2618.153	2634.750	2663.791	2679.303	2686.788	2713.686	2695.478	2701.226	2700.765
1952	2710.972	2725.087	2747.804	2753.526	2739.995	2707.879	2640.905	2779.112	2840.534	2822.910	2851.196	2857.717
1953	2875.572	2895.987	2918.874	2923.885	2929.645	2904.088	2923.129	2910.775	2874.451	2892.809	2860.795	2822.931
1954	2830.167	2856.954	2848.455	2830.209	2849.828	2864.878	2879.605	2879.667	2882.174	2908.454	2941.722	2960.379
1955	3001.940	3010.875	3049.423	3051.433	3079.693	3078.604	3113.033	3107.321	3113.782	3139.777	3126.940	3123.487
1956	3133.366	3105.626	3114.774	3157.081	3144.802	3129.199	3042.250	3162.889	3217.484	3213.519	3164.427	3199.764
1957	3186.681	3222.646	3229.707	3203.524	3201.678	3212.708	3228.679	3241.263	3242.216	3238.358	3200.282	3173.043
1958	3144.888	3110.218	3107.066	3092.901	3133.253	3197.518	3196.567	3221.776	3223.309	3243.933	3320.145	3303.019
1959	3322.718	3347.404	3386.265	3429.953	3401.354	3451.695	3465.655	3432.026	3392.489	3451.893	3399.815	3467.787
1960	3500.542	3515.880	3535.120	3505.582	3512.162	3476.994	3527.785	3486.769	3531.601	3501.670	3503.737	3405.427
1961	3473.754	3497.866	3509.489	3539.386	3554.728	3564.949	3570.375	3638.172	3655.209	3662.126	3719.381	3695.360
1962	3741.373	3757.465	3775.603	3752.018	3810.241	3814.188	3819.719	3837.254	3859.355	3841.042	3840.495	3872.726
1963	3887.669	3896.407	3896.370	3901.860	3939.189	3970.500	4007.974	4021.570	4041.722	4056.113	4045.632	4048.696
1964	4131.551	4131.712	4143.397	4156.250	4174.485	4211.041	4210.459	4238.405	4288.890	4240.899	4237.151	4299.088
1965	4432.675	4253.339	4400.319	4390.567	4433.671	4427.437	4484.742	4530.565	4530.975	4594.504	4618.292	4645.578
1966	4679.104	4740.996	4775.564	4743.052	4745.533	4755.553	4780.641	4792.446	4791.675	4837.368	4839.580	4805.664
1967	4905.908	4839.445	4865.543	4893.157	4872.354	4854.349	4892.061	4977.029	4889.085	4854.000	4960.561	5054.870
1968	5060.760	5026.678	5085.220	5158.693	5145.442	5121.964	5165.209	5257.174	5123.194	5234.399	5201.465	5170.772
1969	5260.930	5271.512	5318.349	5302.360	5319.941	5276.574	5331.034	5363.753	5309.013	5343.323	5289.299	5293.046
1970	5263.230	5340.838	5297.887	5328.566	5275.426	5320.500	5384.783	5406.371	5280.077	5300.469	5294.181	5304.366
1971	5448.526	5411.503	5470.827	5476.584	5481.611	5460.982	5503.083	5517.346	5533.787	5493.421	5495.026	5604.650
1972	5648.260	5569.029	5680.657	5749.247	5781.125	5751.038	5760.219	5845.348	5838.995	5905.037	5909.862	5921.761
1973	6045.064	6046.828	6083.740	6139.100	6110.417	6124.001	6138.623	6002.500	6135.780	6124.797	6154.647	6170.950
1974	6109.855	6051.846	6130.073	6080.741	6128.982	6125.530	6070.777	6015.673	6075.485	6065.374	6006.835	6019.183

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Table K.4 (continued)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1975	5955.068	5995.962	5920.075	5975.513	5996.920	6026.398	6085.832	6098.302	6122.844	6198.425	6168.456	6186.709
1976	6303.228	6348.070	6319.649	6332.877	6378.371	6398.827	6406.564	6378.889	6429.231	6454.685	6403.041	6495.805
1977	6534.427	6505.368	6543.314	6623.461	6725.720	6614.217	6758.664	6767.648	6797.060	6721.784	6790.245	6811.748
1978	6760.559	6691.654	6936.567	7031.266	7050.364	7095.130	7052.607	7191.436	7145.702	7176.130	7220.855	7280.265
1979	7194.330	7254.515	7267.337	7238.215	7229.665	7271.482	7420.220	7254.697	7225.925	7351.112	7293.878	7310.616
1980	7484.830	7266.982	7272.859	7388.506	7085.944	7096.417	7200.591	7144.595	7200.044	7285.433	7272.886	7388.712
1981	7386.498	7469.008	7521.560	7354.357	7414.594	7442.283	7523.580	7423.110	7530.525	7358.589	7475.067	7398.647
1982	7187.856	7308.594	7390.444	7458.537	7185.806	7342.393	7378.044	7186.488	7338.157	7278.558	7287.839	7345.053
1983	7398.560	7396.879	7404.759	7524.898	7511.560	7668.910	7649.581	7732.556	7777.101	7775.955	7901.842	7964.586
1984	7976.193	8036.093	8092.255	8084.343	8247.167	8189.499	8181.975	8357.798	8217.623	8298.223	8309.736	8352.638
1985	8347.371	8433.795	8421.294	8454.829	8491.461	8478.070	8601.233	8682.308	8529.120	8721.930	8652.620	8630.015
1986	8673.920	8793.134	8780.327	8813.888	8768.332	8783.351	8820.745	8843.939	8953.119	8983.565	8826.096	8950.919
1987	8930.035	8960.019	9069.048	9091.465	9073.622	9084.680	9118.617	9126.638	9240.817	9263.038	9301.326	9393.632
1988	9298.613	9342.648	9461.245	9423.601	9515.747	9532.434	9511.926	9564.759	9561.932	9603.807	9648.185	9768.224
1989	9847.098	9737.549	9730.527	9811.576	9817.223	9910.080	9925.288	9923.662	9908.734	9915.940	9952.294	9948.066
1990	10000.654	10081.673	10059.832	10112.773	10103.152	10035.640	10146.567	10048.410	10076.730	9972.829	10040.904	9982.379
1991	9942.444	9984.867	9928.437	10070.265	10001.783	10016.482	10077.825	10025.752	10137.009	10110.916	10156.597	10078.474
1992	10176.135	10237.736	10295.434	10317.135	10288.166	10436.986	10446.934	10437.725	10464.360	10525.911	10558.251	10591.782
1993	10565.635	10600.226	10562.964	10603.922	10649.689	10659.930	10625.439	10674.866	10765.513	10724.148	10874.843	10902.970
1994	10906.508	10951.140	10959.700	11003.952	11156.129	11102.003	11120.994	11192.397	11143.137	11251.580	11253.208	11335.008
1995	11375.949	11264.233	11319.671	11313.760	11335.013	11412.390	11389.703	11436.705	11524.522	11514.553	11511.603	11558.045
1996	11607.510	11600.238	11635.506	11810.956	11772.370	11841.094	11894.777	11903.466	11943.946	12074.657	12065.521	11973.147
1997	12061.435	12146.213	12138.768	12305.204	12269.418	12377.040	12443.949	12442.329	12526.752	12583.640	12539.847	12608.999
1998	12578.242	12742.866	12790.117	12776.384	12774.535	12913.097	12897.044	12941.742	13109.471	13161.330	13230.266	13183.413
1999	13228.721	13304.435	13413.635	13396.901	13441.640	13441.703	13572.863	13571.492	13669.958	13736.756	13843.423	13903.761
2000	13805.302	13869.232	13959.907	14107.550	14123.377	14161.797	14073.350	14202.779	14159.807	14254.936	14254.409	14179.950
2001	14218.273	14173.164	14157.923	14257.575	14328.610	14228.897	14192.910	14333.387	14117.251	14182.716	14169.014	14408.991
2002	14411.700	14315.981	14390.675	14432.792	14442.505	14507.248	14570.049	14481.378	14507.471	14512.859	14533.565	14566.316
2003	14578.126	14687.791	14576.507	14694.157	14685.792	14850.752	14931.450	14979.510	15055.386	15142.871	15183.212	15162.198
2004	15130.520	15275.018	15340.502	15334.008	15448.123	15318.419	15523.857	15518.549	15495.451	15668.514	15659.587	15684.539
2005	15861.915	15802.337	15869.929	15885.504	15865.467	16017.376	16042.075	16110.158	15990.528	16070.784	16095.238	16244.180
2006	16260.480	16302.162	16498.863	16364.689	16409.770	16413.994	16380.650	16408.614	16472.950	16530.109	16610.163	16545.326
2007	16580.149	16674.862	16580.060	16696.074	16743.171	16700.697	16676.637	16802.982	16949.142	16867.690	16876.475	17001.408
2008	16970.744	16757.566	16800.699	16909.845	16912.319	17007.709	16983.374	16852.655	16726.856	16569.966	16623.444	16262.640
2009	16353.991	16302.313	16238.481	16277.540	16313.952	16215.944	16247.253	16338.019	16393.571	16579.207	16508.057	16420.998
2010	16559.617	16551.224	16637.288	16817.201	16751.734	16660.552						

Table K.5: Monthly nominal GDP, January 1919–December 1963 (billions of current dollars, annual rates)

Notes: Seasonally adjusted annual-rate levels are point allocations without monthly uncertainty intervals. Average the three months within a quarter to recover its quarterly anchor; do not sum them. Proportional Denton allocation uses industrial production multiplied by producer prices. Quarterly anchors are the separately estimated nominal GDP reconstruction before 1947 and BEA quarterly nominal GDP thereafter. Nominal estimates do not enter real-GDP specification selection. Quarterly prediction tests do not establish monthly timing accuracy. Values are rounded to three decimal places; accounting holds at the full precision retained in the electronic release.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1919	78.990	74.929	72.946	75.390	75.678	78.708	80.920	82.472	79.468	81.530	81.985	86.064
1920	91.807	90.064	87.648	88.343	92.243	94.139	90.323	91.891	91.707	89.195	83.576	80.017
1921	78.200	76.600	75.534	74.070	74.886	73.134	71.722	73.969	73.461	76.150	73.258	70.785
1922	69.627	72.135	73.346	69.111	72.604	75.137	75.390	72.104	74.549	76.311	78.541	80.826
1923	80.617	82.908	86.045	87.114	86.727	86.900	86.330	86.654	88.165	88.603	88.659	86.133
1924	88.011	90.058	89.343	89.270	87.114	84.284	83.469	87.036	88.456	88.447	88.096	89.848
1925	90.831	90.270	89.647	90.040	90.266	90.444	93.954	91.355	89.020	91.639	94.470	95.452
1926	95.375	95.789	96.078	97.687	97.320	98.504	97.736	98.641	100.288	99.768	99.050	98.385
1927	95.574	98.364	98.960	96.564	97.189	96.729	95.505	96.611	95.888	95.452	95.457	95.298
1928	96.231	96.097	95.678	96.414	98.150	97.496	98.194	99.148	99.472	99.667	100.797	102.317
1929	103.881	103.349	104.062	105.018	105.903	106.119	107.058	105.916	105.803	106.136	102.184	99.243
1930	99.491	99.412	96.710	96.061	95.848	93.682	89.112	89.519	89.216	87.674	85.856	83.338
1931	83.141	82.879	83.739	82.463	80.654	78.301	77.920	76.014	72.716	70.554	70.993	69.319
1932	66.487	64.634	65.018	61.790	60.230	57.803	55.945	56.468	58.380	57.109	55.848	54.552
1933	54.410	53.900	49.587	49.460	55.825	61.093	64.403	59.289	57.933	60.472	59.558	59.918
1934	61.705	64.602	66.719	65.757	67.794	68.743	66.756	68.426	65.739	67.981	67.609	69.770
1935	72.792	71.932	71.348	71.610	72.754	73.561	72.586	74.834	75.318	76.387	77.745	80.025
1936	80.462	79.481	79.495	82.784	82.663	84.238	85.926	86.634	86.758	87.391	89.700	92.428
1937	91.694	92.311	95.082	95.427	95.621	93.309	93.654	94.888	96.393	94.712	89.176	83.769
1938	84.512	85.542	87.307	86.022	84.859	84.782	86.990	88.280	88.832	89.044	91.211	90.844
1939	90.222	91.135	91.324	90.706	90.595	91.483	92.257	90.696	97.317	98.533	97.948	99.030
1940	100.412	98.543	96.622	97.830	100.562	102.775	103.392	103.352	104.341	106.585	108.589	111.785
1941	113.569	115.604	118.804	119.988	125.786	128.619	131.368	134.684	136.556	140.296	141.053	145.380
1942	148.746	153.143	157.735	157.903	160.847	161.872	165.428	170.042	173.295	177.296	180.462	184.655
1943	186.164	192.617	195.219	198.769	200.717	199.127	203.705	206.953	211.468	214.114	214.555	213.600
1944	216.406	218.912	220.646	221.959	222.105	223.768	223.738	227.853	227.759	229.578	229.585	231.052
1945	232.534	234.162	233.842	232.981	233.327	236.385	242.096	224.584	210.357	208.338	221.972	225.506
1946	214.703	205.701	228.462	225.314	212.920	219.978	235.981	239.078	224.775	239.459	243.809	240.239
1947	241.004	242.147	246.340	245.080	246.281	246.543	246.413	249.016	253.326	256.262	259.941	263.031
1948	269.702	266.068	261.456	266.326	272.739	278.636	279.427	279.996	278.166	281.463	280.746	278.889

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Table K.5 (continued)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1949	277.807	275.004	272.291	273.058	270.667	270.327	270.006	272.613	276.048	265.533	271.760	274.588
1950	278.877	279.946	283.661	287.207	289.766	294.177	302.306	311.174	310.979	315.365	317.232	327.238
1951	332.662	337.343	337.995	340.726	343.148	348.396	350.093	349.361	354.701	354.424	356.654	357.457
1952	358.135	359.070	362.256	362.762	361.589	358.740	351.341	371.980	379.781	378.839	381.963	381.634
1953	383.864	387.830	392.246	391.796	393.688	389.762	395.303	390.578	387.632	389.955	385.484	382.472
1954	384.287	386.612	385.136	383.749	386.648	387.966	391.088	391.201	390.699	394.889	401.643	402.671
1955	409.532	412.441	417.246	418.883	420.942	424.771	428.624	429.371	432.669	438.170	436.033	437.073
1956	440.764	438.345	440.130	445.606	446.563	445.860	433.819	455.277	464.477	462.600	455.813	462.975
1957	464.379	471.393	473.565	471.456	470.569	474.050	478.038	481.510	478.922	478.140	474.147	472.305
1958	469.603	465.575	467.443	463.368	471.426	481.139	481.883	487.621	488.019	491.516	504.745	502.404
1959	506.921	512.239	511.831	515.813	522.985	529.161	529.906	520.195	525.001	520.870	519.642	545.288
1960	549.953	540.384	537.607	538.820	542.619	541.801	545.355	547.967	543.490	545.368	540.482	534.740
1961	542.555	545.299	547.199	551.733	556.428	558.474	566.444	570.397	566.151	573.446	580.801	587.589
1962	585.174	596.706	600.158	601.325	600.581	599.191	605.528	606.629	614.924	610.705	613.496	612.639
1963	618.267	623.369	623.380	622.117	630.945	636.194	639.948	643.442	649.942	652.536	656.676	652.602