Monetary Policy

Part 1: Basic Macroeconomic Concepts

Lecture 1: GDP Measurement, Growth and Business Cycles

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Organizational Issues Regarding the Online Lecture

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Please note that the provision of the recordings is an additional service of the Chair. The recordings will be available only for a limited time (approx. 2 weeks).

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There are two options for asking questions during the lecture. First, you can unmute yourself and interrupt me directly. Alternatively, you can send your questions via the Zoom-chat function. You can also write in the chat if you have the feeling that the speed of the lecture is too fast (or too slow).

Questions during the lecture will be recorded and uploaded while the recording will be stopped before questions at the end of the lecture.

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Overview

Purpose of this course

- Bridge between theory and practice of monetary policy

- Learn key concepts and analytical tools and apply them to real-world situations to …

  - … make sense of and engage in current debates

  - … understand how professional economists and policymakers think

  - … analyze current economic developments to give policy advice, make investment decisions and incorporate macroeconomic/policy aspects in management decisions

Teaching Approach

- Rather non-technical approach, focus on intuition

- Focus on the most important concepts to memorize these far beyond the exam

- Concepts are nevertheless based on state-of-the-art theories and empirical methods

Other courses offered by my Chair on the Master level

International Financial Management (Winter 2021/22)

- International aspects of monetary economics, international aspects of financial management

- Topics include foreign exchange market, the international monetary system and capital markets, determination of exchange rates and foreign currency risk

- A good complement to the current course as international/global developments are increasingly important

- The course is thought to be be appealing not only for economics, but also for business students.

Applied Empirical Macroeconomics (Summer 2022)

- Applied introduction to time series analysis including applications to monetary policy.

- Very useful preparation for students who want to work as Macroeconomists. In this course you learn the most important methods used by Macroeconomists in practice.

- Very useful preparation for a research-oriented Master thesis and for students interested in PhD studies.

Seminar in Monetary Economics (Summer and Winter Term)

- Study in more depths a topic in the area Monetary Economics

- Highly advisable to take this seminar if you want to write your Master Thesis at my Chair

Prerequisites / What I expect from you

Prerequisites

- Basic Microeconomics and Macroeconomics

What I expect from you

- Being open minded. I teach concepts that economists generally agree on and that are of immediate relevance for real-world problems.

- Interest in macroeconomics and economic policy

- Regularly attending the lecture and the exercise session

- Study the material again in detail after the lecture. Reserve some time in your regular weekly schedule for this, not just before the exam!

Outline

Part 1: Basic Macroeconomic Concepts

- Lecture 1: GDP Measurement, Growth and Business Cycles

- Lecture 2: The Long Run: Solow Model and Equilibrium Unemployment

- Lecture 3: The Long Run: Natural Interest Rate and Quantity Theory

- Lecture 4: The Short Run: The IS-MP-PC Model

Part 2: Conventional Monetary Policy

Part 3: Monetary Policy at the Zero Lower Bound on Nominal Interest Rate

Part 4: Monetary and Fiscal Interactions

Part 5: Financial Stability (if time permits)

Mock Exam

Literature

- The slides are relatively detailed, so that they also serve as the script of this course. Together with the exercise sessions, the slides are the main source to study for the exam.

- The course does not directly follow one specific textbook, but some key references are given for each lecture that can be studied for a better understanding.

- I will also sometimes point to some additional optional literature. Optional literature refers to references that are truly optional for interested students and are not needed for studying for the exam.

Textbooks

Useful textbooks on Monetary Economics that some of the material in this course is based on:

1. Carl Walsh (2017). Monetary Theory and Policy, MIT Press, 4th edition
   - The key reference for Monetary Economics
   - Broad coverage, highly technical, research oriented
   - Beyond the level of this course, suitable for highly advanced Master students and for PhD studies

2. Jordi Galí (2015). Monetary Policy, Inflation, and the Business Cycle, Princeton University Press, 2nd ed.
   - Key reference on New Keynesian Model.

3. Peter Birch Sørensen and Hans Jørgen Whitta-Jacobsen (2010). Introducing Advanced Macroeconomics, McGraw Hill, 2nd Edition.
   - The best book on Macroeconomics on the Master level in my view
   - Includes monetary policy, but has a much broader coverage including growth and business cycles

4. Bénassy-Quéré, Cœré, Jacquet, and Pisani-Ferry (2019). Economic Policy: Theory and Practice, Oxford University Press, Second Edition.
   - Written by four economists who have held high level policy positions. For example, Benoît Cœré served for eight years on the executive board of the European Central Bank
   - The book presents the main theoretical and empirical analytical tools relevant to addressing real-life policy issues and applies them to recent policy debates. Non-technical approach (more technical stuff in separate "boxes")
   - Includes not only monetary policy, but also fiscal policy, financial stability and growth policies

Useful Links / Relevant Journals

Current debates: https://voxeu.org/

Virtual Macro Seminar: https://sites.google.com/view/virtualmacro/

Working Paper: http://ideas.repec.org/

Data: https://fred.stlouisfed.org/

Everything else / more details on the stuff above: https://www.aeaweb.org/rfe/

Relevant Journals

- Top 5 journals: American Economic Review, Econometrica, Journal of Political Economy, Quarterly Journal of Economics, Review of Economic Studies

- General Interest Journals: Journal of Economic Perspectives, Review of Economics and Statistics, Economic Journal, International Economic Review, European Economic Review, Journal of the European Economic Association, Economic Policy, Brooking Papers on Economic Activity

- Macro Field Journals: Journal of Monetary Economics, American Economic Journal: Macro, Review of Economic Dynamics, Journal of Money Credit and Banking, Journal of Economic Dynamics and Control, Macroeconomic Dynamics, Journal of Macroeconomics, International Journal of Central Banking

- International Field Journals: Journal of International Economics, Journal of Common Market Studies, Journal of International Money and Finance

- Econometrics Field Journals: Journal of Econometrics, Journal of Business and Economic Statistics, Journal of Applied Econometrics, Oxford Bulletin of Economic Research, International Journal of Forecasting, Journal of Forecasting, Empirical Economics, Studies in Nonlinear Dynamics & Econometrics

- Review Journals from regional Federal Reserve Banks, ECB Monthly Bulleting, …

ECB Forum on Central Banking 2021

The ECB's most important conference

- For the second time it took place online this year and is accessible to the general public

- Link to the 2021 Forum "Beyond the pandemic: the future of monetary policy":
  https://www.ecb.europa.eu/pub/conferences/ecbforum/html/index.en.html

- Link to the 2020 Forum:
  https://www.ecb.europa.eu/pub/conferences/html/20201111_ecb_forum_on_central_banking.en.html

Lecture 1: GDP Measurement, Growth and Business Cycles

Learning Objective of Today's Lecture

1. Review the definition and measurement of GDP

2. Define growth and business cycles

3. Understanding the difference between potential output and the output gap, their main drivers, and why the difference between the two is critical to policy analysis

Literature

Required reading

- Unless you are fully familiar with the definition and measurement of nominal and real GDP, I suggest that you read about in an undergraduate textbook. For example:
  The Global Economy, Chapter 2 "Macroeconomic Data", NYU Stern,
  https://www.stern.nyu.edu/sites/default/files/assets/documents/The_Global_Economy_Amazon_Digital%20%283%29.pdf

Optional reading on real-time business cycle measurement

- Croushore and Stark (2000). "A Funny Thing Happened on the Way to the Data Bank: A Real-Time Data Set for Macroeconomists", *Federal Reserve Bank of Philadelphia Business Review*, Sept./Oct. 2000.

- Chauvet and Piger (2003). "Identifying Business Cycle Turning Points in Real Time". *Federal Reserve Bank of St. Louis Review*, March-April 2003.

- Orphanides and van Norden (2002). "The Unreliability of Output-Gap Estimates in Real Time," *The Review of Economics and Statistics*, 84(4):569-583.

1.1 Output: Concept and Measurement

Measuring Aggregate Output: Gross Domestic Product (GDP)

- Definition: Market value of final goods and services produced within a country over a specific period $\rightarrow Y = \sum_{i=1}^{N} P_i Q_i$

- Lots of measurement problems and imperfect measure for welfare, but nevertheless the most important measure of economic performance

- Can be measured in three ways that provide different perspectives

  1. Aggregate production of final goods and services

  2. Aggregate demand for these goods and services: $Y = C + I + G + EX - IM$

  3. Income generated from producing these goods and services

- Use per capita concept for cross-country comparisons

Transformation to Real GDP

- Use prices of a base year:

$$y^{2019}(2019\ prices) = \sum_{i=1}^{N} P_i^{2019} Q_i^{2019}$$

$$y^{2020}(2019\ prices) = \sum_{i=1}^{N} P_i^{2019} Q_i^{2020}$$

Notice the correction of the slides here.

- Growth rate of real GDP: $\dfrac{y^{2020}(2019\ prices)}{y^{2019}(2019\ prices)} - 1$

- Measure of the price level: GDP Deflator = Nominal GDP / Real GDP

$$P^{2020} = \frac{\sum_{i=1}^{N} P_i^{2020} Q_i^{2020}}{\sum_{i=1}^{N} P_i^{2019} Q_i^{2020}} = \frac{Y^{2020}}{y^{2020}}$$

- Real GDP equals nominal GDP divided by the price level: $y^{2020} = Y^{2020}/P^{2020}$

- In growth rates approximately: real growth = nominal growth $-$ inflation
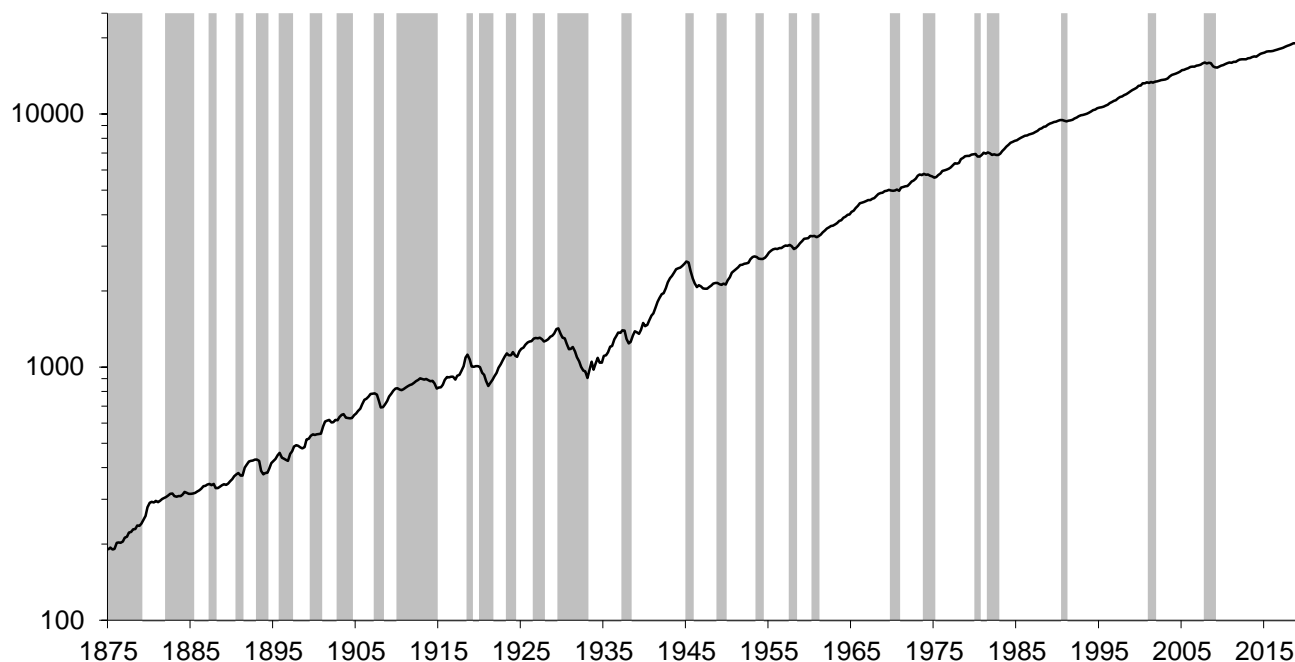
Example: US real GDP

Billions of Chained 2012 Dollars
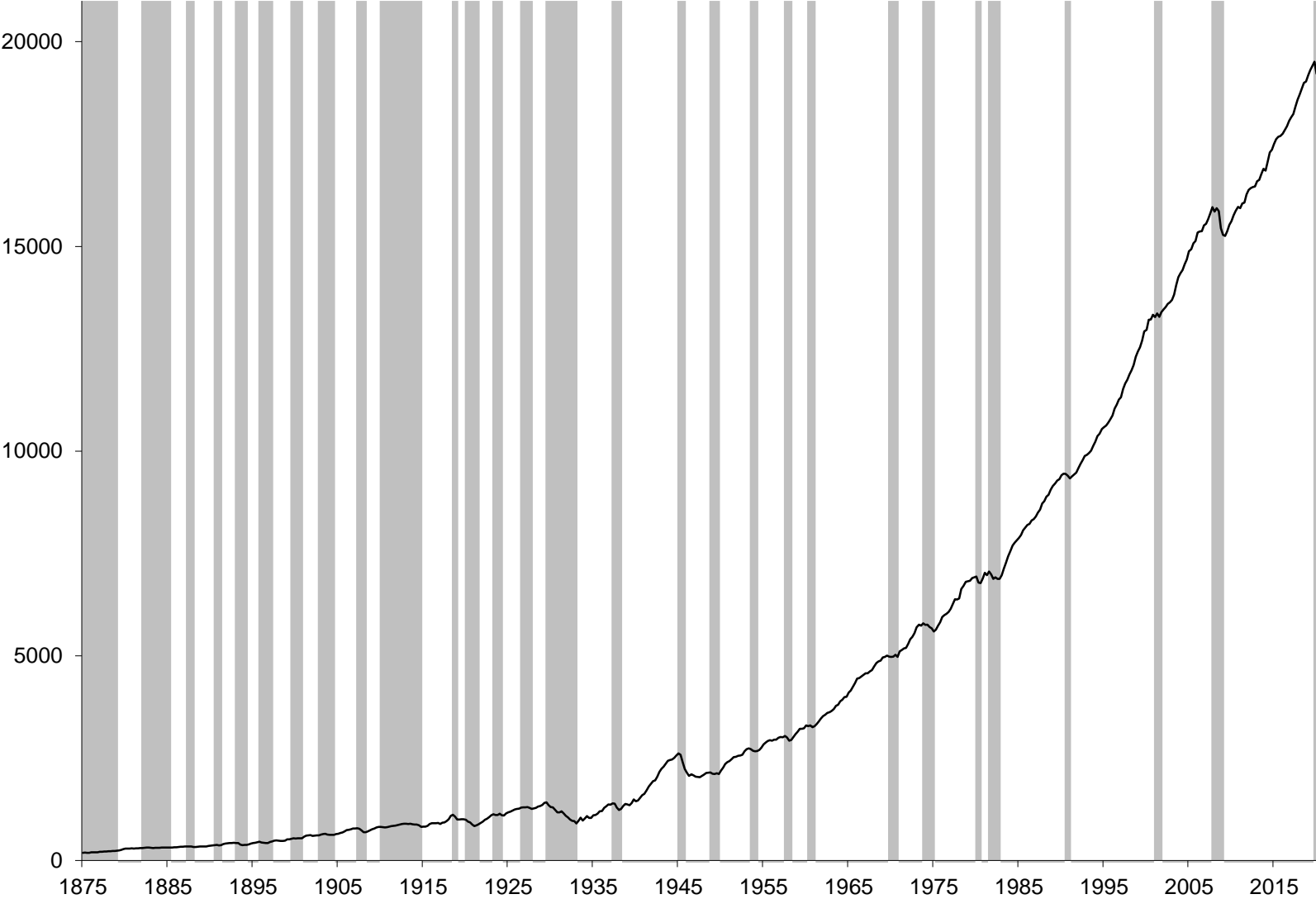
Source: NBER, BEA, own computations

Often a log representation of GDP is used

- The same distance on a log scale shows the same percentage increase. Example: Distance from 100 to 1000 amounts to a tenfold increase, just as an increase from 1000 to 10000.

- Easier to distinguish periods of above and below average growth. If there was a constant growth rate, log GDP would just be a straight line.

- Taking logs is useful for linearizing functions:
$Y = AK^\alpha L^{1-\alpha} \rightarrow \ln(y) = \ln(A) + \alpha \ln(K) + (1-\alpha)\ln(L)$

- Interpretation of regression coefficients as elasticities: $\ln(C) = \alpha + \beta \ln(Y - T)$. A one percent increase in disposable income $(Y - T)$ leads to a increase of β percent in consumption (C).

- Also recall that the growth rate can be approximated by the first log difference:
$\frac{Y_t - Y_{t-1}}{Y_{t-1}} \approx \ln(Y_t) - \ln(Y_{t-1})$

Nominal and Real GDP (US)

Billions of Dollars
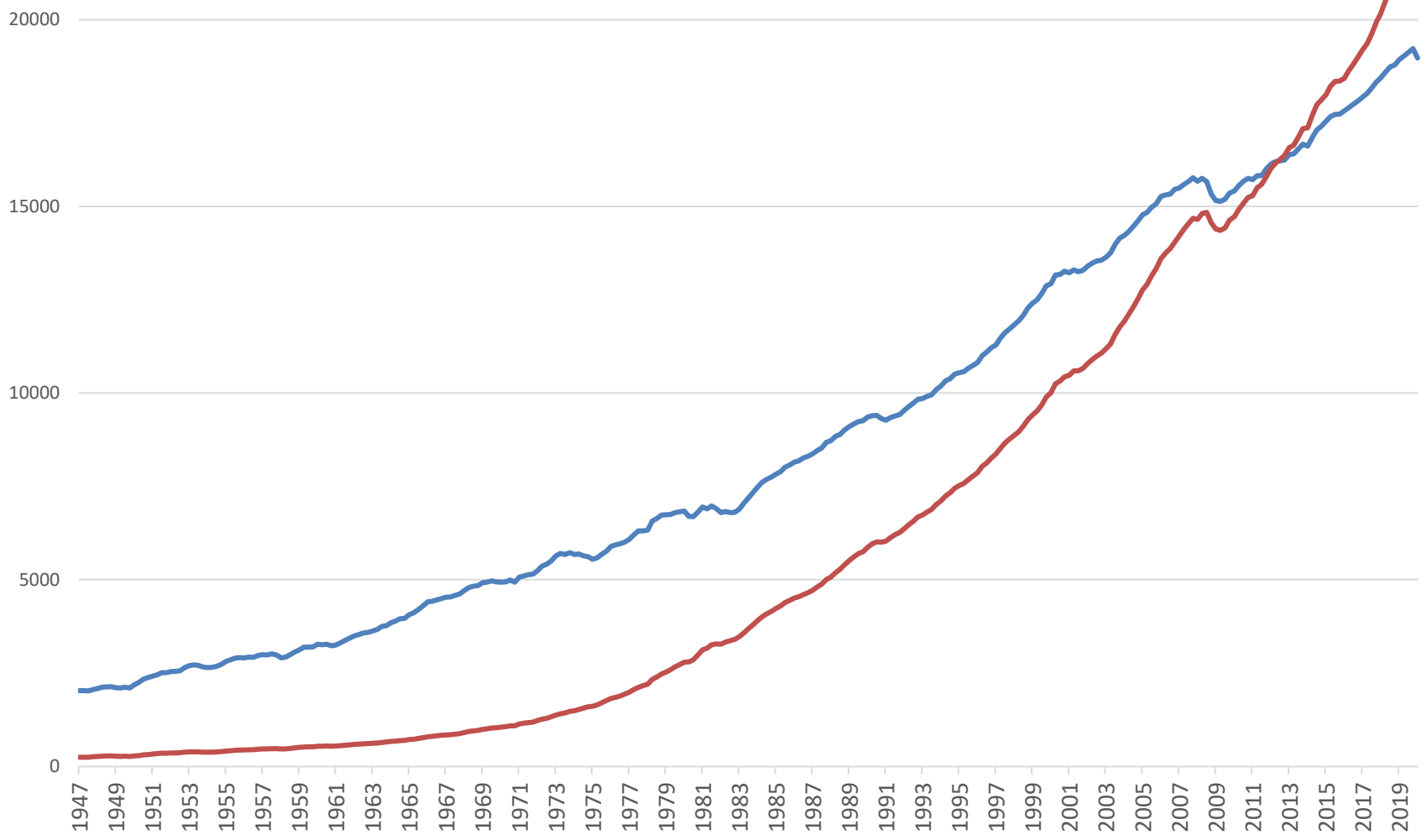
GDP and Its Components are Flow Variables, Not Stock Variables

Example 1: German industrial production during the Corona crisis

- In June 2020 industrial production fell to the lowest level in 26 years.

- This does not mean that 26 years of production were destroyed, but that in one month it was produced as little as in a month 26 years ago.

- If the recession does not destroy the production capacities, production could in principle quickly jump back to the pre-crisis level.

Some Measurement Issues: GDP is an Estimate

Real GDP UK (Index, 2005Q1=100)
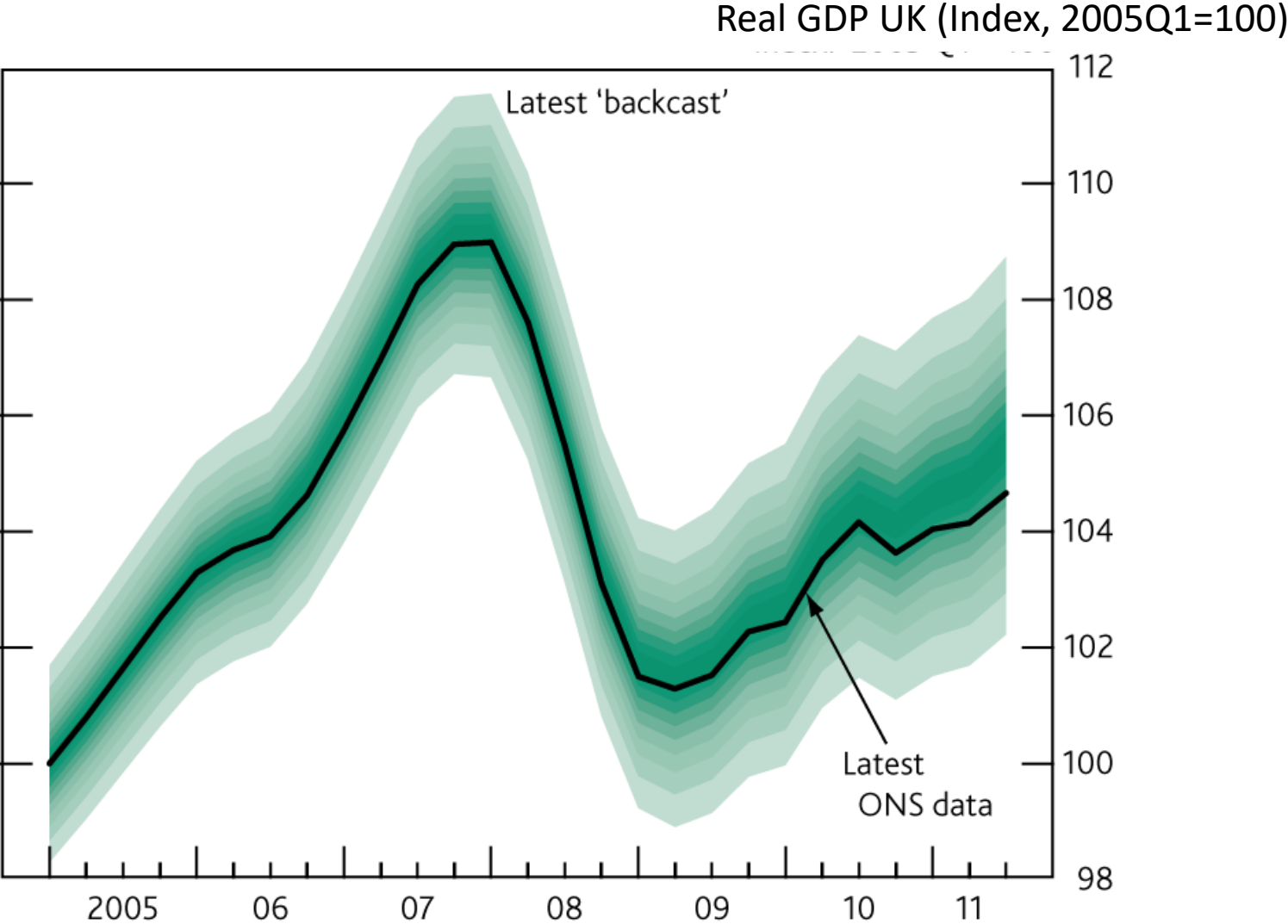
Sources: ONS and Bank of England calculations.

(a) Chained-volume measures. The fan chart depicts an estimated probability distribution for GDP over the past. It can be interpreted in the same way as the fan charts in Section 5 and forms the first part of the fan shown in **Chart 5.5** on page 42.

Some Measurement Issues: Informal Sector

Estimates of the informal sector in % of GDP in 21 OECD countries:
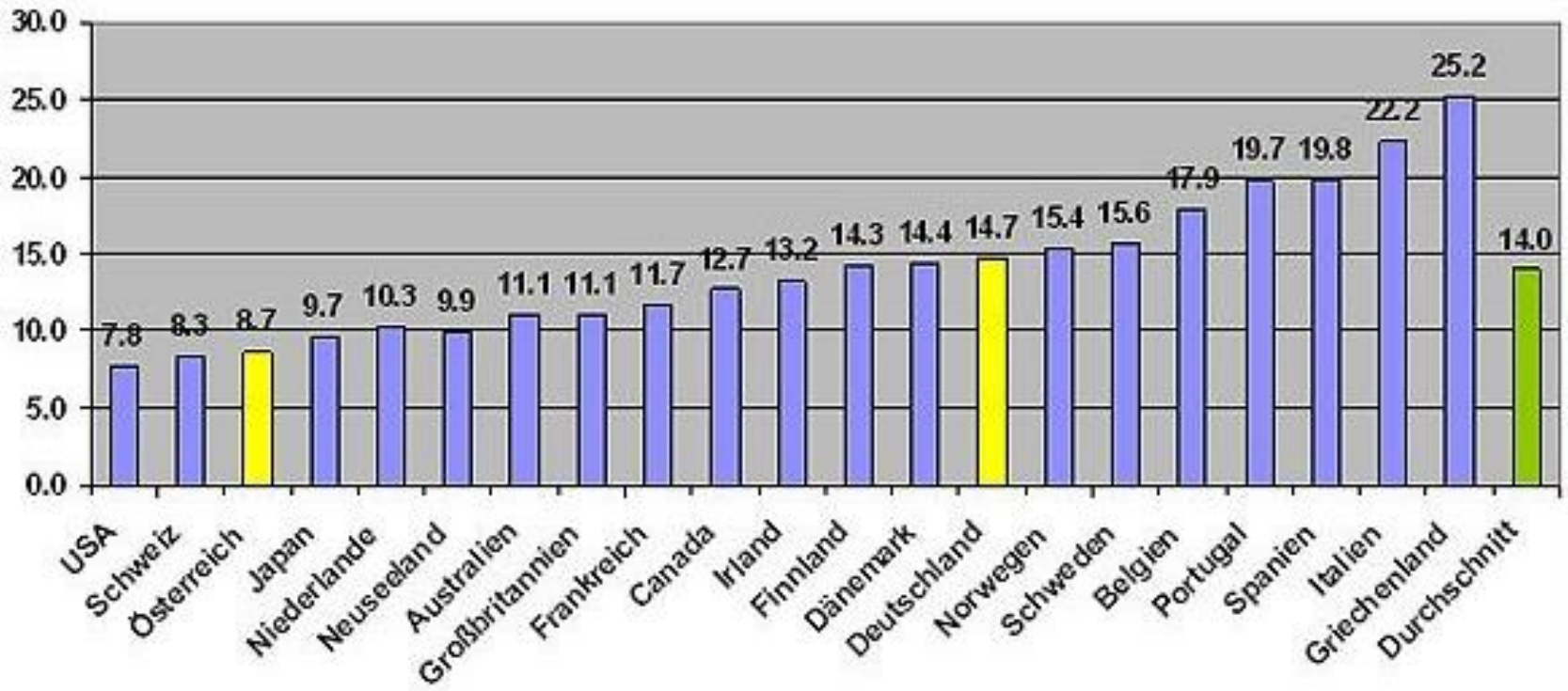
Source: Enste, Dominik H. / Schneider, Friedrich, Hrsg., Jahrbuch Schattenwirtschaft 2010/2011

Some Measurement Issues: Seasonal Adjustment

- Raw data German GDP in black

- Seasonally adjusted data in green

Source: German Statistical Office

Some Measurement Issues: Regular Revisions

GDP is heavily revised over time

- Initial estimates are based on incomplete data. Over time more data becomes available, so that estimates should become more reliable. Example: Tax data

- Further, there are benchmark revisions that incorporate new source data and may also include changes in definitions of variables or changes in methodology.

Size of revisions of US GDP growth rates between 1965 and 1999:

Source: Croushore and Stark (2000)
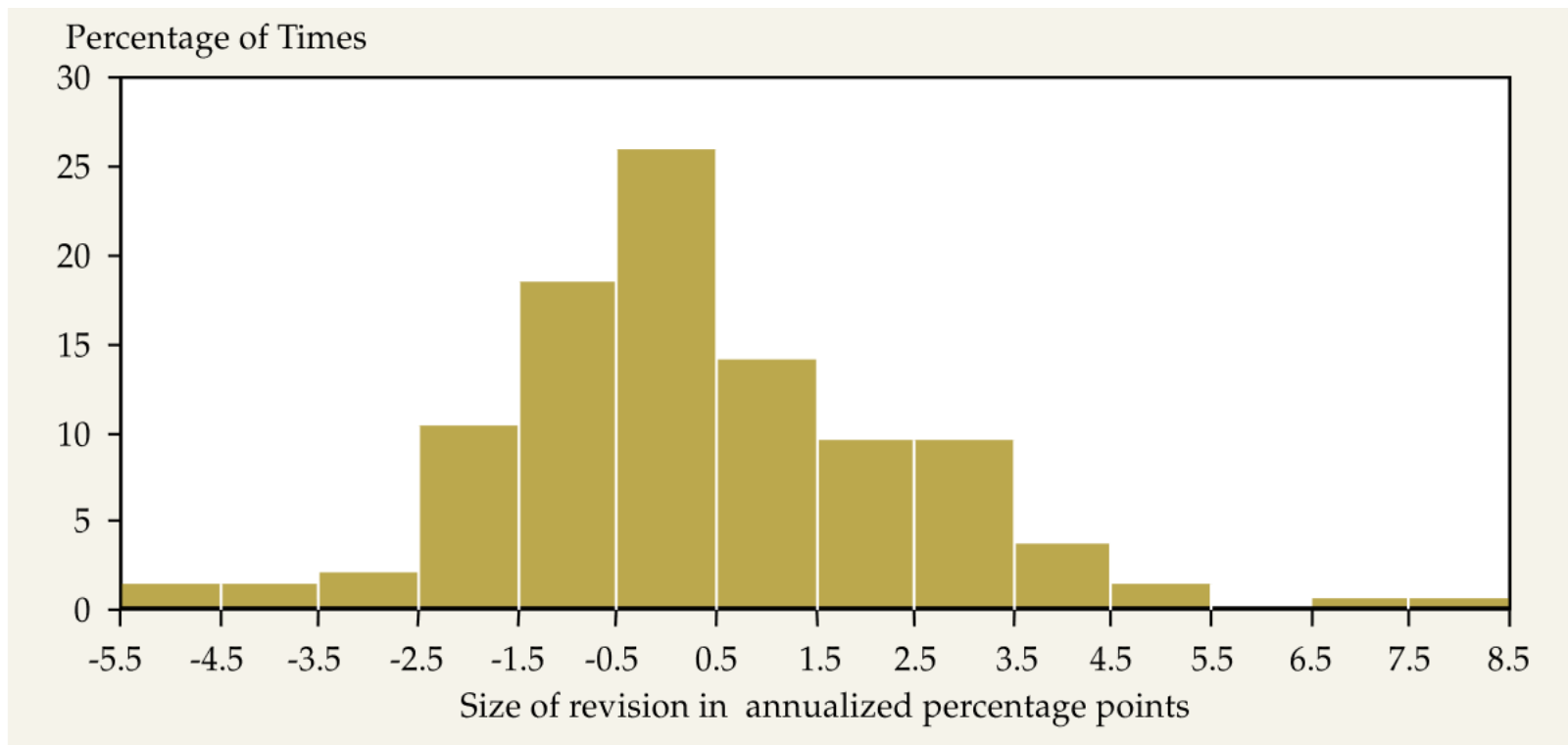
Some Measurement Issues: Benchmark Revisions

Example: German GDP before (light blue) and after (dark blue) general revision of 2014

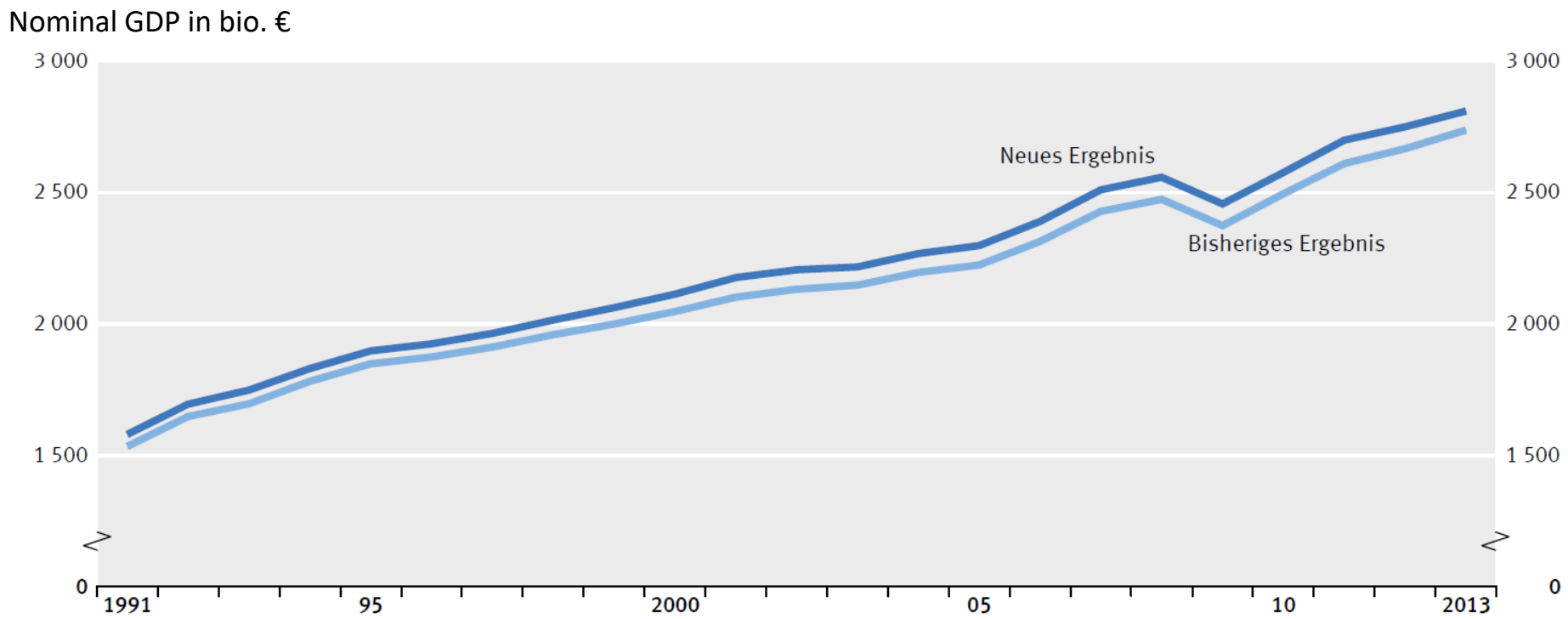Nominal GDP in bio. €

Neues Ergebnis

Bisheriges Ergebnis

Abbildung: Statistisches Bundesamt, Wiesbaden 2014

Real-time Data

For economic policy analysis it is often important to use exactly the data that was available to policy makers at the time of the policy decision.

Using revised and/or new data would distort the analysis.

Policy makers need to be advised using concepts that are applicable in real time.

Structure of real-time data vintages of US GDP published between 2019M7 and 2020M6

Date	2019M7	2019M8	2019M9	2019M10	2019M11	2019M12	2020M1	2020M2	2020M3	2020M4	2020M5	2020M6
2019:Q1	18.910	18.927	18.927	18.927	18.927	18.927	18.927	18.927	18.927	18.927	18.927	18.927
2019:Q2	#N/A	19.024	19.023	19.022	19.022	19.022	19.022	19.022	19.022	19.022	19.022	19.022
2019:Q3	#N/A	#N/A	#N/A	#N/A	19.113	19.122	19.121	19.121	19.121	19.121	19.121	19.121
2019:Q4	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	19.220	19.221	19.222	19.222	19.222
2020:Q1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	18.988	18.975
2020:Q2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

Source: https://www.philadelphiafed.org/research-and-data/real-time-center/real-time-data/data-files/routput

- Real-time data sources: http://svannorden.org/original-vintage-data-sources/

1.2 Potential Output, Business Cycles, Output Gap

Growth and Business Cycles

- Long-run growth: standard (neoclassical) growth theory implies that long-run growth is driven by changes in supply, which usually evolve slowly over time.

- Business cycles: standard (Keynesian, New Keynesian) theory implies that business cycles are mainly driven by fluctuation in demand.

- Over time demand and supply should converge.

- Distinguishing whether GDP fluctuations are caused by changes in long-run growth or can attributed to short-run cyclical dynamics is important to decide for a suitable policy:

  - Supply oriented growth policies vs. demand oriented stabilization policies.

- Long-run growth and business cycles are often analyzed separately (different theories), but there are also episodes where the two are interlinked.

  - Example 1: Permanent reduction in housing value after the global financial crisis reduced the value of collateral used to finance investment.

  - Example 2: Contractionary shock to equity financing in 2001 reduced spending on R&D.

  - Example 3: The COVID-19 crisis reduced both demand and supply

Definition of Business Cycles and Recessions

"Business cycles are a type of fluctuation in the aggregate economic activity of nations that organize their work mainly in business enterprises. A cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic."

(Burns and Mitchell, "Measuring Business Cycles", National Bureau of Economic Research, 1946, p.3, https://www.nber.org/chapters/c2980.pdf)

Standard business cycle length 2-8 years, recent work emphasis the increasing importance of longer cycle up to 10 years (Beaudry et al., 2020, American Economic Review) and of medium-term cycles up to 30 years.

Definition of Recessions

- Definition often used in the press: two consecutive quarters of negative growth

- NBER: Significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales.

- CEPR Euro Area Business Cycle Dating Committee: A significant decline in the level of economic activity, spread across the economy of the euro area, usually visible in two or more consecutive quarters of negative growth in GDP, employment and other measures of aggregate economic activity for the euro area as a whole; and reflecting similar developments in most countries

- Depression: a particularly severe and prolonged downturn in economic activity

Determining Business Cycle Dates in Real Time

- Difficulty of determining business cycle dates in real time due to publication lags and data revisions.

- Business cycle dating committees base their dating decisions on a wider range of indicators.

  For example NBER: industrial production, employment, sales and personal income are particularly important (see Leamer, 2008, for an algorithm that reproduces the NBER dates).

- Announcements are done with a lag to ensure that the data on which they are based are as accurate as possible.

Factor models

- To identify recession more timely often factor models are used. These extract the joint dynamics from many time series of different frequencies and the resulting factor time series can be interpreted as a business cycle index. The level of this factor switches between different business cycle states.

- Example of such a model with three states (expansion, ordinary recession, severe recession) for Germany:
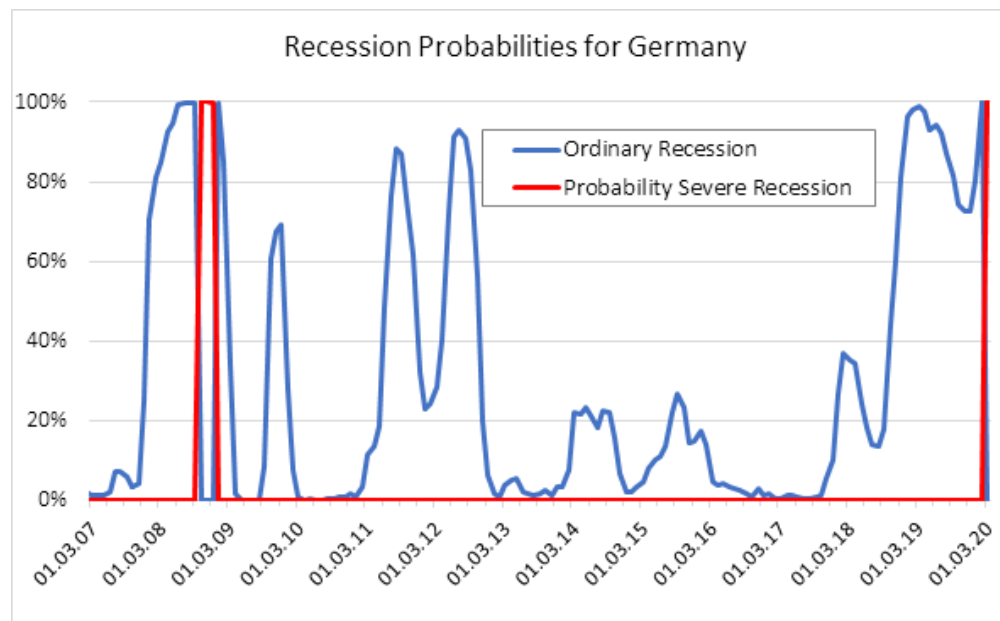
Source: Carstensen, Heinrich, Reif, Wolters (2020). Predicting Ordinary and Severe Recessions Using a Three-State Markov-Switching Dynamic Factor Model, International Journal of Forecasting, 36(3): 829-850

Potential Output and the Output Gap

## Potential Output – definition by the Congressional Budget Office

- Trend growth in the productive capacity of the economy. Measures the maximum sustainable level of real GDP that is consistent with a stable rate of inflation.

## The Output Gap – a measure of the business cycle

- The output gap measures the difference between actual and potential output

- If actual output rises above its potential level (typically during expansions), then constraints on capacity begin to bind and inflationary pressures build.

- If output falls below potential (generally during recessions), then resources are lying idle and inflationary pressures abate.

- Economic activity above or below the normal capacity is typically viewed as being inefficient, so that the output gap is an important target for policy makers.

Actual Output, Potential Output and the Output Gap

GDP and Potential GDP (Congressional Budget Office)
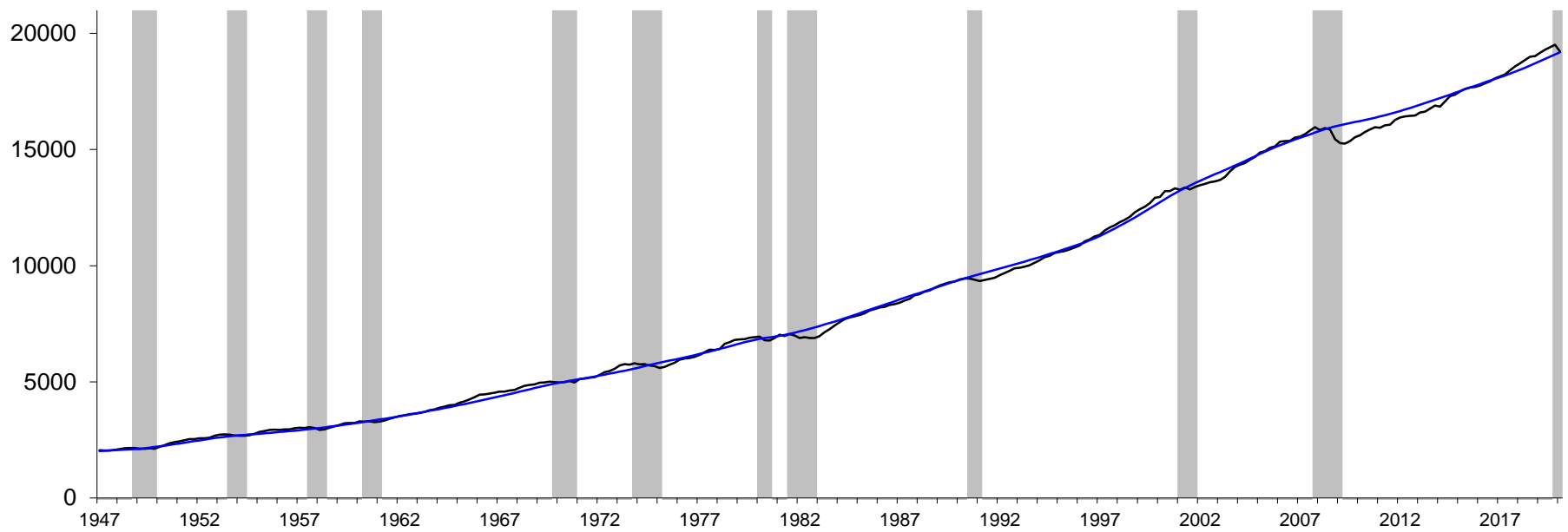
Output Gap
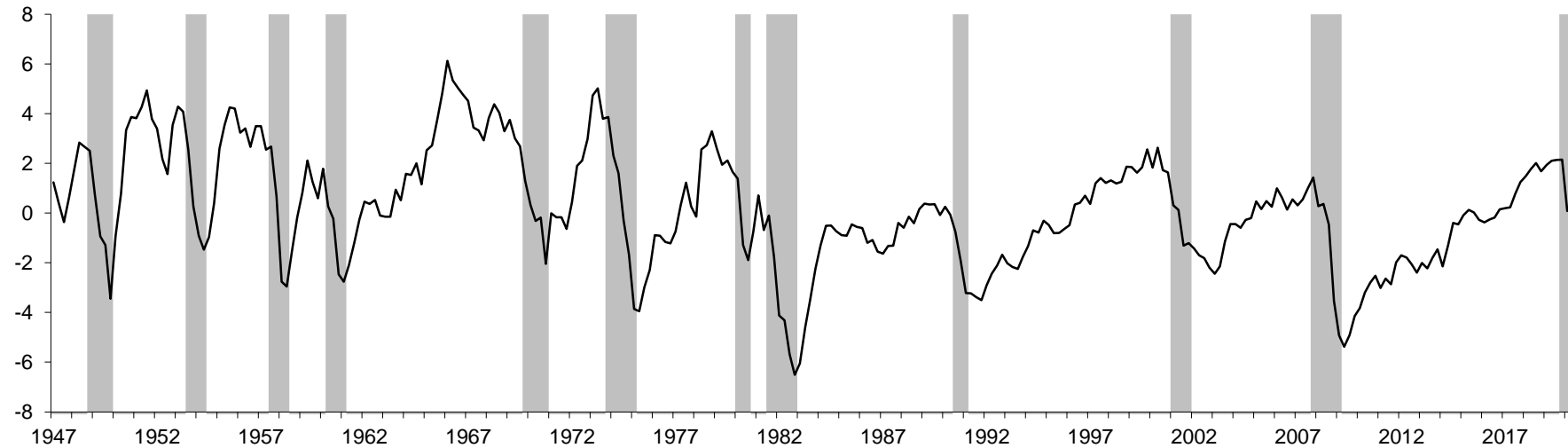
Source: FRED (St. Louis Fed), own computations

Potential Output and the Output Gap: Unobservables

Potential output and the output are unobservable and need to be extracted from GDP, i.e. one time series is split up into two:

$$y_t = g_t + c_t$$

y_t: log real GDP

g_t: log potential real GDP

c_t: output gap (percentage deviation of actual GDP from potential GDP)

- Measuring potential output is essential for growth-oriented policy measures and for projecting GDP over medium horizons (3 to 5 years) as over time cyclical factors fade out (supply and demand converge).

- Measuring the output gap is important for business cycle analysis and stabilization policies.

Three Main Business Cycle Estimation Techniques

- Often statistical trend-cycle-decomposition techniques are used as supply determining long-run growth is assumed to evolve slowly over time.

- Unobserved components model: Small semi-structural models that link unobservable variables (trend and cycle) to observable ones.

- Dynamic Stochastic General Equlibrium (DSGE) models.

Problem of Unreliable Real-time Estimates

- Estimation techniques also use data that is subject to constant revisions, so the estimates change as new data becomes available or data is revised.

- Output gap estimates are therefore particularly unreliable at the end of the sample. Orphanides and van Norden (2002) show that revisions are of the same size as the output gaps themselves.
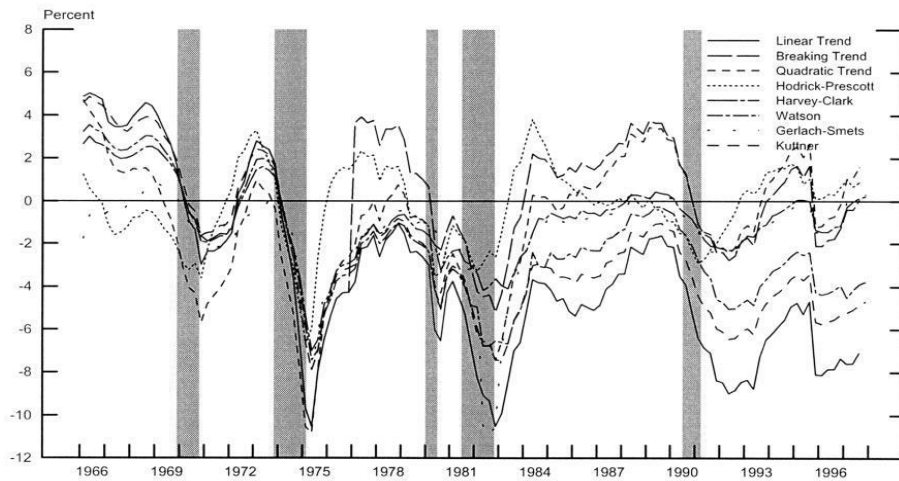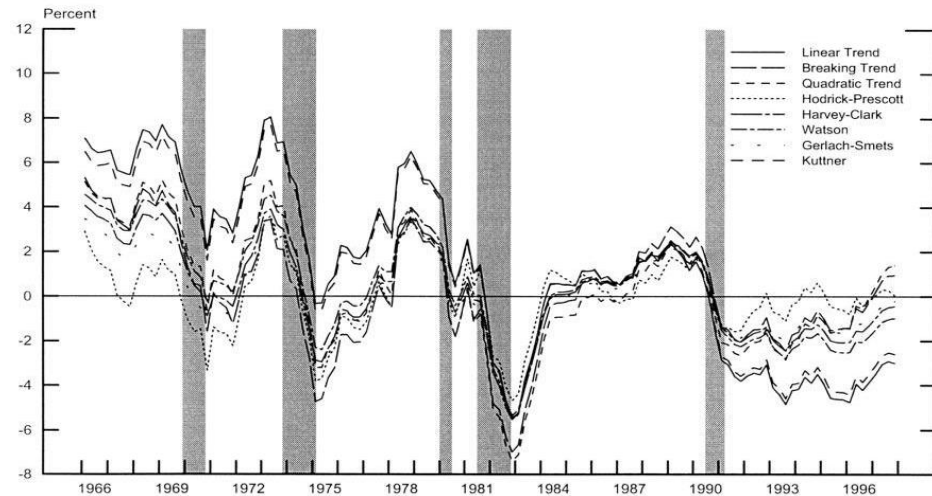
Source: Orphanides and van Norden (2002)

Summary

- GDP is an imperfect, but still the best measure of aggregate output that we have.

- We distinguish nominal and real GDP and absolute and per capita GDP.

- Business cycles consists of expansions and recessions across many sectors of the economy. Difficult to determine business cycle dates in real time.

- Splitting up GDP into potential output and the output gap is important as dynamics in the two would require different kinds of policies (supply vs. demand-oriented ones)

- Measurement of potential output and the output gap is not easy, in particular in real time. Time series filtering techniques as well as structural models can be used. Two-sided techniques are particularly prone to revisions.