A Real-Time Data Set
for German Macroeconomic Variables

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1. Introduction

A group of economists at the Bundesbank has compiled a real-time data set for Germany which is available for download from the web site of the Economic Research Centre of the Bundesbank.[1] This data set consists of subsequent historical vintages, or snapshots, of a set of key macroeconomic time series (real and nominal output, the output deflator, the CPI, money growth and production potential).

The primary purpose of studying such subsequent vintages of a given variable is to gain insights about the extent and the dynamics of the revision process that underlies this variable. This information can then be exploited to analyse a broad spectrum of different issues. Real-time data sets may be used to explore the reliability of first releases (see e.g. Swanson and van Dijk 2004), to evaluate forecasts of the respective variable (see e.g. Orphanides and van Norden 2002), to assess the real-time validity of empirical relationships (see e.g. Amato and Swanson 2001), to capture their effects on economic policy research (see e.g. Runkle 1998), to study the behaviour of forecasting models (see e.g. Koenig et al. 2003) or to analyse past policy decisions (see e.g. Gerberding et al. 2004).

This article describes the structure of the data set and gives an overview of the variables and vintages that are available up to now. Furthermore, it discusses the relative importance of measurement errors for two prominent variables, namely real output growth and the output gap. Finally, it reports how the data have been used to assess the reliability of output gap estimates and to estimate the Bundesbank's monetary policy reaction function.

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[1] http://www.bundesbank.de/volkswirtschaft/vo_forschungszentrum_daten.en.php.

2. General structure of the real-time data sets

The data set of every single included variable can be thought of a matrix, with each column representing the vintage (i.e. time series) of data available at that vintage date.

Table 1

Structure of the real-time data set for real output

observation date t	vintage date v (date of publication)						
	December 1971	January 1972	February 1972	March 1972	. . .	March 1999	April 1999
1st Quarter 1962	$x^{12/71}_{1/62}$	$x^{1/72}_{1/62}$	$x^{2/72}_{1/62}$	$x^{3/72}_{1/62}$	$x^{v}_{1/62}$	$x^{3/99}_{1/62}$	$x^{4/99}_{1/62}$
⋮	$x^{12/71}_{t}$	$x^{1/72}_{t}$	$x^{2/72}_{t}$	$x^{3/72}_{t}$	x^{v}_{t}	$x^{3/99}_{t}$	$x^{4/99}_{t}$
3rd Quarter 1971	$x^{12/71}_{3/71}$	$x^{1/72}_{3/71}$	$x^{2/72}_{3/71}$	$x^{3/72}_{3/71}$	$x^{v}_{3/71}$	$x^{3/99}_{3/71}$	$x^{4/99}_{3/71}$
4th Quarter 1971			$x^{2/72}_{4/71}$	$x^{3/72}_{4/71}$	$x^{v}_{4/71}$	$x^{3/99}_{4/71}$	$x^{4/99}_{4/71}$
⋮						⋮	⋮
3rd Quarter 1998						$x^{3/99}_{3/98}$	$x^{4/99}_{3/98}$
4th Quarter 1998						$x^{3/99}_{4/98}$	$x^{4/99}_{4/98}$

Table 1 illustrates the general structure of the data set for one typical variable, in this case (seasonally adjusted) real output. Each column is headed by the vintage date which corresponds to the date of publication of that particular time series. Consequently, the first column contains the real output series that was published in December 1971 when quarterly data on real output in Germany were first published. In general, the published series reach back about ten years so that the series available from December 1971 starts with an observation for the first quarter of 1962 etc. Whereas the frequency of the data is quarterly, the frequency of the vintages is monthly, reflecting the frequency of the underlying publication. Consequently, the second column represents the time series on real output published in January 1972 etc. Due to the lag in the release of national accounts data, a figure for the fourth quarter of 1971 was only published in February 1972 (third column). As one moves to the right from column to column, new data points become available and older data are

revised at regular intervals. The comparability of the observations across vintages is limited by the fact that, first of all, the data were occasionally rebased (on average every five years), and second, that the published time series only reach back about ten years. However, more recent vintages may be extended backwards, for example, by using data from earlier vintages to fill up the matrix.

3. The available data sets

Table 2 lists the variables for which such matrices of real-time data sets are available. With the exception of the Bundesbank's real-time estimates of potential output, the data sets were compiled from official publications. All seasonally adjusted (s.a.) data are taken from the statistical supplements called "Seasonally Adjusted Business Statistics" which the Bundesbank publishes regularly in conjunction with its monthly reports. The non-seasonally adjusted (n.s.a.) data on real output are reproduced from several monthly and quarterly periodicals issued by the Federal Statistical Office (FSO).[2] The n.s.a. real-time data on the CPI are taken from the statistical section of the Bundesbank's monthly reports. The real-time estimates of the production potential were reconstructed from official Bundesbank publications and from internal documents such as the briefing material for the Council's discussions on the monetary target.

In the following, we briefly describe the main characteristics of the data sets for each variable. Further details on the data (statistical changes, dates of benchmark revisions etc.) are given in the documentation which, along with the data files, is available for download from the web site of the Bundesbank's Economic Research Centre (see footnote 1).

3.1 Real and nominal output

The data sets for real and nominal output reflect the shift from GNP to GDP as the headline measure of output which occurred in June 1992. Whereas the Bundesbank published its own estimates of seasonally adjusted quarterly GNP from December 1971 on, the FSO started publishing non-seasonally adjusted quarterly data on GNP only in January 1978. Quarterly data on all-German GDP were first published in September 1995 (see Table 2). The data sets

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[2] Real-time data on non-seasonally adjusted output are collected from the following periodicals, issued by the Federal Statistical Office: "Wirtschaft und Statistik" (published monthly), "Vierteljahresergebnisse der Inlandsproduktberechnung Fachserie 18 R 3" (published quarterly), annual report "Fachserie 18 R 1.3"), Statistischer Wochendienst (published weekly, its quarterly supplements contain quarterly data on output) and the special series "Revidierte Vierteljahresergebnisse der Inlandsproduktberechnung Fachserie 18 R S", which documents the major historical revisions.

currently end with the vintages of April 1999 or the vintages of June 2000, respectively. However, more recent vintages have already been compiled and a regular update of the data set is planned for the near future.

Table 2

Overview of the real-time data files currently available at the Bundesbank

Variable	Source	frequency of		area	vintages		observations	
		vintages	data		first	last	first	last
GNP, real and nominal, s.a.	Bbk, MR, Sup	monthly	quarterly	West Germany	Dec 71	Aug 95	62Q1	94Q4
GDP, real and nominal, s.a.	Bbk, MR, Sup	monthly	quarterly	West Germany	Jun 92	Apr 99	76Q3	98Q4
				Germany	Sep 95	Apr 99	91Q1	98Q4
GNP, real, n.s.a.	FSO	monthly	quarterly	West Germany	Jan 78	Aug 95	68Q1	94Q4
				Germany	Sep 95	Jun 00	91Q1	00Q1
GDP, real, n.s.a.	FSO	monthly	quarterly	West Germany	Jan 78	Mar 99	68Q1	98Q4
				Germany	Sep 95	Jun 00	91Q1	00Q1
production potential (as estimated by Bundesbank staff)	Bbk, MR, Sup	monthly	annual	West Germany	Apr 74	Jan 99	1962	2000
				Germany	Aug 95	Jan 99	1991	2000
CPI, s.a.*)	Bbk, MR, Sup	monthly	monthly	West Germany	Jan 73	Dec 99	Jan 68	Nov 99
				Germany	Nov 95	Dec 99	Nov 93	Nov 99
CPI, n.s.a.*)	Bbk, MR	monthly	monthly	West Germany	Nov 73	Jun 99	Sep 72	May 99
				Germany	Oct 95	Jun 99	Aug 94	May 99
central bank money stock, s.a.	Bbk, MR, Sup	monthly	monthly	West Germany	Oct 74	Feb 88	Mar 69	Jan 88
money stock M3, s.a.	Bbk, MR, Sup	monthly	monthly	West Germany	Jan 88	Jun 95	May 82	Dec 90
				Germany	Sep 91	Mar 99	Jan 91	Dec 98

Notes: Bbk: Bundesbank; MR: monthly report; Sup: supplement; FSO: Federal Statistical Office.

*) Cost-of-living index for all households.

During the period covered by our data set, GNP / GDP data for a new quarter were usually released by the FSO in the third month of the following quarter, that is in March, June, September and December. In contrast with this

practice, the Bundesbank published a first estimate of GNP/GDP for the fourth quarter of each year already in February (based on the preliminary annual figure for the past year). The release of new data by the FSO usually came with a revision of earlier data which then also showed up in the seasonally adjusted data published by the Bundesbank. Apart from those regular revisions, GNP/GDP data were occasionally subject to major revisions including changes in base year and refinements of statistical methods. During the period in question, major revisions occurred in July 1977, August 1982, August 1985, March 1991, September 1993 and April 1999.

3.2 Production potential

From 1974 to 1998, the growth rate of the production potential was a key input for the derivation of the Bundesbank's annual monetary targets. Therefore, the Bundesbank staff had to review and update their estimates of the aggregate production potential at least once a year. However, the Bundesbank rarely published these estimates, at least as regards the *level* of potential output. Most of data in this file are therefore taken from internal briefing material produced for the Council's discussion on the monetary target for the year to come or for the mid-year review of the target.

New estimates of the production potential became available at irregular intervals (the exact dates of which are given in the data files). The frequency of the data is annual. During the period covered by the data set (1974–1999), estimates were always available without lag, often even with a lead of one year. In combination with the real-time data on real output, the real-time estimates of the production potential can be used to reconstruct the Bundesbank's real-time perceptions of the output gap.

3.3 CPI

The data set for the CPI includes seasonally adjusted data (levels and annualised six-month rates of change) as well as non-seasonally adjusted rates of change against the previous year. The frequency of the data is monthly. During the period in question, CPI data for the past month were released by the FSO in the first or second week of the following month. Therefore, they appear in the Bundesbank publications with a lag of (at least) one month. However, the release of the official figure was usually just an affirmation of the first estimate which was presented by the FSO around the 25th/26th of the reported month. Hence, depending on the purpose of investigation, it may be reasonable to assume that data on the rate of inflation in month t were already available at the end of the same month.

3.4 Money

The data on money reflect the shift in the definition of the Bundesbank's target variable from the central bank money stock (defined as currency in circulation plus required minimum reserves on domestic deposits calculated at constant reserve ratios with base January 1974) to the broad aggregate M3 which occurred in January 1988. The data sets contain the real-time vintages of the s. a. (annualised) six-month rates of change of these variables as well as the s. a. (annualised) rates of change against the last quarter of the previous year (starting with the vintage of June 1989), both of which were adjusted by the Bundesbank for statistical breaks. The changeover from West- to all-German money growth data occurs with the figures for January 1991 (published in March 1991). This is consistent with the fact that the monetary target for 1991 was for the first time formulated for the new extended currency area.[3]

Official data on monetary developments in month t usually became available around the 20th of the following month. However, in our data set, the vintages are dated according to the month of issue of the respective publication. Depending on whether the "Seasonally Adjusted Business Statistics" were published before or after the release of new data on money growth, the reported data display a lag of one or two months. However, users can safely assume that money data for the past month were always available to policy makers (and known to the public) by the end of the following month.

4. The extent of the revisions

The magnitude of the measurement errors present in the data can be illustrated by comparing the real-time figures – that is, the values at initial publication – with the ex post revised data. In Figure 1, the real-time data on output growth are shown along with their respective ex post values (as of March 1999). As regards this variable, the measurement error – though at times substantial – does not display a visible bias nor a pronounced degree of serial correlation.[4]

As shown in Figure 2, the problem of measurement error is much more severe for the output gap: until the first quarter of 1988, the real-time series is always below the ex post series, suggesting that the initial estimates during that period consistently overestimated the amount of slack in the economy. The fact that the mean forecast error is always positive strongly suggests

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[3] For further details on the data problems arising in this context, see Gerberding et al. (2004), 12.

[4] For a more detailed description of the revision process, see Deutsche Bundesbank (2004), 19.

a downward bias in the initial estimates. The measurement error is also quite persistent. Overall, both problems are much less due to revisions of actual output data than to persistent downward revisions of the Bundesbank's estimates of potential output. The latter reflect the fundamental difficulty inherent in correctly estimating the level of an economy's production potential, especially in the wake of adverse supply shocks like the ones encountered in the 1970s.
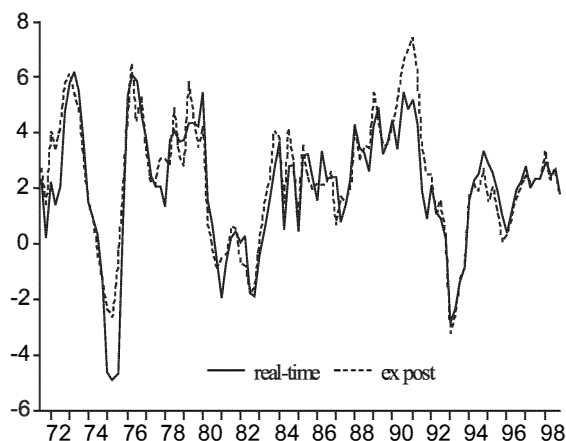

Figure 1: Initial and ex post data on real output growth.
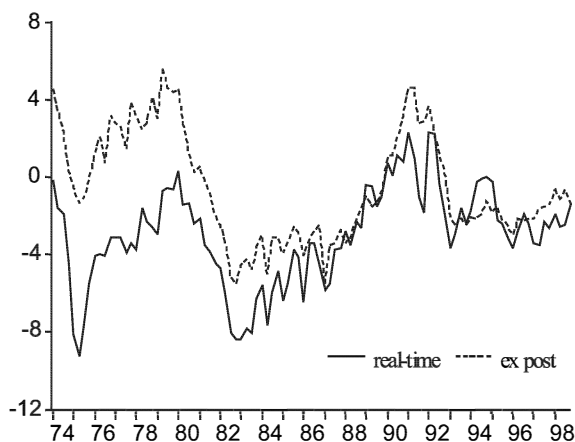Change from previous year in %, quarterly data

Figure 2: Initial and ex post estimates of the output gap
in %, quarterly data

The problem of data revisions is much less acute for consumer prices and almost non-existent for money growth (at least as regards the annual rates of change).[5] The latter result backs the Bundesbank's claim that revisions in money data were negligible and the data are thus more reliable compared to other macroeconomic data.

5. Existing studies based on real-time data sets

Research on issues regarding real-time data and data revisions owes much to the pioneering work of Dean Croushore and Tom Stark from the Federal Reserve Bank of Philadelphia who developed a comprehensive real-time data set for the US economy.[6] At the same time, Athanasios Orphanides reconstructed the real-time data and forecasts available to the decision-making body of the Federal Reserve System. Based on this data set, he was the first to point out that the problem of measurement error is likely to be particularly severe for the output gap – a concept which figures very prominently in modern macroeconomic theory.[7]

More recent studies for other countries (the UK, Canada, Japan, Germany) have very much backed the results presented by Orphanides.[8] As regards Germany, Döpke (2004) analyses real-time output gaps that were estimated with different methods on the basis of the real-time data on real GDP / GNP. In accordance with Orphanides / van Norden (2002), he finds that the estimated real-time gaps differ considerably from their counterparts based on the latest vintage of data. One period where the difference between today's estimates and the real-time perception of the output gap was particularly pronounced is the economic boom following German reunification. In this particular case, the error was due to a temporary underestimation of actual output as well as to a more persistent overestimation of potential output.

Gerberding et al. (2004) have used the real-time data set presented here to re-examine the result obtained by Clarida et al. (1998) that the Bundesbank in effect followed a forward-looking variant of the Taylor rule. Using real-time data instead of ex post revised data, they find that the Bundesbank responded to deviations of (real-time) money growth, inflation and output growth from their respective target or equilibrium values whereas there is no significant

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[5] See Deutsche Bundesbank (2004), 24.

[6] More information on this data set and background reading may be found on the web site of the Federal Reserve Bank of Philadelphia (http:// www.phil.frb.org / econ / forecast / reaindex.html).

[7] See Orphanides (2003).

[8] For an overview, see the papers presented at the Bundesbank Conference on Real-Time Data and Monetary Policy which may be found on the Bundesbank's web site. See footnote 1.

response to the real-time estimates of the level of the output gap. In this respect, their results back the argument made by Orphanides (2003) that successful central banks have placed much less emphasis on (real-time estimates of) the output gap than suggested by simple activist policy rules such as the Taylor rule. They are also in line with new theoretical work on optimal monetary policy which concludes that central banks should respond to the change in the output gap rather than to its level.[9]

6. Perspectives of the Data Set

As reported in Table 2, the data sets for most variables currently start with vintages from the early 1970s and end with vintages from 1999 or 2000. However, as far as GDP and the CPI are concerned, more recent vintages have already been compiled and are available from the Bundesbank on request. A regular update of the data set is planned for the near future. It is also planned to compile additional real-time data sets for the expenditure, production and cost components of GDP.

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[9] See Woodford (2003), Ch. 8, and Walsh (2003).

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