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Do Ifo Indicators Help Explain Revisions in German Industrial Production?*

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1 Introduction

The Ifo Institute for Economic Research was founded in 1949. Ifo – short for ***I**nformation und **Fo**rschung*, information and research – is particularly known for its Ifo Business Climate Index, based on monthly surveys of German firms; see Theil (1955) for an early appraisal and, e.g., Strigel (1990) or Oppenländer (1997). A business climate indicator provides qualitative information on the business cycle and is therefore frequently included in composite leading indicators, see, e.g., Zarnowitz (1992).

Rather than focusing on the forecasting ability of Ifo Business Survey indicators, as is done for instance by Langmantel (1999), Fritsche and Stephan (2002) and Hüfner and Schröder (2002), our paper deals with the strength of some of these indicators in explaining revisions of growth rates of German industrial production. We carry out a real-time analysis and examine vintages of data series on industrial production. A typical vintage of data consists of preliminary, first reported or unrevised data, partially revised, and fully revised or final data. Recently, problems associated with real-time data sets attracted a lot of attention. Three broad areas are distinguished: data revision, forecasting and policy analysis.[1] Real-time macroeconomic data sets exist for the US (Croushore and Stark 1999, 2001), the UK (Egginton, Pick and Vahey,

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[1]See http://www.phil.frb.org/econ/forecast/reabib.html for literature on real-time data analysis.

2001) and Australia (Stone and Wardrop, 2002). However, to our knowledge a real-time data set for Germany is not available.

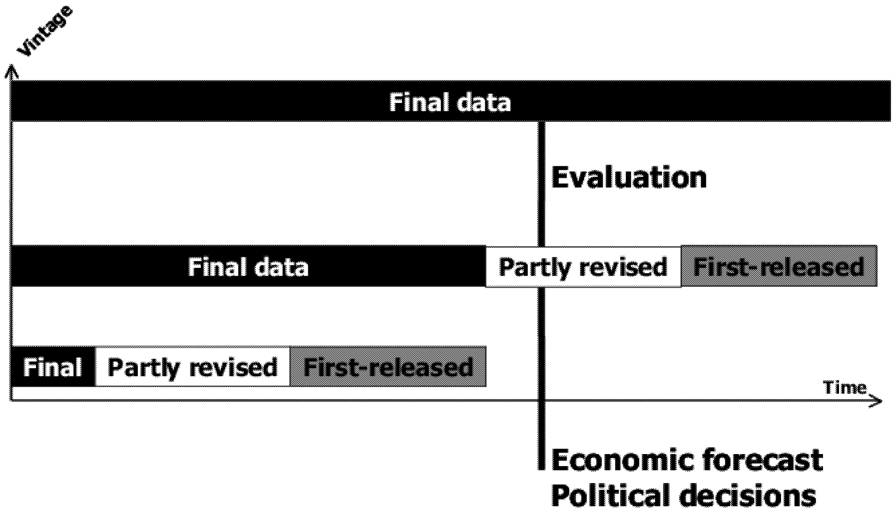


Fig. 1. Real-Time Data

Figure 1 illustrates some of the difficulties associated with real-time data. Especially for economic forecasting a closer look at questions pertaining to the quality of preliminary data releases is needed. Economic forecasters routinely use "currently available" data, which are almost by definition formed of final, partly-revised and first-released data. Their predictions are initially appraised against preliminary releases. Ex post or in sample benchmarking of forecasting performance, however, is usually based on final figures, i.e. a recently released vintage. Along the same lines, policymakers most often use preliminary data, while ex post, their actions are scrutinized on the basis of revised or even final data. Assuming that we are interested in the true but unobserved situation and data revisions improve the quality of our observable indicator, then a natural question to ask is whether it is possible to improve preliminary data by predicting future revisions using past revisions or other available indicators.

Our paper is inspired by Swanson, Ghysels and Callan (1999), who examine a real-time dataset for the US consisting of vintages of seasonally adjusted and unadjusted industrial production, and the composite leading indicator. We carry out a similar exercise for Germany. Our dataset consists of industrial production and two Ifo Business Survey indicators, one on the current business climate (Ifo business situation), the other on developments in industrial production (Ifo production). A feature of our dataset is that Ifo indicators are not revised in subsequent releases in contrast to US composite leading indicators or inflation, one of the variables used by Bajada (2003) in a similar study for Australia. Since Ifo indicators measure the sentiment of firm managers qualitatively and directly, they might be informative on revisions in industrial production growth rates. We conclude that this is indeed the case: our Ifo indicators help explain revisions in industrial production. However, the Ifo Business Situation Indicator actually has more explanatory power, i.e. contains more complementary information with respect to industrial production, as the Ifo Production indicator.

The paper proceeds as follows. Section 2 describes the Ifo Business Survey and some of the indicators that can be derived from it. Section 3 presents our real-time data set on growth rates of German industrial production and discusses the actual revision practice as conducted by the official statistical agency (Statistisches Bundesamt) in Germany. Section 4 shows our data. In Sect. 5 we carry out a number of regressions to model the revison process of industrial production and investigate the impact of the Ifo indicators on the quality of German industrial production revision forecasts. Section 6 concludes.

2 The Ifo Business Survey and Its Indicators

Each month, Ifo sends a survey ('Konjunkturtest Gewerbliche Wirtschaft') to close to 7,000 firms in the sectors industry, construction and (retail and wholesale) trade all over Germany (Nerb, 2004). In general, this so-called Ifo Business Survey intends to capture the firm's appraisals of the business situation and their short-term planning and expectations. For instance, it asks firms to judge their current business situation, tendencies in production volume against the previous month and business expectations for the next six months. These and other questions are posed on a monthly basis. Special questions are included, which return at a quarterly (or annual) frequency. For example, the March, June, September and December surveys enquire whether firms work overtime or are faced with a reduction in working hours. Occasionally, the survey is completed with a question that is only included once to serve, for instance, scientific purposes.[2]

Firms are invited to answer most of the questions on a three-category scale: "good/better", "satisfactorily/same" or "bad/worse". The replies are weighted according to the importance of each firm and its industry, and aggregated. The percentage shares of the positive and negative responses to each question are balanced (ignoring the answer "satisfactorily"). In this way each qualitative question is converted into a single Ifo indicator.[3]

The well-known Ifo Business Climate Index combines the assessment of the current business situation and business expectations for the next six months.

[2] For more detailed information, we refer to Oppenländer (1997).

[3] The series of balances thus derived are linked to a base year (currently 1991) and seasonally adjusted.

To be precise, it is the geometric mean of the indicators derived from the balances to question 1) "We judge our current business situation for product group XY to be good, satisfactorily, or bad"; and question 12) "With respect to the business cycle, our business situation for product group XY is expected to be somewhat better, more or less the same, or somewhat worse in the next six months."

Instead of using the Ifo business climate index, we prefer to analyse the information content of two Ifo indicators that do not have an expectation component: the Ifo business situation indicator and the Ifo production indicator. The former is constructed from the answers to the above-mentioned question 1) of the survey. The latter explicitly asks for the development of production as compared to the previous month: question 6) "Our domestic production for XY has increased, has stayed more or less the same, or has become less" as compared to the previous month (complemented with a fourth option of no notable domestic production at all).[4]

Apart from publishing Ifo Business Survey indicators for west and east Germany separately, Ifo has recently started to release figures for the whole of Germany as well.[5] We will use these relatively new figures as they allow for better comparison with our other series of interest, the official index of German industrial production. Furthermore, for obvious reasons we concentrate on that part of the survey which captures the industrial sector (*Verarbeitendes Gewerbe*) and therefore exclude construction firms and enterprises focusing on retail and wholesale trade.

One important feature of Ifo Business Survey indicators is the fact that they are not revised in the course of time.[6] As we will see, this quality of Ifo Business Survey indicators can be helpful when investigating series, like industrial production, in which revisions frequently take place.

3 Industrial Production

The official index of German industrial production is collected by the Statistical Government Agency (Statistisches Bundesamt).[7] Each month t new

[4]Starting January 2002 this question is asked in retrospect, i.e. comparing the production in the previous month with that of the month before.

[5]Due to differences in the division of sectors, the weighting schemes in the aggregation procedure vary. This makes direct comparison of the indicators for west, east and whole Germany difficult.

[6]Only when using seasonally-adjusted Ifo data some very minor realignments might occur. To be nevertheless on the safe side, we use unadjusted series in our analysis.

[7]See Jung (2003) for a detailed analysis of the revision process of German industrial production.

official data are published, giving a preliminary, first estimate for month $t-2$ and partially revised figures for earlier months.[8]

We have vintages released in March 1990 up to December 2003, which include data from 1990:1 up to and including 2003:10. As we are using growth rates and need at least one revision for each month, our dataset in principle covers 1990:1–2003:8. However, we confine our analyses to 1995:12–2003:8, starting from the first vintage (March 1996) that contains more than two observations and utilises data for the whole of Germany. We adopt the convention that our first release for period t is the figure published two months later, our second release the figure published three months later, etc.

Our dataset has some peculiarities. First, the statistical agency did not publish figures on industrial production in March and April 1999. To correct this, two issues were published during May and June that same year.[9] This gave the statistical agency the opportunity to incorporate additional information in these releases, which normally would have taken place in March and April. To capture this, we experimented by including dummy variables for releases during this period. The qualitative results do not change and are not reported for sake of brevity. Secondly, whereas data on thirteen months are published between March 1996 and February 1999, only six monthly figures are supplied from the May 1999 publication onwards with the exception of five months between December 2001 and April 2002, with two, five, three, thirteen and fourteen observations, respectively.

In this paper we analyse the revision process for the monthly growth rates of industrial production (seasonally unadjusted). The data is not rebased, thus avoiding problems associated with level shifts. Let $y_i(t)$ be the ith release of the growth rate of industrial production in period t. Two types of revisions are distinguished, fixed width revisions and increasing width revisions. Fixed Width Revisions are defined as $\Delta y_i \equiv y_{i+1}(t) - y_i(t)$. Increasing Width Revisions are defined as $\nabla y_i(t) \equiv y_{i+1}(t) - y_1(t)$. By construction, the first fixed width revision equals the first increasing width revision (and is therefore omitted from all tables that follow). The increasing width revisions represent the accumulated fixed width revisions.

The increasing width revision for $i = \infty$ is the difference between the "final" release (FR), and the first release. It is quite possible that true final data will never be available for the economic time series we use. This is because benchmark and definitional changes are ongoing and may continue into the indefinite future, for instance. Ideally, no revisions should be made after the final release. We assume that a period of two years is sufficient to reach this

[8] In fact, twice each month data are released: normally a first estimate is given in the second week, whereas at the end of the month its first revision takes place. However, as we have to rely on written publications, i.e. Statistisches Bundesamt (several issues), we only have access to the first publication each month (in which the first revision as released at the end of the previous month is reported as well).

[9] This delay was caused by changes in the way in which survey results for east and west Germany were aggregated.

goal, and hence when comparing the final release for industrial production $y_\infty(t)$ with the first release $y_1(t)$, we take the sample 1995:1–2001:10 and use the official data as available in February 2004 (in which data up to 2003:12 are incorporated).

4 Data

Our data set consists of two Ifo indicators and fixed and increasing width revisions of German industrial production. Figure 2 shows the two Ifo indicators for the period under consideration 1995:12–2003:8. Although the pattern in the Ifo production indicator is quite erratic, the correlation between the indicators is fairly high (0.62). In Sect. 5 we will use the *change* in the Ifo business situation indicator to explain actual revisions. The correlation between this and the Ifo production indicator is 0.52 in our sample.

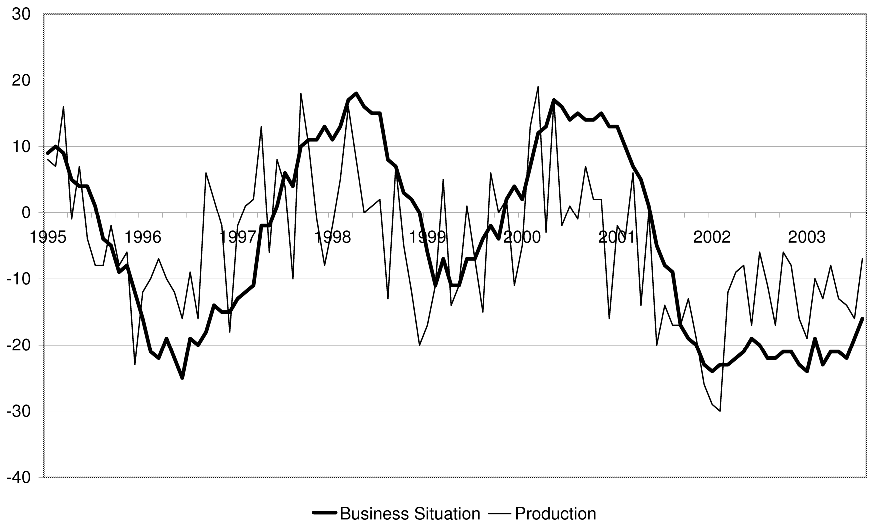


Fig. 2. Ifo Business Survey Indicators

The top panel of Table 1 lists summary statistics of the Ifo indicators. We report the mean, standard deviation, skewness and kurtosis, together with the number of observations. We observe that there is a downward trend in both indicators. The level and annual difference of the Ifo production indicator shows evidence of relatively large (but symmetric) tails. The other indicators seem to follow a normal distribution with some clear differences in variance. For the interpretation of the estimates in Sect. 5, it is important to note that the standard error of the change in the Ifo business situation indicator is small compared to the other series.

Table 1. Summary Statistics for Ifo Indicators and German Industrial Production (available observations in 1995:12–2003:8)

Panel A. Ifo Indicators

	Obs.	Mean	St.Dev.	Skewness	Kurtosis
	Production				
Level	93	−6.0000	10.5191	0.253	−0.245
First Difference	93	−0.0108	10.8583	0.167	−0.297
Annual Difference	93	−1.5699	12.6735	−0.012	−0.699
	Business Situation				
Level	93	−5.3763	14.1958	0.190	−1.495**
First Difference	93	0.0860	3.1335	0.161	0.204
Annual Difference	93	−2.9570	19.3160	0.008	−1.190*

Panel B. Monthly Growth of Industrial Production

	Obs.	Mean	St.Dev.	Skewness	Kurtosis
First Release	93	0.1736	8.4182	0.337	−0.051
Final Release	71	0.6514	9.5927	0.486	−0.237

Panel C. Fixed Width Revisions

	Obs.	Mean[a]	St.Dev.	Skewness	Kurtosis
$i = 1$	93	0.1389	0.9527	−0.031	0.972
$i = 2$	92	−0.0368	0.1821	−5.068**	30.762**
$i = 3$	91	0.0105	0.2327	6.618**	58.943**
$i = 4$	90	0.0093	0.3075	0.969**	22.507**

Panel D. Increasing Width Revisions

	Obs.	Mean[a]	St.Dev.	Skewness	Kurtosis
$i = 1$	93	0.1389	0.9527	−0.031	0.972
$i = 2$	92	0.1036	0.9885	−0.033	0.873
$i = 3$	91	0.1140	0.9647	0.111	0.823
$i = 4$	90	0.1236	0.9724	0.063	0.804
$i = FR$	71	0.2130	1.1413	0.026	0.462

Notes: The superscripts * and ** denote significance at the 5% and 1% level, respectively. For the final release we take the official figures as published in February 2004 and use the sample 1995:12–2001:10.

[a] The null hypothesis that the mean is equal to zero is not rejected for all revisions.

Figure 3 shows first and final revisions for German industrial production for the period 1995:12–2001:10. It suggests that the first revision ($i = 1$) is the dominant one, with revisions between -2.5 and $+2.5$ per cent.[10] Among the first four revisions on which we focus, first revisions have by far the largest number of non-zero observations (86 out of 93 observations). The next three fixed width revisions ($i = 2, 3, 4$), which are associated with quarterly revisions, occur less frequently but are sizeable too.[11] After the fourth revision the industrial production revision process is far from over; in more than 95 per cent of the cases (i.e., 68 out of 71 observations) we observe subsequent revisions in our database.

As follows from the number of black bars compared to the number of white bars in Fig. 3, most subsequent revisions go in the same direction as the first revision. Nevertheless, in nearly 40 per cent (i.e. 26 out of 71 observations) of the cases the first revision is partly undone by subsequent revisions.

The last two panels of Table 1 present summary statistics for fixed width and increasing width revisions, respectively. The horizon is $i = 1, \ldots, 4$, for both types, while the final release as defined above is included for increasing width revisions. For the US, Swanson, Ghysels and Callan (1999) find a systematic (downward) bias in early revisions of industrial production. Using this information would allow an increase in the accuracy of preliminary releases in the US. For Germany the null hypothesis of a mean equal to zero is never rejected independent of whether we look at fixed or increasing width revisions. In other words, there is no systematic bias in the revisions for Germany. The skewness and kurtosis statistics indicate deviations from normality in the second, third and fourth fixed width revisions, which is probably due to a large number of zeros in these revisions.

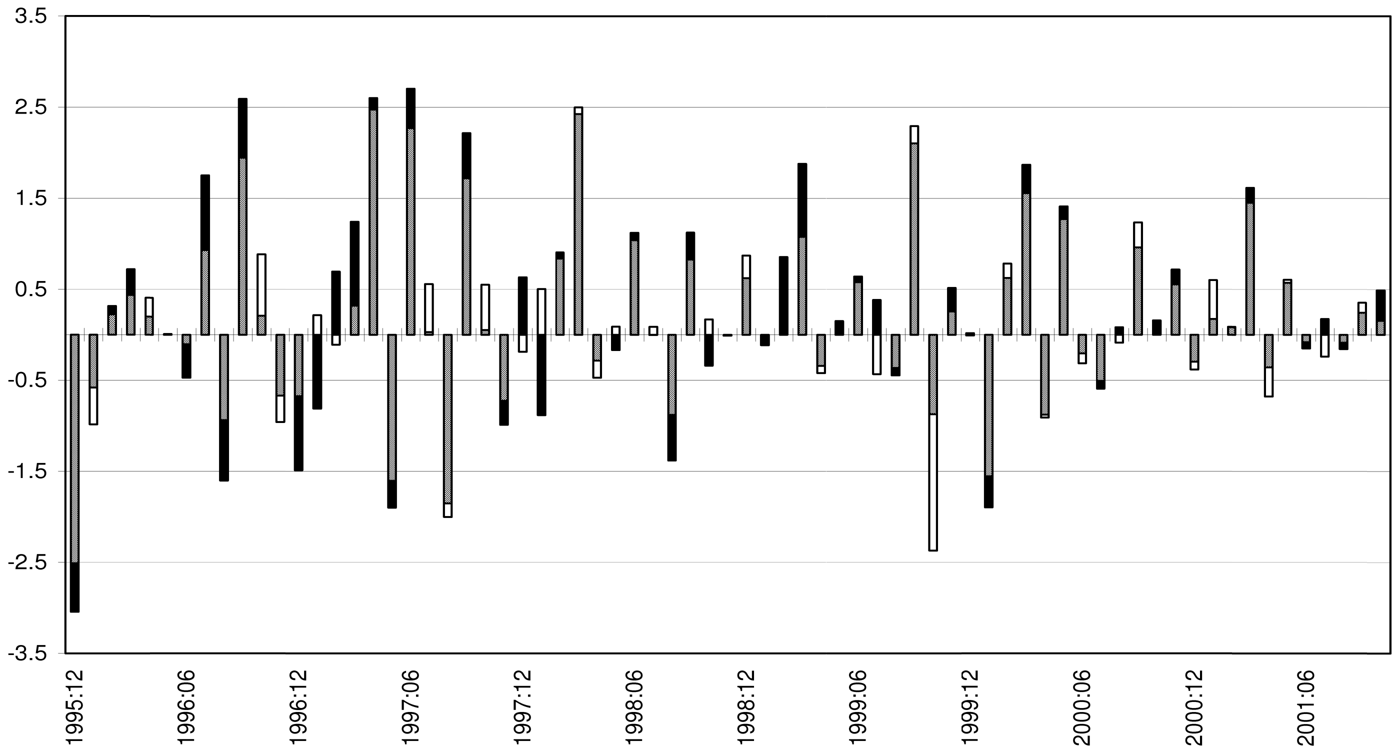
Before we present the outcomes of our empirical analyses, we show 3D-bar graphs of autocorrelation functions for revisions in German industrial production growth in Fig. 4. One axis displays the autocorrelation order j, the other the revision index i. So, each row i shows the autocorrelations of one revision, $\rho\,[\varDelta y_i(t), \varDelta(y_i(t-j)]$ for fixed width revisions, and $\rho\,[\nabla y_i(t), \nabla(y_i(t-j)]$ for increasing width revisions, where ρ denotes autocorrelation, i is the revision index, and j is the autocorrelation order or lag. The figure only shows correlation outcomes that differ from zero at the 10 per cent level.[12]

For the fixed width revisions in the top panel of the figure, almost all significant autocorrelations are first revisions. Autocorrelations for first revisions

[10] Note that the monthly growth rates of industrial production during our sample fluctuate between roughly -17 and $+25$ per cent.

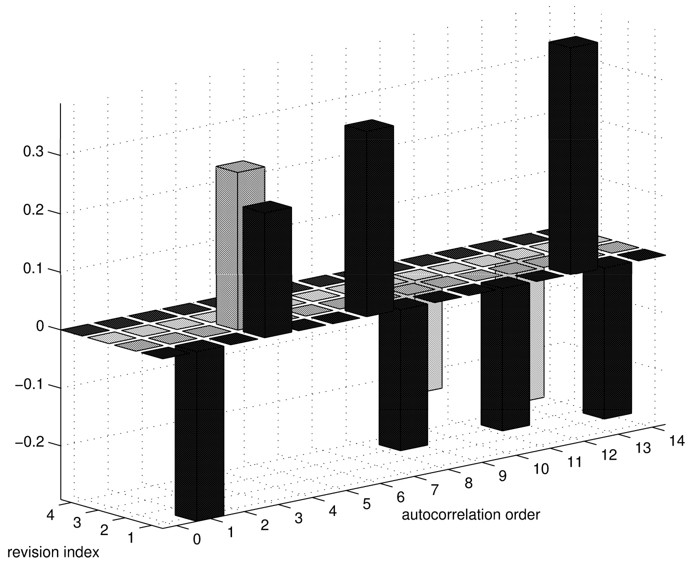
[11] Approximately 25 per cent of the fixed width observations for $i = 2, 3, 4$ are non-zero.

[12] We approximate the variance of the autocorrelation estimators by $\mathrm{var}\,(\hat{\rho}(j)) \approx \frac{1}{T}\left(1 + 2\sum_{k<j} \hat{\rho}^2(k)\right)$, where T is the number of observations. This is an increasing function of j, the autocorrelation order. We use the t-distribution to determine the significance level.

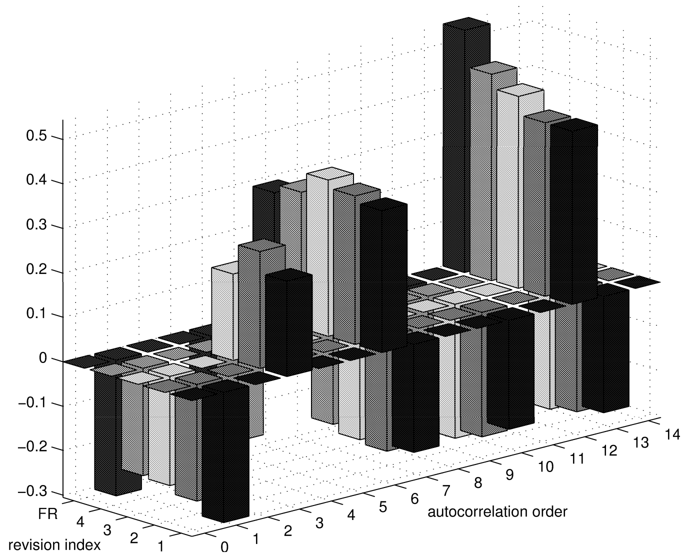


The sum of the grey and white bars depict the first revision of industrial production growth in Germany, i.e. Δy_1. The sum of all revisions (i.e. the increasing width final revision, ∇y_{FR}) is shown by the sum of the grey and black bars. Therefore, black bars indicate that the sum of all subsequent revisions went in the same direction as the first revision, whereas white bars point out that subsequent revisions undo part of the first revision.

Fig. 3. First and Final Revisions of German Industrial Production (1995:12–2001:10)



Panel A. Fixed Width Revisions



Panel B. Increasing Width Revisions

Note: Only autocorrelations significant at a 10% level are shown.

Fig. 4. Autocorrelation Functions for German Industrial Production:

appear at lags of approximately one month, one quarter, two quarters, three quarters and a year. The second revision ($i = 2$) only shows one positive and significant autocorrelation at three months lag. At three quarters and a year's lag the third revision ($i = 3$) turns out to have significant negative autocorrelation coefficients. All this is in line with the revision patterns as discussed in Sect. 3.

The bottom panel illustrates the cumulative property of increasing width revisions. Autocorrelations are more persistent and are significant at lags of one month, two quarters, 10 months and a year for all revisions.

5 Modelling Revisions

In this section, we investigate whether there are predictable patterns in the revision process, in particular we seek to establish a role for our Ifo indicators in the revision process. Jung (2003) and Nierhaus and Sturm (2003) observe the following pattern in the revision process. The first estimate of industrial production is a very preliminary one. For firms that did not yet provide their most recent figures the statistical agency imputes production figures as observed in the previous month. The first revision takes place within three weeks in which the imputed figures of last month are updated. We label this the *partial carry-over* effect. The statistical agency releases both monthly and quarterly figures on industrial production. The latter is based on a substantially larger survey. For this reason, a second revision of the monthly figures occurs as soon as the quarterly survey results are utilised. New annual information may necessitate a further revision.

Apart from the partial carry-over effect (i) we assume that revisions depend on: (ii) autoregressions, (iii) earlier revisions and (iv) deviations of release i from one of our Ifo Business Survey indicators (*ifo*). For fixed width revisions this amounts to

$$\Delta y_i(t) = \underbrace{\vartheta_i y_i(t)}_{\text{(i)}} + \underbrace{\sum_j \theta_j \Delta y_i(t-j)}_{\text{(ii)}} + \underbrace{\sum_{k=1}^{i-1} \phi_k \Delta y_k(t)}_{\text{(iii)}} \underbrace{-\gamma_i(y_i(t) - \delta_i ifo(t)}_{\text{(iv)}} + \varepsilon_i(t),$$

where constants and dummies are omitted. For increasing width revisions the difference operator Δ is replaced by ∇, and the partial carry-over channel becomes $\vartheta_i y_1(t)$.

We analyse the last three channels first individually and then jointly. In the first two models we also test for the partial carry-over effect (as described in Sect. 3) by including a level term, i.e. we add $+\vartheta y_i(t))$ in fixed width models and $+\vartheta y_1(t)$ in increasing width models. Here we sequentially add variables and lags to the model and employ Akaike's (1969, 1970) Final Prediction

Error (FPE) criterion to select significant regressors.[13] In the tables below the regressors are listed in the order in which they are selected by the FPE criterion, i.e. the lag which results in the lowest FPE criterion when compared to all other possible explanatory variables is listed first. The third model, in which only the deviation of industrial production from an Ifo indicator is included, is handled slightly differently, as will be explained later. In the final model, we allow for all four channels to play a role and use the FPE criterion to select the regressors. Besides the estimated coefficients, we report the number of observations, the adjusted R^2 and a Lagrange Multiplier test statistic for autocorrelation of order 1 for each of the models in the subsequent tables. In general, we do not find serious autocorrelation problems.

Autoregressions

Table 2 presents the outcomes of the autoregressions for both types of regressions; fixed width revisions in the top panel, increasing width revisions in the bottom panel. In the upper half of each panel only lagged dependent variables are included using Akaike's FPE as selection criterion. To capture the partial carry-over effect, each lower half contains the first-released growth rate as additional explanatory variable.

In the fixed width revision regressions lags enter at one, three, five, six, nine, ten and twelve months, in line with the revision schedule sketched above. Previous revisions are especially important for first revisions. In subsequent revisions autocorrelations do not play a role. The level term y_i significantly enters the autoregression for the first revision and very clearly improves the fit (The adjusted R^2 jumps to 0.66 coming from 0.31). As expected, we do not find a level effect for the other revisions.

Since the level is important in the first revision, this effect feeds through in all increasing width revisions, as can be seen from the bottom panel. We further observe that more lags enter the equations here, which is in line with the 3D-bar autocorrelation graphs in Fig. 4.

[13] As with all information criteria which have been proposed for allowing the data to determine the model, it involves using a function of the residual sum of squares RSS combined with a penalty for large numbers of parameters (K): $T \log(RSS)+2K$, where T is the number of observations.

Table 2. Revisions of German Industrial Production: Autoregressions

Panel A. Fixed Width Revisions

$\Delta y_i(t)\,(\equiv y_{i+1}(t) - y_i(t)) = c + \vartheta y_i(t) + \sum_j^J \theta_j \Delta y_i(t-j) + \varepsilon_i(t)$

	Constant	y_i	Significant Regressors as Selected by the FPE Criterion					Obs.	$\bar{R}^2$	LM(1)
$i=1$	0.164^{+}		$0.320^{**}\Delta y_1(-12)$	$-0.306^{**}\Delta y_1(-1)$	$-0.165\ \Delta y_1(-10)$	$0.156\ \Delta y_1(-6)$		81	0.31	0.23
$i=2$	-0.028		$0.271^{*}\ \Delta y_2(-3)$					89	0.04	0.21
$i=3$	0.017							91	0.05	1.77
$i=4$	0.008							90	-0.02	0.00
$i=1$	0.112^{+}	$0.093^{**}y_1$	$0.086\ \Delta y_1(-3)$	$0.220^{**}\Delta y_1(-9)$	$-0.166^{*}\ \Delta y_1(-12)$	$-0.095\ \Delta y_1(-5)$		81	0.66	0.56
$i=2$	-0.030	$0.002\ y_2$	$0.260^{*}\ \Delta y_2(-3)$					89	0.04	0.30
$i=3$	0.018	$-0.000\ y_3$						91	0.04	1.85
$i=4$	0.008	$-0.002\ y_4$						90	-0.03	0.00

Panel B. Increasing Width Revisions

$\nabla y_i(t)\,(\equiv y_{i+1}(t) - y_1(t)) = c + \vartheta y_1(t) + \sum_j^J \theta_j \nabla y_i(t-j) + \varepsilon_i(t)$

	Constant	y_1	Significant Regressors as Selected by the FPE Criterion					Obs.	$\bar{R}^2$	LM(1)
$i=2$	0.117		$0.311^{**}\nabla y_2(-12)$	$-0.256^{*}\ \nabla y_2(-1)$	$-0.185^{+}\nabla y_2(-10)$	$0.176^{+}\nabla y_2(-6)$		80	0.30	0.07
$i=3$	0.139		$0.332^{**}\nabla y_3(-12)$	$-0.244^{*}\ \nabla y_3(-1)$	$-0.189^{+}\nabla y_3(-10)$	$0.186^{+}\nabla y_3(-6)$		79	0.33	0.01
$i=4$	0.194^{*}		$0.439^{**}\nabla y_4(-12)$	$-0.239^{*}\ \nabla y_4(-1)$	$-0.167^{+}\nabla y_4(-4)$	$-0.164\ \nabla y_4(-10)$		78	0.34	1.29
$i=FR$	0.401^{**}		$0.462^{**}\nabla y_{FR}(-12)$	$-0.287^{**}\nabla y_{FR}(-1)$	$-0.260^{*}\ \nabla y_{FR}(-4)$	$-0.161^{+}\nabla y_{FR}(-10)$	$-0.156\nabla y_{FR}(-5)$	59	0.52	7.41^{**}
$i=2$	0.063	$0.088^{**}y_1$	$0.195^{**}\nabla y_2(-3)$					89	0.64	0.15
$i=3$	0.067	$0.099^{**}y_1$	$0.271^{**}\nabla y_3(-9)$	$-0.189^{*}\ \nabla y_3(-12)$	$0.143^{*}\ \nabla y_3(-6)$	$0.097\ \nabla y_3(-1)$		79	0.73	0.07
$i=4$	0.098	$0.102^{**}y_1$	$0.208^{**}\nabla y_4(-9)$	$-0.135\ \nabla y_4(-12)$	$0.128^{+}\nabla y_4(-6)$	$0.121\ \nabla y_4(-1)$	$-0.092\nabla y_4(-4)$	78	0.71	3.27^{+}
$i=FR$	0.188^{*}	$0.093^{**}y_1$	$0.211^{**}\nabla y_{FR}(-9)$	$-0.204^{**}\nabla y_{FR}(-4)$	$0.086\ \nabla y_{FR}(-10)$			61	0.72	0.79

Notes: The superscripts $^{+}$, * and ** denote significance at the 10%, 5% and 1% level, respectively. The maximum number of lags for the autocorrelation part (J) is set at 12. LM(p) denotes the Lagrange Multiplier test statistic for autocorrelation of order p. Dummies for the irregular publications of March and April 1999 are not reported. For the final release we take the official figures as published in February 2004 and use the sample 1995:12–2001:10.

Effects of Earlier Revisions

The top panel of Table 3 illustrates that earlier revisions as selected by the FPE criterion occasionally contribute to the explanation of fixed width revisions. The impact for especially the fourth revision is substantial in terms of increase in fit. Apparently, autocorrelations (i.e. revisions of earlier data points) seem to be able to explain early revisions, whereas later revisions in turn depend more on these earlier revisions (of the same data point).

Interestingly, a level effect appears in some of these models. Despite including the first revision in which the partial carry-over effect is clearly incorporated (see Table 2 and the above discussion), subsequent revisions are still affected by it. For third revisions the level term (y_i or y_1) is even significant at the 1 per cent level in both fixed and increasing width specifications.

The parameter estimates for earlier increasing width revisions add approximately up to one, see the bottom panel, as is to be expected because of the cumulative character of this type of revision.

Table 3. Revisions of German Industrial Production: Effects of Earlier Revisions

Panel A. Fixed Width Revisions
$\Delta y_i(t)\ (\equiv y_{i+1}(t) - y_i(t)) = c + \vartheta y_i(t) + \sum_k^{i-1} \phi_k \Delta y_k(t) + \varepsilon_i(t)$

	Constant	y_i	Significant Regressors as Selected by the FPE Criterion			Obs.	$\bar{R}^2$	LM(1)
$i=2$	-0.038^{+}					92	-0.02	0.14
$i=3$	0.026		$-0.060^{*}\ \Delta y_1$			91	0.11	2.40
$i=4$	-0.022		$-0.873^{**}\Delta y_2$	$-0.279^{*}\ \Delta y_3$		90	0.29	0.01
$i=2$	-0.039^{+}	$0.003\ y_2$				92	-0.01	0.19
$i=3$	0.035	$0.013^{**} y_3$	$-0.160^{**}\Delta y_1$			91	0.20	1.79
$i=4$	-0.023	$0.001\ y_4$	$-0.883^{**}\Delta y_2$	$-0.280^{*}\ \Delta y_3$		90	0.28	0.03

Panel B. Increasing Width Revisions
$\nabla y_i(t)\ (\equiv y_{i+1}(t) - y_1(t)) = c + \vartheta y_1(t) + \sum_k^{i-1} \phi_k \nabla y_k(t) + \varepsilon_i(t)$

	Constant	y_i	Significant Regressors as Selected by the FPE Criterion			Obs.	$\bar{R}^2$	LM(1)
$i=2$	-0.039^{+}		$1.014^{**}\nabla y_1$			92	0.97	0.23
$i=3$	0.023		$0.944^{**}\nabla y_2$			91	0.95	2.47
$i=4$	-0.021		$0.863^{**}\nabla y_1$	$0.712^{**}\nabla y_3$	$-0.583^{**}\nabla y_2$	90	0.93	0.00
$i=FR$	0.043		$1.047^{**}\nabla y_4$			71	0.89	1.61
$i=2$	-0.038^{+}	$0.005\ y_1$	$0.983^{**}\nabla y_1$			92	0.97	0.12
$i=3$	0.028	$0.013^{**} y_1$	$0.862^{**}\nabla y_2$			91	0.95	2.06
$i=4$	-0.015	$0.006\ y_1$	$0.839^{**}\nabla y_1$	$0.660^{**}\nabla y_3$	$-0.551^{*}\ \nabla y_2$	90	0.93	0.04
$i=FR$	0.053	$0.016^{+}\ y_1$	$0.943^{**}\nabla y_4$			71	0.89	1.91

Notes: The superscripts $^{+}$, * and ** denote significance at the 10%, 5% and 1% level, respectively. LM(p) denotes the Lagrange Multiplier test statistic for autocorrelation of order p. Dummies for the irregular publications of March and April 1999 are not reported. For the final release we take the official figures as published in February 2004 and use the sample 1995:12–2001:10.

Effects of Ifo Indicators

The regression model to test for the effect of deviations of industrial production from our Ifo Business Survey indicators is derived from an error-correction mechanism

$$\text{Fixed Width: } \Delta y_i(t) = -\gamma \left(y_i(t) - \delta \text{ifo}(t) \right), \quad (1)$$

$$\text{Increasing Width: } \nabla y_i(t) = -\gamma \left(y_1(t) - \delta \text{ifo}(t) \right). \quad (2)$$

Note that due to the carry-over effect, the level term (y_i or y_1) may play a separate role in the explanation of the revisions as well through ($+\vartheta y_i(t)$ or $+\vartheta y_1(t)$). So, the parameters γ (and ϑ) are not identified. Therefore, we simplify the framework to an equation with separate parameters for the level effect ($\alpha = \vartheta - \gamma$) and the Ifo indicator ($\beta = \gamma \times \delta$). We employ the two Ifo indicators described in Sect. 2: *Ifo Business Situation* denoted by ifo^{BS} and *Ifo Production* indicated by ifo^{P}. The first enters the regression models in first-differenced form, whereas the latter already is a flow variable by construction and therefore enters in levels.[14]

We observe a significant Ifo effect on only the first fixed width revision, both for the Ifo business situation indicator and the Ifo production indicator (Tabel 4, top panel). The latter effect is, however, more than four times as large. This cannot completely be explained by the difference in volatility of the two Ifo indicators (see Table 1). Also the explanatory power of the Ifo business situation indicator is slightly higher than that of the Ifo production indicator. For the first fixed width revision, the positive and significant α-coefficient indicates that the partial carry-over effect dominates the error-correction mechanism. Confirming the results in Tables 2 and 3 and the estimated β-coefficients, the partial carry-over and error correction effects do not show up in subsequent revisions.

The bottom panel shows that in general our Ifo indicators contribute to the explanation of increasing width revisions. The Ifo production indicator is always significant at the 5 per cent level, except when using final release data. The Ifo business situation indicator is even significant at the 1 per cent level for all revisions. The adjusted R^2's in models using the second indicator slightly outperform those using the first. We therefore conclude that the (change in the) Ifo business situation indicator does a better job in explaining revisions than the Ifo production indicator.[15] A possible explanation for this result is that – because we have the level of industrial production already included – the Ifo Production indicator, which more or less measures the same,

[14]The inclusion of the level of the Ifo business situation indicator produces qualitatively similar outcomes, albeit less significant.

[15]We also have estimated models in which both Ifo indicators are included. In such regressions only the Ifo business situation indicator appears significant, which confirms our conjecture that this indicator has more explanatory power when analysing revisions in industrial production growth than the Ifo production indicator.

does not contain as much additional complementary information as the Business Situation indicator. Indeed, when the partial carry-over term is removed from the regressions, the adjusted R^2's for models with Ifo Production clearly outperform those with the Ifo Business Situation included.[16]

[16]Another possible explanation might be structural breaks in the first indicator: the Ifo Production question has been slightly reformulated a couple of times during the sample under consideration (see e.g. footnote 4). This has not been the case for the question from which the Ifo Business Situation is derived.

Table 4. Revisions of German Industrial Production: Effects of Ifo Indicators

Panel A. Fixed Width Revisions
$y_{i+1}(t) - y_i(t) = c + \alpha y_i(t) + \beta ifo(t) + \varepsilon_i(t)$

	Constant	y_i	Production	Bus.Situation	Obs.	$\bar{R}^2$	LM(1)
$i = 1$	0.184^{*}	0.075^{**}	0.014^{*}		93	0.65	1.75
$i = 2$	−0.020	0.001	0.003		92	−0.00	0.41
$i = 3$	0.035	−0.002	0.003		91	0.05	1.78
$i = 4$	−0.003	−0.000	−0.002		90	−0.04	0.01
$i = 1$	0.103^{+}	0.076^{**}		0.062^{**}	93	0.67	1.42
$i = 2$	-0.039^{+}	0.003		0.001	92	−0.02	0.15
$i = 3$	0.018	−0.000		0.001	91	0.03	1.95
$i = 4$	0.009	−0.003		0.010	90	−0.03	0.03

Panel B. Increasing Width Revisions
$y_{i+1}(t) - y_1(t) = c + \alpha y_1(t) + \beta ifo(t) + \varepsilon_i(t)$

	Constant	y_1	Production	Bus.Situation	Obs.	$\bar{R}^2$	LM(1)
$i = 2$	0.170^{*}	0.080^{**}	0.020^{*}		92	0.62	0.86
$i = 3$	0.211^{**}	0.078^{**}	0.019^{**}		91	0.64	0.57
$i = 4$	0.218^{**}	0.082^{**}	0.017^{*}		90	0.63	0.67
$i = FR$	0.224^{*}	0.091^{**}	0.015		71	0.61	1.68
$i = 2$	0.061	0.084^{**}		0.066^{**}	92	0.63	0.27
$i = 3$	0.103^{+}	0.082^{**}		0.069^{**}	91	0.65	0.44
$i = 4$	0.122^{+}	0.084^{**}		0.072^{**}	90	0.65	0.38
$i = FR$	0.186^{*}	0.091^{**}		0.081^{**}	71	0.65	0.81

Notes: The superscripts $^{+}$, * and ** denote significance at the 10%, 5% and 1% level, respectively. LM(p) denotes the Lagrange Multiplier test statistic for autocorrelation of order p. Dummies for the irregular publications of March and April 1999 are not reported. For the final release we take the official figures as published in February 2004 and use the sample 1995:12–2001:10.

Full Model

The final table brings it all together and presents the outcomes of the full model in which the statistical relevance of the channels is judged by Akaike's FPE criterion. All previously distinguished channels seem to play a role in the fixed width revisions as well as in the increasing width revisions when combining them. We observe an autoregression effect at a lag of one quarter in the top panel for first and second revisions, at a lag of three quarters (and at one year and five months in the model with the Ifo production indicator) for the first revision and at one month for the third revision. An earlier revisions effect is present in the third and fourth revisions, and a carry-over effect in the first and third revisions. Most important from our perspective is the outcome that both the Ifo production indicator (ifo^P) and the Ifo business situation indicator (ifo^{BS}) have explanatory power in the system for the first revisions. For third revisions the Ifo Production idicator also explains a small part. The fit of the equation for the first revisions is by far the best. In those specifications a one standard deviation shock in either Ifo indicator results in a revision of roughly 0.2 per cent.

As expected, the regressions using increasing width revisions show that once earlier revisions are included as explanatory variables not much is left to explain by the other channels. Only for $i = 3$ and $i = FR$ the autocorrelation parts and the partial carry-over effect play a role. For the final revision this is at least partly caused by data limitations; we do not have the most recent earlier revision included in that model (i.e. $\nabla y_{FR-1}(t)$). For the same reason, the goodness of fit – as measured by the adjusted R^2 – is lower than for the other increasing width revision models. The Ifo business situation indicator is included in the fourth fixed width revisions; the Ifo production indicator enters the second increasing width revision model.

Table 5. Revisions of German Industrial Production: Full Model

Panel A. Fixed Width Revisions

$\Delta y_i\,(\equiv y_{i+1}(t) - y_i(t)) = c + \sum_j^J \theta_j \Delta y_i(t-j) + \sum_{k=1}^{i-1} \phi_k \Delta y_k(t) + \alpha y_1(t) + \beta ifo(t) + \varepsilon_i(t)$

	Constant	Significant Regressors as Selected by the FPE Criterion						Obs.	$\bar{R}^2$	LM(1)
	Production									
$i=1$	0.197*	$0.084^{**} y_1$	$0.089\ \Delta y_1(-3)$	$0.016^{*}\ ifo^P$	$0.220^{**} \Delta y_1(-9)$	$-0.183^{*} \Delta y_1(-12)$	$-0.090 \Delta y_1(-5)$	81	0.68	1.10
$i=2$	−0.008	$0.272^{*}\ \Delta y_2(-3)$	$0.004^{+}\ ifo^P$					89	0.08	0.43
$i=3$	0.063*	$-0.184^{**} \Delta y_1$	$0.012^{**} y_3$	$0.004\ \ ifo^P$	$0.115\ \ \Delta y_3(-1)$			90	0.24	0.27
$i=4$	−0.022	$-0.873^{**} \Delta y_2$	$-0.279^{*}\ \Delta y_3$					90	0.29	0.01
	Business Situation									
$i=1$	0.111+	$0.076^{**} y_1$	$0.118^{+}\ \Delta y_1(-3)$	$0.064^{**} ifo^{BS}$				90	0.64	1.80
$i=2$	−0.028	$0.271^{*}\ \Delta y_2(-3)$						89	0.04	0.21
$i=3$	0.038+	$-0.176^{**} \Delta y_1$	$0.014^{**} y_3$	$0.129\ \ \Delta y_3(-1)$				90	0.22	0.12
$i=4$	−0.022	$-0.873^{**} \Delta y_2$	$-0.279^{*}\ \Delta y_3$					90	0.29	0.01

Panel B. Increasing Width Revisions

$\nabla y_i\,(\equiv y_{i+1}(t) - y_1(t)) = c + \sum_j^J \theta_j \nabla_i y_i(t-j) + \sum_{k=1}^{i-1} \phi_k \nabla y_k(t) + \alpha y_1(t) + \beta ifo(t) + \varepsilon_i(t)$

	Constant	Significant Regressors as Selected by the FPE Criterion				Obs.	$\bar{R}^2$	LM(1)
	Production							
$i=2$	−0.014	$0.991^{**} \Delta y_1$	$0.004^{+}\ ifo^P$			92	0.97	0.36
$i=3$	0.025	$0.846^{**} \nabla y_2$	$0.017^{**} y_1$	$0.058^{*}\ \nabla y_3(-1)$		90	0.95	0.67
$i=4$	−0.021	$0.863^{**} \Delta y_1$	$0.712^{**} \nabla y_3$	$-0.583^{**} \nabla y_2$		90	0.93	0.00
$i=FR$	0.100+	$0.824^{**} \nabla y_4$	$0.056\ \ \nabla y_{FR}(-12)$	$-0.084^{+}\ \nabla y_{FR}(-4)$	$0.017^{+}\ y_1$	59	0.90	0.35
	Business Situation							
$i=2$	−0.039+	$1.014^{**} \Delta y_1$				92	0.97	0.23
$i=3$	0.025	$0.846^{**} \nabla y_2$	$0.017^{**} y_1$	$0.058^{*}\ \nabla y_3(-1)$		90	0.95	0.67
$i=4$	−0.016	$0.849^{**} \Delta y_1$	$0.685^{**} \nabla y_3$	$-0.565^{**} \nabla y_2$	$0.015\ \ ifo^{BS}$	90	0.93	0.18
$i=FR$	0.100+	$0.824^{**} \nabla y_4$	$0.056\ \ \nabla y_{FR}(-12)$	$-0.084^{+}\ \nabla y_{FR}(-4)$	$0.017^{+}\ y_1$	59	0.90	0.35

Notes: The superscripts $^{+}$, * and ** denote significance at the 10%, 5% and 1% level, respectively. The maximum number of lags for the autocorrelation part (J) is set at 12. LM(p) denotes the Lagrange Multiplier test statistic for autocorrelation of order p. Dummies for the irregular publications of March and April 1999 are not reported. For the final release we take the official figures as published in February 2004 and use the sample 1995:12–2001:10.

Forecast Experiments

So far, we have concentrated on describing past revisions without explicitly looking at the forecast ability of these models for future revisions. Now, we turn to the role of the Ifo indicators in predicting revisions. As a first step, we explore how often the Ifo indicators have been right in predicting the direction of the future first revisions in our sample. Table 6 summarizes the outcomes of this signalling test. Both the Ifo Production and the Ifo business situation indicator gave a correct signal for the direction of the first revision of German industrial production growth in over 62 percent of the time. Bootstrap techniques show that this significantly outperforms "throwing a coin", which would correctly predict the sign in only 49 percent of the cases due to the long-run trend in industrial production growth. The production indicator seems to slightly outperform the business situation indicator when it comes to signalling the direction of the first revision.

Table 6. Signalling Quality of Ifo Indicators

	Sample	Observations	Correct Signal	Percentage	t-Statistic
	Predicting Direction of First Revision (Δy_1)				
ifo^P	1995:12–2003:8	93	61	0.656	3.268**
ifo^{BS}	1995:12–2003:8	93	58	0.624	2.647**
ifo^P	1995:12–2001:10	71	49	0.690	3.392**
ifo^{BS}	1995:12–2001:10	71	45	0.634	2.437*
	Predicting Direction of Final Increasing Width Revision (∇y_{FR})				
ifo^P	1995:12–2001:10	71	43	0.606	1.960*
ifo^{BS}	1995:12–2001:10	71	49	0.690	3.392**

Notes: In case of the sample 1995:12–2003:8 (1995:12–2001:10) with 93 (71) observations the bootstrapped distribution – based upon 10,000 draws – has a mean of 0.486 (0.489) and a standard deviation of 0.052 (0.059) if we use the Ifo production indicator. If we use the Ifo business situation indicator the mean changes somewhat to 0.489 (0.500), whereas the standard deviation is not affected. The superscripts * and ** denote significance at the 10%, 5% and 1% level, respectively, of the null hypothesis that the Ifo indicators do not outperform pure chance.

Of course, we are not only interested in predicting the first revision, but also in getting as close as possible to the final release data. The lower part of Table 6 reports that the Ifo business situation indicator does a good job in signalling the direction of the final increasing width revision. Whereas the performance of the Ifo production indicator deteriorates (from 49 to 43 correct signals), the Ifo business situation indicator becomes more successfull (from 45 to 49 correct signals).

Finally, we assess the forecasting performance of the Ifo business situation indicator in the preferred specification of Table 5 for the first revision. We begin with using only data up to and including 2001:10 and forecast the first revision for 2001:11. This procedure is repeated 22 times in which the sample is successively expanded by one month to forecast next month's revision.[17] These forecasts are then compared with the realisations of the first revisions. We use Theil's U statistic to assess the forecast quality. This statistic is the ratio of the root mean square error for the model of interest to the root mean square error for a "zero-forecast" model, i.e. a model which sets each revision forecast equal to zero. This is a convenient measure because it is independent of the scale of the variable. If the Theil's U statistic is below one, then the model in question outperforms the naive zero-forecast model, i.e. has a smaller root mean squared error.

This exercise is carried out with and without the business climate indicator. In the first case, Theil's U statistic turns out to be 0.778, whereas in the latter it results in 0.774. Hence, both models clearly outperform the zero-forecast model and show that there is ample room for improving the first release data. Furthermore, the Ifo indicator does improve the forecast ability of our partly carry-over/autoregression model, but this effect is quite moderate.

6 Conclusion

Ifo Business Survey indicators, with the Ifo business climate index as most prominent member, have an outstanding position in the world, both domestically and overseas. Recent figures are published in the popular press each month and scrutinized by financial specialists and policy analysts alike. This paper has studied one aspect of the information content of Ifo Business Survey indicators: do some of these indicators help explain subsequent data revisions of German industrial production? To that purpose we constructed a real-time data set of industrial production and exploited the property that Ifo indicators are not revised in subsequent releases.

We can indeed establish a relationship between the Ifo indicators we analyse – one on current production developments, the other on the current business situation – and especially the first and by far most dominant revision of industrial production growth. Furthermore, we find evidence that past revisions of industrial production have predictive content for current and future

[17] When using the same procedure as underlying Table 5 for this smaller sample results in exactly the same model specification with only slightly changed coefficient estimates: $\Delta y_i = 0.117 + 0.078 y_1 + 0.148 \Delta y_1(-3) + 0.067 ifo^{BS}$. These variables are held fixed, whereas the coefficients are re-estimated using the expanded data set.

revisions. All this suggests that it is possible to improve upon our estimates (or preliminary releases) of final data for industrial production.

The Ifo Business Survey asks firm managers about their ideas on the current situation and plans and expectations for the near future. An untested assumption of ours is that Business Survey indicators are more reliable in assessing the current business situation than other sentiment indicators based on for instance consumer surveys or expert opinions, since firm managers are asked to judge their own production and order position. Future real-time data analyses should reveal whether the Ifo Business Survey indicators indeed give "better" signals than other sentiment indicators. For obvious reasons, such an exercise should not only be restricted to industrial production. Other aspects of the information content of the indicators, their strength in forecasting and policy analysis, should then be addressed as well. For all this, a first important step would be the construction of a comprehensive real-time data set for Germany.

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