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Revisions to the Czech National Accounts: Properties and Predictability*

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Abstract
Frequent revisions to GDP and its components cause policymakers to face considerable uncertainty about the current state of the economy. In this paper, we provide stylized facts about the magnitude of revisions to the Czech national accounts. Using data over the 2003–2012 period, we find that the revisions are rather large. Revisions to real GDP growth are on average 1.4 for the annualized quarterly growth rate and 0.7 percentage points for the annual growth rate. Revisions to other variables are even larger: the average size of the revisions ranges from 1 to 12 percentage points for annualized quarterly growth rates and from 0.5 to 4 percentage points for annual growth rates. We investigate whether the revisions could have been predicted using the information available at the time of announcement. We find evidence for in-sample predictability for most of the variables, suggesting that the first releases of these variables are not efficient predictors of the actual values. In a real-time out-of-sample exercise, however, we find that the revisions to real GDP, gross fixed capital formation, and government consumption are not predictable. Only revisions to the GDP deflator can be predicted with substantial gains relative to zero-revisions forecasts.

1. Introduction

Crucial indicators about the state of the economy—GDP and its components—are measured imperfectly. They are available only after a significant lag and are often subject to revisions. The fact that important macro aggregates are imprecisely measured is of importance for policymakers, who must make decisions that depend vitally on the current state of the economy. If data are often revised, a question arises as to how much weight policymakers should attribute to initial data releases. The pursuit of optimal policy might be jeopardized by an over-reaction to current data (Orphanides, 2003; Kugler et al., 2005). Indeed, policymakers regularly discuss expected revisions to the new data in their monetary policy deliberations.[1] Additionally, the revisions are often one of the main sources of Czech National Bank (CNB) forecast errors.[2]

The importance of using real-time data is already well recognized in the literature on forecasting and monetary policy analysis (Robertson and Tallman,

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[1] See, for example, the recent minutes of the Bank Board Meeting on 27 September 2012, where expected revisions to investment data were discussed (http://www.cnb.cz/en/monetary_policy/bank_board_ minutes/2012/amom_120927.html).

[2] See, for example: http://www.cnb.cz/en/public/media_service/comments/2012/12_hdp_2q.html.

1998; Croushore and Stark, 2001; Croushore, 2011). To that end, several real-time databases have been established (Croushore and Stark, 2001; McKenzie, 2006; Fernandez et al., 2011; Giannone et al., 2012). An increasing number of papers point out that many results obtained using revised data are sensitive to real-time data issues (Swanson and White, 1997; Amato and Swanson, 2001; Orphanides, 2001; Orphanides and van Norden, 2002; Christoffersen et al., 2002; Molodtsova et al., 2008).

The reasons why statistical offices perform revisions are discussed in McKenzie (2006). The Czech Statistical Office (CZSO) revises the data of the current year with each regular release of quarterly data. The CZSO states that more complete and updated information are the main reason for the revisions. In addition, revisions are made twice a year because of annual account compilation affecting the data as far as three years ago. Furthermore, revisions originating from seasonal adjustment are made each quarter to the current year data, and once a year to the whole series.[3] In addition to these regular revisions, the CZSO occasionally performs benchmark revisions, which reflect changes in methodology and affect the whole time series.

Mankiw et al. (1984) propose that the revision process might be characterized as either reflecting measurement error (revisions are then referred to as *noise*) or reflecting new information (revisions are referred to as *news*). If revisions are noise, the first release of a variable is an imperfect measure of the true variable. We can therefore make use of other information available at the time of the release to produce a better forecast of the true value. The optimal forecast of the true value is then a weighted average of the first-release value and the conditional mean of other observable data. For example, we can use the mean of the underlying variable itself (in such cases the optimal forecast of future revisions is related to the deviation of the value of the first release from the mean of the underlying variable). The larger is the variance of the measurement error, the smaller is the weight that should be attributed to the first-release observation.

If revisions contain news, they are not predictable using the information available at the time of first release. Therefore, it is optimal to put a weight of one on the value of the first release and a weight of zero on other observable data. In other words, the optimal forecast of future revisions is zero. When revisions are news, the first releases are often referred to as rational or efficient forecasts of the true value of the variable.

Mankiw et al. (1984) find that revisions to U.S. money aggregates can be characterized as noise. Mankiw and Shapiro (1986) find that revisions to U.S. nominal and real output can be characterized as news. Croushore and Stark (2001) find that short-term revisions to U.S. GDP contain news, while long-term revisions seem to reduce noise. Using a longer sample, Aruoba (2008) provides evidence showing that revisions to most U.S. macro variables are biased and cannot be characterized as reflecting news. Garratt and Vahey (2006) come to similar conclusions for the UK. Faust et al. (2005) document that revisions to GDP are predictable in most G-7 countries. Recently, de Castro et al. (2011) have shown that the revisions to releases of budget deficit data in the EU-15 are biased downward and cannot be considered news.

[3] See the description of the methods used for the compilation of national accounts by the Czech Statistical Office available at: http://www.czso.cz/eng/redakce.nsf/i/gross_domestic_product_(gdp).

The above-mentioned literature attempts to characterize revisions as either news or noise. There is also a related strand of literature that focuses on optimal forecasting and inference in the presence of revisions (Sargent, 1989; Kapetanios and Yates, 2010). Jacobs and van Norden (2011) try to connect these two strands of literature and model news and noise simultaneously within a state-space framework.

There is virtually no evidence about the properties of Czech real-time data.[4] The main objective of this paper is to fill this void and to enhance our understanding about the size and the properties of revisions to the Czech national accounts. We gather real-time vintages of Czech GDP and its components over 2003–2012 and provide evidence about their statistical properties. Moreover, in line with the above-mentioned literature, we test whether the revisions to the Czech national accounts can be viewed as noise or news. We therefore investigate the predictability of the revisions both in-sample and in a real-time out-of-sample exercise. Note that the analysis is not meant to criticize the statistical agency: the CZSO certainly has limited resources and tries to minimize revisions subject to its operational constraints. The main objective of our analysis is to improve our understanding of the properties of revisions.

Our results suggest that the revisions to real GDP and its components are largely unbiased, with the exception of a positive bias in short-term revisions to the annual growth rates of exports and imports. Revisions to the GDP deflator, on the other hand, are biased downward for both quarterly and annual growth rates. The revisions are rather large: the mean absolute revision to annualized quarterly GDP growth is roughly 1.4 percentage points and that to the annual growth rate is roughly 0.7. The revisions to other variables are even larger. Judging by the size of the revisions relative to the size of the original variables, the largest relative revisions seem to occur in consumption and gross fixed capital formation. On the other hand, exports and imports have the smallest noise-to-signal ratios among the components of GDP. Next, we find that revisions to GDP are predictable in-sample and thus the first releases cannot be characterized as news. In addition to the in-sample evidence, we investigate whether the revisions are predictable in a real-time out-of-sample exercise. We find evidence of out-of-sample predictability for the revisions of the GDP deflator, and to a lesser extent for the revisions of consumption and the year-on-year growth rates of exports and imports, while for other variables zero-revision forecasts seems to perform better in the real-time exercises. The results from the real-time exercise should be viewed with caution, however, since the out-of-sample period is very small and covers the recent crisis period.

The remainder of the paper is structured as follows. Section 2 describes the data. Section 3 provides stylized facts about the revisions, while Section 4 examines their in-sample and out-of-sample predictability. Section 5 summarizes the implications of our key results.

[4] The exceptions are two boxes in the CNB Inflation Reports, which, however, consider only the effects of benchmark revisions: in 2004 (http://www.cnb.cz/en/monetary policy/inflation reports/2004/2004 october/ /boxes annexes/zpinflace 04 october b3.html) and in 2011 (http://www.cnb.cz/en/monetary policy/inflation reports/2012/2012 I/boxes and annexes/zoi 2012 I box 2.html).

Figure 1 Revision Triangle

		Vintage		
1	$\cdots$	$t-v$	$\cdots$	$t+1$
y_0^1	$\cdots$	y_0^{t-v}	$\cdots$	y_0^{t+1}
	$\ddots$	$\vdots$		$\vdots$
		y_{t-v-1}^{t-v}	$\cdots$	y_{t-v-1}^{t+1}
			$\ddots$	$\vdots$
				y_t^{t+1}

2. The Data

We gather historical vintages of Czech data on nominal GDP, the GDP deflator, and real GDP and its expenditure components: real private consumption, real gross fixed capital formation (GFCF), real government consumption, real exports, and real imports. The source of our data is the *OECD Real-Time Data and Revisions Database*.[5] Note that the Czech Statistical Office provides a history of its announcements on its website starting from 2003. We prefer to work with the OECD database because it provides us with the whole time series of data for each component of GDP at each vintage, while the CZSO archive does not always provide time series for the components. Nevertheless, we double-checked the data for the first releases obtained from the OECD real-time database against the archive of the Czech Statistical Office to ensure consistency.[6]

Figure 1 illustrates how the real-time data are typically structured in a so-called revision triangle. The subscript denotes the reference period which the observation captures, while the superscript denotes the period in which the release is made. The notation emphasizes the fact that national accounts data are available only with a 1 quarter lag.

The real-time vintages for seasonally adjusted real GDP and its components are available from September 2003 through March 2013. That means we have 39 observations available for the period 2003Q2–2012Q4. We do not consider preliminary (flash) estimates, since they are announced only starting from the fourth quarter of 2007.[7]

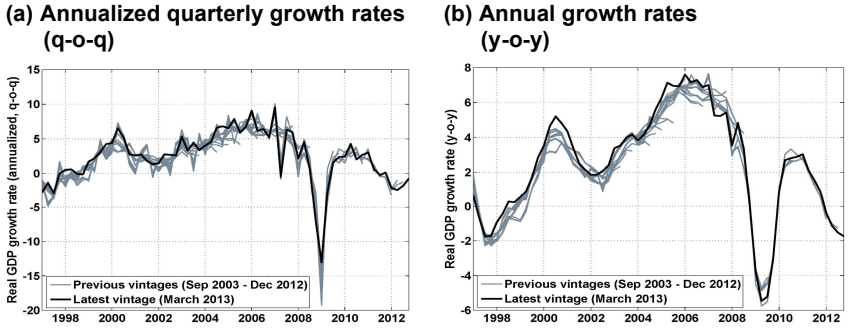
Figure 2 plots all of the available historical vintages of GDP in both quarter-on-quarter and year-on-year growth rates. The figure illustrates the uncertainty about real GDP growth caused by revisions. Note that on some occasions the first-release

[5] Available at http://stats.oecd.org/mei/default.asp?rev=1.

[6] There was only one inconsistency: the 2004Q1 value was missing from the release of the same data in the OECD real-time database, perhaps because the CZSO did not release seasonally adjusted quarterly series. Therefore, for the annual growth we used the value stated on the CZSO website, and for the quarter-on-quarter growth we used the value from the next release. The data at other releases were exactly the same in both sources.

[7] The correlations of the preliminary estimate of the quarterly growth rate of real GDP with the first release and of the preliminary estimate with the final value (as of March 2012) are 0.95 and 0.87, respectively. Similarly, the correlations of the preliminary estimate of the annual growth rate of real GDP with the first release and of the preliminary estimate with the final value (as of March 2012) are 0.99 and 0.97, respectively. The correlations are based on 21 observations. We provide scatter plots in the *Appendix* available on the website of this journal.

Figure 2 Growth Rates of Various GDP Vintages



data point to an acceleration of growth relative to the previous (first-release) value, while the later revisions suggest the opposite.[8] This might be especially problematic for policymakers, because they usually consider potential inflationary vs. anti-inflationary pressures. Such data uncertainty therefore hinders the decision-making about the optimal policy. For an illustration of the data uncertainty of other components and the time series of short-term and long-term revisions, see the supplementary figures in the *Appendix* on the website of this journal.

To mitigate the effect of benchmark revisions we follow the standard practice of analyzing the growth rates of the variables. We analyze both the annualized quarter-on-quarter growth rates and the annual year-on-year growth rates. We decided to work with both transformations, since both of them might be of interest to macroeconomists and policymakers. The year-on-year growth rates are smoother, while the quarter-on-quarter ones might be noisier. On the other hand, the quarter-on-quarter rates might be more efficient for forecasting, while the year-on-year growth rates are autocorrelated by definition.

Since the data are continually revised, it is not clear which observations should be considered the "true" or final ones. The last published data may/should be closest to the "true" values, since they reflect the latest information available to the statistical office and should reflect the latest, most up-to-date methodologies for computing the released data. On the other hand, revisions stemming from changes in definitions and methodologies might not be of interest, since they do not tell us about the efficiency of data releases under the current measurement system (Faust et al., 2005). Furthermore, policymakers might be more interested in revisions to recent data only, since these might have a direct effect on their decision making.

To account for that, we compute two measures of revisions. First, we compute short-term revisions as the difference between the growth rate of a variable a year after the first release was published and the original first-release growth rate $\left(r_t = y_t^{t+5} - y_t^{t+1}\right)$. Second, we compute long-term revisions as the difference

[8] See also *Figures A2* and *A3* in the *Appendix* for better illustration. For example, there are 12 such occasions in the case of short-term revisions to quarter-on-quarter growth, and 8 in the case of long-term revisions to quarter-on-quarter growth. As for the year-on-year growth rates, there are 9 and 8 occasions for short-term and long-term revisions, respectively.

between the growth rate in the last vintage available and the original first-release growth rate ($r_t = y_t^T - y_t^{t+1}$, where T = March 2013). To make sure that each data series has at least some revisions we use only data through to 2011Q4, thus leaving 35 observations for the analysis. This might be considered low, but on the other hand, the practice and methodology of the statistical office have evolved over time, so having a longer sample could raise doubts regarding the presence of structural breaks.

3. Statistical Properties of Revisions

Aruoba (2008) puts forward three basic statistical properties that well-behaved revisions should satisfy. First, the mean of the revisions should be zero. In that case, the first releases of the statistical agency can be considered unbiased estimates of the final values. Second, the variance of the revisions should be small relative to the variance of the underlying variable. Third, the first release of the statistical office should be an optimal forecast of the final value. That means that the revisions should not be predictable using information available at the time of the first release, i.e., revisions should be news. In this section, we focus on the first two of these properties, while the investigation of the predictability of revisions is deferred to the next section.

Table 1 provides information about the mean revisions, the maximum and minimum revision, the standard deviation of revisions, the mean absolute revisions, and the autocorrelation of revisions. Because absolute values may not be very informative about the size of the revisions relative to the size of the original variables, we also report noise-to-signal ratios. The noise-to-signal ratio is defined as the standard deviation of the revisions divided by the standard deviation of the final value of the variable.

The short-term revisions to the quarter-on-quarter growth rates are generally unbiased: their mean revisions are very close to zero. The exception is the bias in the GDP deflator revisions. The short-term quarter-on-quarter growth rates of the GDP deflator seem to be revised systematically downward: on average by –0.57 percentage points and statistically significant at a 10% significance level. We use *t*-statistics based on Newey-West heteroskedasticity and autocorrelation-consistent standard errors with a lag parameter of four to test whether the mean revisions are zero. As for the long-term revisions to the quarter-on-quarter growth rates, we find that they are largely unbiased.

The bottom panel of *Table 1* presents the statistics on the year-on-year growth rates. We find statistically significant bias in both the short-term and long-term revisions of the GDP deflator. In addition, the short-term revisions to exports and imports are biased upward and the bias is statistically significant. This suggests a tendency toward more pessimistic values in the first releases of exports and imports. The short-term revisions in the variables with biased revisions cannot be considered news. The biases in the short-term revisions suggest potential predictability for these three variables. We investigate how this predictability may be exploited to improve the national accounts forecasts.

The magnitudes of the revisions are rather large. The short-term revisions range from –4 to +2 percentage points for real GDP for the annualized quarter-on-

Table 1 Summary Statistics of Revisions

	NGDP	*RGDP*	*GDPD*	*C*	*I*	*G*	*E*	*I*
Annualized quarterly growth rates (q-o-q)								
Short-Term Revisions Mean	-0.62	-0.04	-0.57	-0.30	0.45	0.53	1.98	2.02
p-value	0.40	3.58	0.08	2.36	2.82	1.18	0.27	0.11
Max	2.85	2.02	2.28	5.45	24.16	8.26	21.64	26.25
Min	-9.10	-4.04	-5.00	-7.53	-27.69	-9.51	-12.23	-10.77
Std. Deviation	2.38	1.53	1.66	2.63	9.23	4.13	8.56	7.67
Mean Absolute Revision	1.83	1.30	1.21	1.94	6.27	3.36	6.88	5.46
Noise to Signal	0.53	0.37	0.63	0.99	0.70	0.73	0.49	0.41
AR(1)	-0.18	0.07	-0.29	0.15	-0.17	-0.15	-0.30	-0.17
Long-Term Revisions Mean	-0.50	0.15	-0.63	0.10	1.05	0.17	-0.46	-0.30
p-value	1.02	2.99	0.13	3.45	2.52	3.20	2.77	3.22
Max	8.20	3.53	5.40	10.65	58.75	13.65	27.58	21.28
Min	-9.90	-5.99	-7.20	-8.35	-27.73	-16.64	-38.27	-33.71
Std. Deviation	3.64	2.02	2.97	3.96	17.36	6.62	11.22	12.15
Mean Absolute Revision	2.64	1.52	2.24	3.09	11.92	5.11	7.71	10.02
Noise to Signal	0.67	0.46	0.71	1.10	1.10	0.82	0.67	0.67
AR(1)	-0.47	0.05	-0.55	-0.01	-0.16	-0.27	-0.54	-0.66
Annual growth rates (y-o-y)								
Short-Term Revisions Mean	-0.15	0.17	-0.33	-0.03	-0.94	0.52	1.13	0.87
p-value	0.48	0.41	0.03	0.91	0.19	0.14	0.01	0.01
Max	1.49	1.36	1.12	1.42	6.36	5.25	6.23	4.73
Min	-2.49	-2.05	-1.69	-2.17	-5.97	-2.08	-2.47	-2.27
Std. Deviation	0.94	0.76	0.63	0.90	3.18	1.65	2.23	1.74
Mean Absolute Revision	0.74	0.61	0.56	0.69	2.64	1.28	1.88	1.44
Noise to Signal	0.24	0.24	0.34	0.41	0.59	0.70	0.22	0.18
AR(1)	0.42	0.56	0.40	0.54	0.37	0.34	0.33	0.23
Long-Term Revisions Mean	-0.29	0.31	-0.58	0.05	0.17	0.50	-0.96	-1.32
p-value	0.28	0.27	0.00	0.87	0.90	0.25	0.14	0.10
Max	2.74	2.13	1.32	2.13	17.75	5.53	6.36	3.49
Min	-3.04	-1.80	-2.80	-2.51	-11.44	-1.65	-6.78	-9.43
Std. Deviation	1.28	0.93	0.88	1.16	5.65	1.91	2.81	3.21
Mean Absolute Revision	1.03	0.76	0.79	0.96	4.07	1.34	2.37	2.55
Noise to Signal	0.32	0.27	0.44	0.64	0.80	0.63	0.30	0.35
AR(1)	0.34	0.66	0.30	0.59	0.59	0.35	0.44	0.48

Notes: The summary statistics are based on the 2003Q2–-2011Q4 revisions. *NGDP* denotes nominal GDP, *RGDP* denotes real GDP, *GDPD* denotes the GDP deflator, *C* denotes real consumption, *I* denotes real gross fixed capital formation, *G* denotes real government consumption, *E* denotes real exports, and *M* denotes real imports. The short-term revision is the value from a year after the first release minus the first-release value. The long-term revision is the final value minus the first-release value. Noise to Signal is defined as the standard deviation of the revisions divided by the standard deviation of the final value of the variable. *p*-value is a the statistics from a test that the mean revision is zero using autocorrelation and heterosckedasticity-consistent standard errors. AR(1) denotes an autocorrelation coefficient of the first order.

quarter growth rates and from –2 to +1.4 for the year-on-year growth rates. The range is even larger for other variables and long-term revisions. This is confirmed by the standard deviation of the revisions and the mean absolute revisions. The mean absolute revisions for short-term revisions to the quarter-on-quarter growth rates are smallest for the GDP deflator (1.2 percentage points in annualized growth rates) and largest for exports (6.8 percentage points in annualized growth rates). As for the year-on-year growth rates, the mean absolute short-term revisions range from 0.6 (GDP deflator) to 2.6 (gross fixed capital formation). The mean absolute long-term revisions are smallest for real GDP and largest for gross fixed capital formation.

The fact that the revisions are very large is corroborated by the noise-to-signal ratios, which range from 0.4 to 1.1 for the quarter-on-quarter growth rates and from 0.2 to 0.8 for the year-on-year growth rates. The smallest relative revisions to the quarter-on-quarter growth rates are made to real GDP (noise-to-signal ratio approximately 0.4). The largest relative revisions seem to occur for consumption and gross fixed capital formation. On the other hand, exports and imports seem to have the smallest relative revisions among the components of GDP. The revisions to the components are generally larger than those to GDP as a whole. Research on revisions of the GDP expenditure components is generally very scarce. However, our results are in line with U.S. evidence provided by Aruoba (2008), who also finds that the revisions to components are larger than those to aggregate GDP.

The revisions to the quarter-on-quarter growth rates are generally not very persistent, as indicated by low first-order autocorrelation coefficients. The coefficients are mostly below 0.5. The revisions to the quarter-on-quarter real GDP growth rate seem not to be autocorrelated. Note that the low autocorrelation suggests that autoregressive models will be relatively uninformative for predicting revisions. As for the year-on-year growth rates, as expected, the order of autocorrelation is generally higher: most of the variables have autocorrelation coefficients higher than 0.4.

As for the international comparison of the magnitudes of the revisions, McKenzie (2006) reports mean absolute revisions to quarter-on-quarter growth of GDP for 18 OECD countries over the 1995–2004 period. The short-term mean absolute revisions range from 0.1 for Spain to almost 0.7 for Norway. The average mean absolute revision in these 18 OECD countries is 0.3, which is 1.2 percentage points at an annualized rate. Bearing in mind that the sample period for which the revisions are computed differs from that in our study, it seems that the short-term revisions to Czech GDP are on average similar in magnitude to those in OECD countries.

4. News and Noise in Czech National Accounts Revisions

We can decompose the first-release data $\left(y_t^{t+1}\right)$ as being equal to the final data $\left(y_t^f\right)$ plus an error term (ε_t):

$$y_t^{t+1} = y_t^f + \varepsilon_t \tag{1}$$

The literature views the revision process in two ways: revisions can be viewed as either capturing noise or reflecting news. Under the noise view, the first-release data contain a measurement error that is uncorrelated with the true values: y_t^f is

orthogonal to ε_t. Under the news view, revisions reflect new information that becomes available to the statistical office over time: y_t^{t+1} is orthogonal to ε_t.

We will run so-called forecast efficiency regressions (Mincer and Zarnowitz, 1969; Mankiw et al., 1984; Mankiw and Shapiro, 1986; Faust et al., 2005; Aruoba, 2008) to determine whether revisions to the Czech national accounts can be viewed as noise or news. We test for noise by running the following regression:

$$r_t = \alpha_1 + \beta_1 y_t^f + \varepsilon_{1t} \tag{2}$$

The null hypothesis is that the revisions reduce noise, i.e., they are not related to the true values of the variable ($\alpha_1 = \beta_1 = 0$). If data revisions are noise, it would be optimal to discount the first-release observation. More precisely, the optimal forecast for the variable would be a weighted average of the preliminary announcement and the conditional mean of the underlying variable.

To test the news hypothesis, we run the following regression:

$$r_t = \alpha_2 + \beta_2 y_t^{t+1} + \varepsilon_{2t} \tag{3}$$

The null hypothesis in this case is that revisions reflect new information and thus are not predictable by the information available at the time of release ($\alpha_2 = = \beta_2 = 0$). When the revisions are news, the first-release observation is an efficient forecast of the variable, and thus it is optimal to assign it a full weight.

As noted by Aruoba (2008) these hypotheses are mutually exclusive but not collectively exhaustive—one can reject both hypotheses (for example, if the constant is significant in both regressions). In small samples, one can reject or fail to reject both hypotheses because of sampling errors. Note also that in reality, it is likely that the revisions contain both noise and news components.

4.1 Testing for Noise

The upper panel of *Table 2* presents the results of noise regressions for the variables in quarter-on-quarter growth rates. It shows that we are able to reject the noise hypothesis for almost all variables in quarter-on-quarter growth rates. Short-term revisions of nominal GDP and the GDP deflator are the exceptions.

The bottom panel of *Table 2* presents the results of noise regressions for the variables in year-on-year growth rates. The results are mixed: for short-term revisions to most variables the noise hypothesis cannot be rejected, while for long-term revisions we reject the noise hypothesis for most variables except for consumption, exports, and imports.

4.2 Testing for News: Baseline Regressions

To investigate whether the revisions behave as news we run regression (3) and test whether $\alpha_2 = \beta_2 = 0$. The results are reported in *Table 3*.

The upper panel of *Table 3* presents the results for the variables in quarter-on-quarter growth rates. The *F*-statistics suggest we can only reject the hypothesis of news for the GDP deflator and consumption. Short-term revisions to other variables seem to be unpredictable in these baseline naive regressions. The degree of predictability for the GDP deflator and consumption is relatively high, with R^2=0.25 and

Table 2 Testing for Noise

	NGDP	*RGDP*	*GDPD*	*C*	*I*	*G*	*E*	*M*
Annualized quarterly growth rates (q-o-q)								
Short-Term Revisions Final Release	0.001	0.089**	-0.082	0.165*	0.356***	0.170*	0.182**	0.079
	(0.054)	(0.036)	(0.052)	(0.090)	(0.099)	(0.091)	(0.073)	(0.055)
Constant	-0.626*	-0.326	-0.463*	-0.702	-0.560	0.507	0.580	1.534
	(0.319)	(0.232)	(0.242)	(0.475)	(0.712)	(0.479)	(1.050)	(0.933)
F	0.00	5.97	2.49	3.35	12.96	3.50	6.23	2.03
p-value	0.98	0.02	0.12	0.08	0.00	0.07	0.02	0.16
R^2	0.00	0.07	0.04	0.05	0.37	0.11	0.13	0.03
Long-Term Revisions Final Release	0.441***	0.243**	0.488***	0.730***	0.964***	0.642***	0.307	0.229*
	(0.070)	(0.095)	(0.091)	(0.096)	(0.154)	(0.100)	(0.187)	(0.131)
Constant	-0.621***	-0.158	-0.316***	-0.424**	-0.424	0.0203	-0.706	-0.428
	(0.170)	(0.110)	(0.112)	(0.181)	(0.430)	(0.152)	(0.586)	(0.495)
F	39.60	6.49	29.12	57.88	39.26	41.15	2.70	3.05
p-value	0.00	0.02	0.00	0.00	0.00	0.00	0.11	0.09
R^2	0.43	0.28	0.48	0.44	0.77	0.62	0.21	0.12
Annual growth rates (y-o-y)								
Short-Term Revisions Final Release	0.048	0.031	0.017	0.072	0.114**	-0.008	0.093**	0.020
	(0.036)	(0.024)	(0.070)	(0.125)	(0.045)	(0.133)	(0.041)	(0.041)
Constant	-0.372*	0.069	-0.345*	-0.221	-1.240*	0.527	0.334	0.734*
	(0.199)	(0.162)	(0.184)	(0.410)	(0.715)	(0.328)	(0.480)	(0.383)
F	1.74	1.57	0.06	0.34	6.35	0.00	4.99	0.23
p-value	0.20	0.22	0.81	0.56	0.02	0.95	0.03	0.64
R^2	0.04	0.02	0.00	0.02	0.07	0.00	0.15	0.01
Long-Term Revisions Final Release	0.111**	0.119***	0.168***	-0.055	0.540***	0.308*	0.021	0.006
	(0.052)	(0.038)	(0.055)	(0.163)	(0.143)	(0.179)	(0.056)	(0.052)
Constant	-0.804***	-0.097	-0.781***	0.195	-1.257	0.305	-1.145**	-1.360**
	(0.193)	(0.167)	(0.219)	(0.544)	(1.258)	(0.371)	(0.561)	(0.613)
F	4.46	9.65	9.22	0.11	14.33	2.97	0.14	0.01
p-value	0.04	0.00	0.00	0.74	0.00	0.09	0.71	0.90
R^2	0.12	0.20	0.15	0.01	0.46	0.24	0.01	0.00

Notes: *NGDP* denotes nominal GDP, *RGDP* denotes real GDP, *GDPD* denotes the GDP deflator, *C* denotes real consumption, *I* denotes real gross fixed capital formation, *G* denotes real government consumption, *E* denotes real exports, and *M* denotes real imports. The short-term revision is the value from a year after the first release minus the first-release value. The long-term revision is the final value minus the first-release value. Autocorrelation and heteroskedasticity-consistent standard errors (Newey and West, 1987) in parenthesis.

R^2=0.35, respectively. When looking at long-term revisions we reject (at the 10% significance level) the news hypothesis for consumption, gross fixed capital formation, and exports and imports. The bottom panel of *Table 3* shows the results for the variables in year-on-year growth rates. We are able to reject the news hypothesis for short-term revisions to government consumption and exports and long-term revisions to consumption.

Table 3 Testing for News: Baseline Regressions

	NGDP	*RGDP*	*GDPD*	*C*	*I*	*G*	*E*	*M*
				Annualized quarterly growth rates (q-o-q)				
Short-Term Revisions First Release	-0.065	0.013	-0.274***	-0.496***	0.137	-0.205	0.001	-0.045
	(0.097)	(0.054)	(0.065)	(0.167)	(0.314)	(0.183)	(0.090)	(0.062)
Constant	-0.295	-0.081	-0.040	0.874**	0.207	0.523	1.968	2.312**
	(0.539)	(0.359)	(0.211)	(0.346)	(1.353)	(0.494)	(1.495)	(0.938)
F	0.46	0.05	18.03	8.86	0.19	1.26	0.00	0.54
p-value	0.50	0.82	0.00	0.01	0.66	0.27	0.99	0.47
R^2	0.01	0.00	0.25	0.35	0.02	0.06	0.00	0.01
Long-Term Revisions First Release	-0.013	0.044	-0.021	-0.644***	-0.875*	-0.061	-0.169*	-0.224**
	(0.095)	(0.045)	(0.113)	(0.165)	(0.507)	(0.185)	(0.098)	(0.108)
Constant	-0.441	0.012	-0.589*	1.624**	2.625	0.165	0.918	1.144
	(0.605)	(0.413)	(0.319)	(0.640)	(2.986)	(0.652)	(1.608)	(1.636)
F	0.02	0.96	0.03	15.21	2.99	0.11	2.96	4.29
p-value	0.90	0.33	0.86	0.00	0.09	0.74	0.09	0.05
R^2	0.00	0.01	0.00	0.26	0.18	0.00	0.05	0.11
				Annual growth rates (y-o-y)				
Short-Term Revisions First Release	0.002	-0.016	-0.062	-0.092	-0.170	-0.305***	0.065*	-0.005
	(0.036)	(0.035)	(0.091)	(0.088)	(0.105)	(0.077)	(0.032)	(0.027)
Constant	-0.160	0.223	-0.215	0.218	-0.515	0.564*	0.514	0.906***
	(0.191)	(0.172)	(0.231)	(0.292)	(0.870)	(0.294)	(0.376)	(0.292)
F	0.00	0.21	0.47	1.07	2.63	15.73	4.11	0.03
p-value	0.95	0.65	0.50	0.31	0.11	0.00	0.05	0.86
R^2	0.00	0.00	0.03	0.05	0.08	0.00	0.08	0.00
Long-Term Revisions First Release	0.011	0.058	-0.030	-0.306***	-0.172	-0.109	-0.067	-0.106
	(0.059)	(0.055)	(0.074)	(0.068)	(0.260)	(0.091)	(0.045)	(0.077)
Constant	-0.344	0.130	-0.529***	0.859**	0.599	0.518	-0.319	-0.460
	(0.264)	(0.182)	(0.174)	(0.352)	(1.591)	(0.420)	(0.523)	(0.643)
F	0.04	1.14	0.16	20.29	0.44	1.42	2.24	1.87
p-value	0.85	0.29	0.69	0.00	0.51	0.24	0.14	0.18
R^2	0.00	0.04	0.00	0.35	0.03	0.02	0.05	0.10

Notes: *NGDP* denotes nominal GDP, *RGDP* denotes real GDP, *GDPD* denotes the GDP deflator, *C* denotes real consumption, *I* denotes real gross fixed capital formation, *G* denotes real government consumption, *E* denotes real exports, and *M* denotes real imports. The short-term revision is the value from a year after the first release minus the first-release value. The long-term revision is the final value minus the first-release value. Autocorrelation and heteroskedasticity-consistent standard errors (Newey and West, 1987) in parentheses.

4.3 Testing for News: Augmented Regressions

If revisions are to be deemed news, they should not be predictable using any data available at the time of the announcement of the first release. We therefore test whether some additional variables could be used to enhance the predictability of revisions. Mankiw and Shapiro (1986) use equity prices and short-term interest rates as business cycle indicators. Faust et al. (2005) additionally use oil prices. Therefore,

Table 4 Testing for News: Augmented Regressions

	NGDP	*RGDP*	*GDPD*	*C*	*I*	*G*	*E*	*M*
	Annualized quarterly growth rates (q-o-q)							
Short-Term Revisions First Release	-0.018	0.010	-0.353***	-0.487**	0.143	-0.213	-0.030	-0.028
	(0.110)	(0.104)	(0.071)	(0.189)	(0.337)	(0.252)	(0.109)	(0.058)
Revision (*t*–1)	-0.342*	-0.050	-0.267**	0.140	-0.178	-0.067	-0.334*	-0.163**
	(0.185)	(0.271)	(0.112)	(0.107)	(0.163)	(0.264)	(0.186)	(0.074)
Oil Price	-0.080**	-0.023	-0.066***	0.009	0.035	-0.003	0.044	0.000
	(0.038)	(0.028)	(0.021)	(0.037)	(0.130)	(0.054)	(0.113)	(0.117)
Stock price	0.083	0.029	0.031	-0.001	-0.038	0.130*	0.085	-0.124
	(0.055)	(0.043)	(0.026)	(0.042)	(0.136)	(0.075)	(0.147)	(0.111)
Interest Rate	-0.436	-0.341	0.171	0.052	-1.265	0.782	-1.374	-1.676
	(0.398)	(0.264)	(0.226)	(0.431)	(1.319)	(0.704)	(1.603)	(1.322)
Constant	0.465	0.757	-0.179	0.762	2.945	-1.554	5.877	6.894*
	(1.002)	(0.649)	(0.610)	(0.989)	(3.043)	(1.885)	(4.613)	(3.734)
F	1.08	0.59	0.49	3.29	0.86	7.15	2.48	2.66
p-value	0.39	0.71	0.00	0.02	0.52	0.00	0.06	0.04
R^2	0.19	0.07	0.49	0.35	0.06	0.20	0.15	0.09
Long-Term Revisions First Release	0.087	0.025	-0.112	-0.506**	-0.872	0.121	-0.226***	-0.183***
	(0.121)	(0.092)	(0.125)	(0.222)	(0.581)	(0.212)	(0.053)	(0.058)
Revision (*t*–1)	-0.583***	-0.070	-0.595***	-0.030	-0.127	-0.326**	-0.564***	-0.660***
	(0.135)	(0.329)	(0.135)	(0.086)	(0.136)	(0.144)	(0.140)	(0.122)
Oil Price	-0.033	-0.002	-0.033	0.142***	-0.037	0.156	0.185	0.191
	(0.051)	(0.027)	(0.035)	(0.043)	(0.388)	(0.109)	(0.150)	(0.186)
Stock price	0.101	0.026	0.048	-0.123**	0.066	-0.125	-0.027	-0.173
	(0.084)	(0.038)	(0.039)	(0.057)	(0.335)	(0.138)	(0.214)	(0.184)
Interest Rate	-0.334	-0.519	0.459	-0.195	-1.357	-0.414	-2.660	-3.240*
	(0.580)	(0.360)	(0.371)	(0.690)	(3.287)	(0.995)	(1.607)	(1.639)
Constant	-0.597	1.202*	-1.832	1.202	5.953	0.628	6.461	7.281
	(1.074)	(0.682)	(1.139)	(1.495)	(5.330)	(2.383)	(4.509)	(4.407)
F	5.04	1.48	11.28	7.50	2.12	4.61	16.63	11.87
p-value	0.00	0.23	0.00	0.00	0.09	0.00	0.00	0.00
R^2	0.32	0.09	0.34	0.41	0.20	0.14	0.41	0.55

Notes: *NGDP* denotes nominal GDP, *RGDP* denotes real GDP, *GDPD* denotes the GDP deflator, *C* denotes real consumption, *I* denotes real gross fixed capital formation, *G* denotes real government consumption, *E* denotes real exports, and M denotes real imports. The short-term revision is the value from a year after the first release minus the first-release value. The long-term revision is the final value minus the first-release value. Oil and stock prices are in quarter-on-quarter growth rates. Autocorrelation and heteroskedasticity-consistent standard errors (Newey and West, 1987) in parentheses.

in our exercise, we follow the previous literature and add four more explanatory variables: the lagged value of a revision to capture potential persistence, the growth rate of oil prices (EUCRBRDT index), the growth rate of stock prices (PX index), and the short-term interest rate (PRIBOR 3M).

The results from the augmented news regressions for quarter-on-quarter growth rates are reported in *Table 4*. The results suggest that there is evidence of in-sample predictability of short-term revisions in most variables. *F*-tests reject the hypo-

Table 5 Testing for News: Augmented Regressions

	NGDP	*RGDP*	*GDPD*	*C*	*I*	*G*	*E*	*M*
	Annual growth rates (y-o-y)							
Short-Term Revisions First Release	-0.033	-0.015	-0.231**	-0.066	-0.179	-0.271***	-0.027	-0.014
	(0.058)	(0.057)	(0.096)	(0.097)	(0.110)	(0.068)	(0.061)	(0.040)
Revision (*t*–1)	0.137	0.039	0.159	0.469***	0.270	0.153	0.310**	0.212
	(0.236)	(0.237)	(0.205)	(0.136)	(0.164)	(0.103)	(0.127)	(0.145)
Oil Price	-0.012*	-0.011**	-0.009	0.011**	-0.015	-0.008	0.004	0.005
	(0.007)	(0.004)	(0.005)	(0.004)	(0.013)	(0.007)	(0.013)	(0.009)
Stock price	0.016*	0.014**	0.006	-0.001	0.026	0.019**	0.023	-0.001
	(0.009)	(0.006)	(0.006)	(0.005)	(0.018)	(0.007)	(0.017)	(0.013)
Interest Rate	0.024	-0.253*	0.483**	-0.006	-0.510	0.340**	-0.205	-0.261
	(0.224)	(0.146)	(0.191)	(0.174)	(0.487)	(0.177)	(0.261)	(0.286)
Constant	0.022	0.817**	-0.862**	-0.044	0.682	-0.459	1.089	1.318
	(0.417)	(0.336)	(0.372)	(0.357)	(1.106)	(0.485)	(0.814)	(0.827)
F	4.45	21.72	6.53	8.97	13.39	8.24	2.86	0.6
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.70
R^2	0.32	0.52	0.36	0.47	0.34	0.40	0.22	0.07
Long-Term Revisions First Release	-0.028	-0.038	-0.000	-0.247***	-0.388**	-0.089	-0.171***	-0.127**
	(0.068)	(0.055)	(0.107)	(0.081)	(0.173)	(0.090)	(0.030)	(0.051)
Revision (*t*–1)	0.291**	0.591***	0.272*	0.422***	0.562***	0.279	0.276	0.340**
	(0.135)	(0.185)	(0.138)	(0.135)	(0.067)	(0.195)	(0.180)	(0.137)
Oil Price	0.005	0.004	0.005	0.009	0.010	-0.006	0.027**	0.030*
	(0.005)	(0.004)	(0.005)	(0.006)	(0.030)	(0.008)	(0.010)	(0.017)
Stock price	0.007	0.004	-0.003	0.004	0.041	0.014*	0.019	-0.006
	(0.009)	(0.004)	(0.005)	(0.006)	(0.027)	(0.007)	(0.020)	(0.024)
Interest Rate	-0.017	-0.088	0.108	0.147	0.659	0.232	-0.910*	-0.746
	(0.271)	(0.137)	(0.158)	(0.229)	(0.738)	(0.188)	(0.445)	(0.578)
Constant	-0.253	0.263	-0.724**	0.068	-1.340	-0.402	2.119**	1.256
	(0.504)	(0.291)	(0.269)	(0.450)	(1.366)	(0.378)	(0.882)	(1.232)
F	1.63	11.27	2.13	43.21	24.24	2.35	17.54	3.02
p-value	0.19	0.00	0.09	0.00	0.00	0.07	0.00	0.03
R^2	0.17	0.51	0.14	0.63	0.43	0.22	0.39	0.36

Notes: *NGDP* denotes nominal GDP, *RGDP* denotes real GDP, *GDPD* denotes the GDP deflator, *C* denotes real consumption, *I* denotes real gross fixed capital formation, *G* denotes real government consumption, *E* denotes real exports, and *M* denotes real imports. The short-term revision is the value from a year after the first release minus the first-release value. The long-term revision is the final value minus the first-release value. Oil and stock prices are in year-on-year growth rates. Autocorrelation and heteroskedasticity-consistent standard errors (Newey and West, 1987) in parenthesis.

thesis of forecast efficiency for the GDP deflator, consumption, government consumption, exports, and imports. The business cycle seems to be particularly important for short-term revisions to the GDP deflator (oil prices are statistically significant) and for long-term revisions to consumption (oil and stock prices are statistically significant). For real GDP and gross capital fixed formation we are unable to reject the news hypothesis, suggesting that revisions to quarter-on-quarter real GDP and

gross capital formation growth rates capture news information and thus are unpredictable.

In *Table 5* we present the results of the augmented news regressions for the year-on-year growth rates. The results are similar to the results for the quarter-on-quarter growth rates. In addition, we reject the news hypothesis for revisions to the year-on-year growth rates of real GDP and gross capital formation. In particular, short-term revisions to real GDP now seem to depend heavily on the business cycle: stock prices, oil prices, and interest rates are statistically significant.

We also test the possible effects of quarterly dummies, which might be expected as a consequence of regular revisions due to the compilation of national accounts for the first and third quarter release and as a consequence of revisions to seasonal adjustment methodologies for the first quarter release. Overall, the quarterly dummies were not jointly significant at the 10% level for most of the variables.

4.4 Real-Time Forecasting Exercise

The results from the previous section suggest that there is some evidence of predictability in many variables—especially the GDP deflator and consumption. However, the results are for in-sample predictability. It is well known that in-sample fit by no means guarantees good out-of-sample performance, especially in the presence of uncertain parameter instabilities or structural breaks in the data. Therefore, we perform the following real-time out-of-sample forecasting exercise. We focus on forecasting short-term revisions, since long-term revisions are not known until the last data observation. We design our real-time exercise as follows. After the release of GDP and the national accounts for 2008Q1, we want to forecast its future short-term revision, i.e., the revision as of 2009Q1. We have at our disposal the history of short-term revisions until 2007Q1.

We then use several models (summarized in *Table 6*). The first model is a naive model that assumes no revisions are made. The second model explores the potential presence of bias in the revisions: the forecast of the second model is the mean bias computed from the sample available at the time the forecast is made (for the first forecast 2003Q2–2007Q1). The third model uses the constant and the announced value of the first release of a variable. The fourth model uses the lagged value of past revisions to exploit potential persistence. The fifth model augments the third model by adding the first principal component of stock prices, oil prices, the interest rate, and the first-release value of the respective variable to capture the common factor that should represent the state of the business cycle.[9]

Overall, we perform 16 recursive out-of-sample forecasts for revisions to the 2008Q1–2011Q4 announcements. The results are presented in *Table 6*. We present the root mean square errors of our forecast revisions and compare them with the benchmark model, which assumes zero revisions. We also present the results of the test of Clark and West (2007).[10] Relative root mean square errors that are lower than one and statistically significant are presented in bold.

[9] As for the real-time out-of-sample performance of the augmented regressions, we find that forecast performance deteriorates greatly relative to the baseline forecasts. Since we are working with small samples, it might be that the additional regressors are very imprecisely estimated. Therefore, we perform a slightly different exercise that uses principal component analysis. The variables used for the common factor are standardized in mean and variance.

Table 6 Real-Time Forecasts of Short-Term Revisions

Summary of forecasting model

Model 1 (benchmark, zero revisions): $r_t^f = \varepsilon_t$

Model 2 (constant only): $r_t^f = \alpha + \varepsilon_t$

Model 3 (benchmark and first release): $r_t^f = \alpha + \beta y_t^{t+1} \varepsilon_t$

Model 4 (lagged): $r_t^f = \alpha + \delta r_{t-4} + \varepsilon_t$

Model 5 (factor): $r_t^f = \alpha + \gamma \mathbf{f}_t + \varepsilon_t$

	NGDP	***RGDP***	***GDPD***	***C***	***I***	***G***	***E***	***M***
Annualized quarterly growth rates (q-o-q)								
*RMSE*1	3.06	1.75	1.83	2.67	12.43	3.93	9.09	9.58
*RMSE*2/*RMSE*1	**0.98**	1.12	**0.96**	1.02	1.01	1.02	1.00	**0.97**
Clark-West test *p*-value	0.07	0.96	0.06	0.47	0.71	0.53	0.19	0.04
*RMSE*3/*RMSE*1	1.22	1.85	**0.87**	**0.85**	1.17	1.20	1.05	0.99
Clark-West test *p*-value	0.80	0.96	0.00	0.00	0.61	0.69	0.67	0.18
*RMSE*4/*RMSE*1	1.09	1.13	1.00	1.04	1.11	1.14	1.00	1.03
Clark-West test *p*-value	0.74	0.93	0.27	0.63	0.99	0.83	0.24	0.50
*RMSE*5/*RMSE*1	0.98	1.12	**0.92**	1.06	1.06	1.39	1.02	1.00
Clark-West test *p*-value	0.16	0.87	0.05	0.49	0.50	0.72	0.23	0.11
Annual growth rates (y-o-y)								
RMSE1	1.00	0.74	0.61	1.02	3.62	1.06	2.70	2.39
*RMSE*2/*RMSE*1	1.07	1.32	**0.84**	1.04	0.98	1.55	**0.92**	**0.89**
Clark-West test *p*-value	0.81	0.85	0.01	0.95	0.16	0.92	0.04	0.00
*RMSE*3/*RMSE*1	1.33	2.35	1.30	1.15	1.65	1.27	1.07	0.95
Clark-West test *p*-value	0.90	0.72	0.63	0.88	0.90	0.27	0.11	0.13
*RMSE*4/*RMSE*1	1.23	1.26	**0.91**	1.10	0.99	1.34	1.05	1.03
Clark-West test *p*-value	0.90	0.82	0.00	0.90	0.18	0.99	0.21	0.36
*RMSE*5/*RMSE*1	0.94	1.19	**0.95**	**0.97**	1.63	1.37	**0.82**	**0.92**
Clark-West test *p*-value	0.11	0.38	0.01	0.09	0.93	0.41	0.01	0.00

Notes: *NGDP* denotes nominal GDP, *RGDP* denotes real GDP, *GDPD* denotes the GDP deflator, *C* denotes real consumption, *I* denotes real gross fixed capital formation, *G* denotes real government consumption, *E* denotes real exports, and *M* denotes real imports. $RMSE_i$ denotes the root mean square error of model *i*. Forecasting performance computed over the 2008Q1–2011Q4 period. Factor f_t in Model 5 is computed as the first principal component of oil price growth, stock price growth, the interest rate, and the first-release value of the respective variable.

The results show evidence of real-time out-of-sample predictability of the GDP deflator: most models are able to beat the zero-revisions benchmark. Furthermore, for quarter-on-quarter growth rates we find some evidence of predictability for consumption (Model 3) and imports (Model 2). In the case of year-on-year growth rates, exports and imports seem to be predictable as well (Models 2 and 5). Finally, note that the sample over which the forecasting exercise is performed is rather small (16 observations) and covers the crisis period (2008Q1–2011Q4). Therefore, the results should be interpreted with caution.

[10] This test allows us to compare nested forecasts by accounting for the noise term that is caused by the estimation of additional parameters.

5. Concluding Remarks

In this paper, we investigate the properties and predictability of revisions to the Czech national accounts over the 2002–2012 period. The results show that the revisions are sizeable, which implies that for the results of analyses of Czech macroeconomic policy or forecasting exercises to be relevant one should use real-time data (as also stressed by Croushore, 2011). The revisions are large enough that they appear to be of economic significance for policy-makers, for example: the average mean absolute short-term revision to GDP is roughly 1.4 and 0.7 percentage points for annualized quarter-on-quarter and year-on-year growth rates, respectively. Moreover, the standard deviation of the revisions is roughly 1.6–2 percentage points at an annualized quarter-on-quarter growth rate and roughly 0.8 percentage points for a year-on-year growth rate.

If these revisions reflect new information that was not available at the time of the initial release—the revisions are news—then there is little that can be done about the revisions. But when the revisions are not news and can be predicted, we would like to do so in order to improve our understanding of the state of the economy. The predictability of such revisions could be used to improve the decision-making of agents and policymakers, since their optimal choices depend on the state of the economy. By using the information available at the time of the initial announcement, we found that many variables are predictable in-sample. To see whether we would be able to utilize the in-sample predictability in real-time we performed a proper out-of-sample exercise. On the whole, the revisions are not easily predictable in real time: for most variables the zero-revision forecast works best. Subject to the caveats of small sample size and inclusion of the crisis period, we found that only revisions to the GDP deflator can be predicted with substantial gains over the zero-revisions benchmark. Revisions to consumption and to year-on-year exports and imports can be predicted with some gains. There are no gains in predicting real GDP, gross fixed capital formation, and government consumption.

Our analysis is a first step toward a deeper understanding of the size and nature of revisions to Czech macroeconomic data. A natural extension (once there are more observations of revisions available) would be to use a state-space model in the spirit of Jacobs and van Norden (2011) to characterize the revision process.

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