

Are German Tax-Revenue Forecasts Flawed?

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Abstract: This paper provides an empirical assessment of tax-revenue forecasting in Germany. Following the literature on rational forecasting, an empirical analysis of the forecasts from 1971 until today explores unbiasedness and efficiency of the forecasts. The results point at unbiased and generally efficient tax-revenue forecasts in Germany. A substantial part of the forecast errors can be attributed to uncertainty about the growth rate. However, deviations between the government's growth forecasts and the forecasts of the independent research institutes do not show significant effects. Only with regard to the electoral cycle the results indicate the existence of some possible improvement.

Keywords: Tax Revenue; Forecast; Rational Prediction; Empirical Analysis; Budget Policy

JEL Classification: H68; E32; E62

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1 Introduction

Since 1955 an independent advisory committee, the “Arbeitskreis Steuerschätzung”,¹ provides forecasts for the German tax revenue under the auspices of the German Federal Ministry of Finance. These forecasts play an important role in the preparation and planning of the budget of the federal government, of the state governments as well as of municipal and county governments. In recent years these forecasts have been criticized due to significant forecast errors not only in the media but also by the court of auditors.²

However, the nature and causes of these forecast errors have not systematically been analyzed, so far. Gebhardt (2001) is looking mainly at the methods and problems of the forecasts. In contrast, our aim is to analyze the statistical properties of the forecasts. While forecasters cannot be expected to make precisely correct forecasts because of various uncertainties, the key question is whether the forecasts can be improved. This has long been recognized in the literature on rational expectations and has brought about a literature on forecast evaluation (*e.g.*, Kean and Runkle, 1989, 1990, and Laster, Bennett, and In Sun, 1999, see also Feenberg et al., 1989, McNees, 1978, and Buettner and Horn, 1993).

Following this literature we analyze the official German tax revenue forecasts with respect to the rationality hypothesis controlling for various types of information available at the

¹Among the members of this committee are the German Federal Ministry of Finance, the German Federal Ministry of Economics and Employment, six leading institutes for economic research, the German Federal Statistical Office, the German Central Bank, the Council of Economic Advisors, the State Ministries of Finance as well as municipal government associations.

²Handelsblatt, Bundesrechnungshof rügt Steuerschätzung, 14/11/06.

time of the forecast. Our results indicate that the forecasts do not show significant biases. Moreover, there are only few signs that available information at the time of the forecast is not utilized in an efficient way. The analysis, therefore, suggests that official tax revenue forecasts in Germany do not show significant systematic errors.

The paper is structured as follows. The next section discusses the main principles of forecast evaluation - the hypothesis of rational forecasting - and the investigation approach. More specifically, we derive regression equations to test for forecast rationality, *i.e.*, unbiasedness and efficiency. The subsequent sections provide an empirical analysis of tax revenue forecasting in Germany in the period from 1971 until 2005. Section 3 gives a short description of the dataset, before Section 4 presents the results. Section 5 provides the conclusions.

2 Some Principles of Forecast Evaluation

Tax revenue forecasts operate in an environment which is characterized by great uncertainty. Basically, revenue forecasts are faced with two main problems. First, the forecasters need an appraisal of the business cycle to make predictions about the tax revenue which incorporates another forecast afflicted with uncertainty. Second, the revenue effects of changes in the tax law are notoriously difficult to estimate, official estimates usually ignore any behavioral responses as well as repercussions in the economy (Auerbach, 1996).

Faced with those difficulties, a forecast evaluation would have to consider the rationality

of the forecast. The rationality hypothesis in this context imposes two questions on the forecasts. First, rationality implies unbiasedness of forecasts which requires that the expected value of the revenue is consistent with the forecast. Second, a further question to be answered is whether the predictions of the forecasters are efficient. The efficiency hypothesis requires a forecast which fully exploits the information available at the time the forecast is made (Nordhaus, 1986).

In order to evaluate the forecasts we could relate actual outcome and forecast in a regression equation

$$rev_t = \alpha_0 + \alpha_1 rev_t^f + \alpha_2 X_t + u_t \quad (1)$$

where rev_t is the actual tax revenue in year t and rev_t^f is the tax revenue forecast. X_t constitutes any other variable including information available at the time of the forecast. u_t is the error term - that part of rev_t that is not explained by the equation.

Following standard practice we transform the above equation to obtain

$$fe_t \equiv rev_t - rev_t^f = \alpha_0 + (\alpha_1 - 1)rev_t^f + u_t \quad (2)$$

where the left-hand side represents the forecast error defined by the difference between the actual tax revenue and the forecast. Unbiasedness requires that in a regression without X_t , the coefficients in Equation (1) can be restricted to $\alpha_0 = 0$ and $\alpha_1 = 1$. Thus, based on

Equation (2) we can reject the H_0 hypothesis of unbiasedness, if the constant and/or the forecast prove significant.

With regard to the efficiency hypothesis we want to examine whether the forecasters fully exploit the information available at the time of the forecast. Hence, any variable known to the forecaster at time t should not exert a significant effect on the forecast error. The corresponding regression equation is

$$fe_t = \alpha_0 + (\alpha_1 - 1)rev_t^f + \alpha_2 X_t + u_t \quad (3)$$

For an efficient forecast the value of α_2 should not be significantly different from zero. In other words the forecast error should be uncorrelated with any information available at the time when the forecast is made.

Having defined the main principles of forecast evaluation, the empirical analysis below will investigate the quality of the official tax revenue forecast in Germany.

3 Data and Descriptive Statistics

The empirical analysis employs data on official tax revenue forecasts and data on actual tax revenues in Germany. Every year the forecast consortium (“Arbeitskreis Steuerschätzung”) provides usually two revenue forecasts. The first one - which in recent years was typically

made in May - predicts the revenue for the current and the next four years. The second one - usually made in November - is concerned only with the current and the following year. The forecasters estimate each tax separately. The results contain specific forecasts for the federal tax revenue, the tax revenue for the federal states, and for the municipalities. For our analysis we concentrate on the two major forecasts for federal tax revenue. In a first step, we examine the May forecast predicting the current year. In a second step, we analyze the November forecast for the next year. The forecasts are given in nominal values. In its current version, the time series available to this study covers the years from 1971 to 2005. The data on actual tax revenue come from the German Federal Statistical Office.³ Table 1 provides descriptive statistics for the main variables used.

The forecast error is constructed as the difference between the logarithm of the actual revenue and the logarithm of the forecast. A negative sign of the forecast error implies that the actual revenue is lower than the forecast. Thus, the mean of the forecast errors provided in Table 1 showing negative signs indicates that tax revenue is overestimated on average. However the mean forecast error for the next year is almost zero, for the current year it is also quite small with only 0.2 percentage points.

Figure 1 and Figure 2 depict the development of the forecast errors over the full period analyzed. Both show that revenue is over- as well as underestimated. The overall variation does not seem to increase or decrease.

³German Federal Statistical Office, Fachserie 14 Reihe 4.

Figure 1: Forecast Error (Current-Year Forecast)

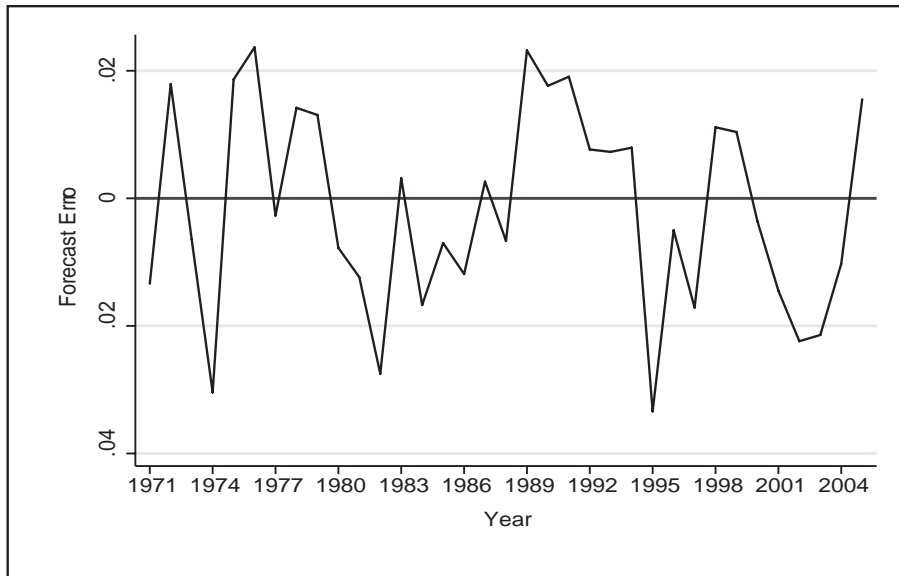
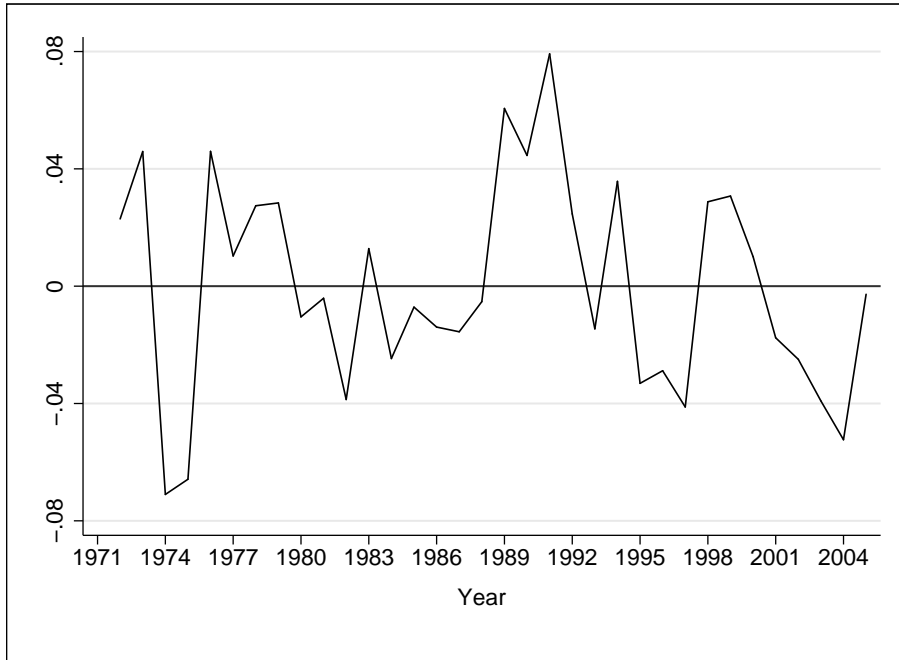


Figure 2: Forecast Error (Next-Year Forecast)



In order to test for the efficiency of the forecasts we consider the information available to the forecasters at the time of the forecast. The most obvious information the forecasters have, is the previous forecast error which we will call $f e_{t-1}$. Taking into account this information we want to test whether the forecasters just tend to respond to their previous forecast error when predicting the tax revenue.

Another information considered relates to a peculiarity of German revenue forecasting, where the federal government provides an own estimate for the GDP growth rate and other macro-economic variables.⁴ The forecasters are asked to base their forecast on this official government prediction. As the government prediction might be influenced by some strategic goals it would be interesting to see whether a deviation of the government forecast from other GDP growth forecasts proves significant. This would be a sign that the federal government's specific view of the economy would tend to bias the forecast and give rise to a forecast error.

To check for this possibility we employ as an alternative GDP growth forecast the figure from the joint prediction of the economic research institutes in Germany (“Gemeinschaftsdiagnose der führenden wirtschaftswissenschaftlichen Forschungsinstitute”). The regression includes the difference between the GDP growth forecast of the government and the one from the research institutes.

Since the forecasters could also take into account the political incentives in an election year

⁴Another peculiarity of German revenue forecasting relates to tax reforms. In general, the forecasters predict the tax revenue based on the applicable taxation law. Thus, if some legislation is planned but has not passed the legislator, it is not considered before the bill has passed. One exception has been the increase of the VAT in 2007.

and correct their forecasts with respect to this information, we also control for the effect of an election year in our test of forecast efficiency. Therefore, we include a dummy variable which is 1 if the year of the forecast is an election year and 0 otherwise.

4 Results

Table 2 presents the results concerning unbiasedness. Recall that unbiasedness requires that the forecast is consistent with the actual value of the tax revenue. In our approach this is equivalent to the hypothesis that the forecast has no impact on the forecast error - which is the difference between the actual tax revenue and the forecast. As discussed above, an unbiased forecast requires the coefficients of the constant as well as of the forecast to be insignificant.

The results in column (1) and (5) indicate that we cannot reject the unbiasedness hypothesis. With regard to the next-year forecast we include a dummy capturing an unusually early forecast in column (6) without, however, showing different results with regard to the unbiasedness. In column (2) and (7) we additionally include a trend variable to check for possible changes over time. The results show that nothing changes compared to our previous results. As a further check of the unbiasedness we also included the actual value of the forecast in columns (3) and (8). The insignificance suggests that also in periods with rather strong or rather weak forecasts the expected forecast error is still zero.

Table 1: Descriptive Statistics

Variable	Obs.	Mean	Std.Dev.	Min.	Max.
Tax Revenue Forecast Error	35	-.002	.016	-.033	.024
Actual Federal Tax Revenue (Bill.€)	34	-.000	.036	-.071	.079
Federal Tax Revenue Forecast (Bill.€)	35	129.5	52.3	47.1	198.8
	35	129.8	52.7	47.7	199.5
GDP Growth Rate Forecast Error	35	133.8	51.8	50.8	199.6
	34	-.303	1.07	-1.6	2.5
	33	-.423	1.67	-4.1	3.3
Differene in GDP Growth Rate Forecasts	34	-.006	.665	-1.0	3.0
	26	-.044	.399	-0.9	1.0
Election Year	35	.286	.458	0	1

Time series covers 1971 - 2005.

Table 2: Results on the Forecast Bias

	<i>Current-Year Forecast</i>				<i>Next-Year Forecast</i>				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	-.002 (.003)	.002 (.006)	.043 (.071)	.061 (.071)	-.000 (.006)	-.000 (.007)	.008 (.013)	-.006 (.184)	.049 (.148)
(log) Tax Revenue Forecast			-.004 (.006)	-.005 (.006)				.000 (.016)	-.004 (.013)
GDP Growth Rate Forecast Error				.006 [*] (.002)					.011 [*] (.003)
Trend							-.000 (.001)		
Dummy for August Forecast						.001 (.022)			
R ²	.000	.013	.012	.200	.000	.000	.015	.000	.302
adj R ²	.000	-.017	-.018	.144	.000	-.031	-.016	-.031	.256
Observations	35	35	35	34	34	34	34	34	33

Dependent variable: Tax Revenue Forecast Error (fe). Standard errors in parentheses. An asterisk indicates significance at the 5% level.

With regard to the sources of the forecast error it is instructive to relate the forecast error to the uncertainty about the business cycle. Hence, we introduce an additional control variable capturing the difference between the actual GDP growth rate and the forecast from the federal government used for the revenue forecast. As is depicted in columns (4) and (9) a substantial part of the uncertainty can be attributed to the uncertainty about the growth.

The results for the efficiency are presented in Table 3. Specifications (1) and (5) as well as (6) include the forecast error from the previous year which is the most obvious information available at the time of the forecast. Using this information we want to test whether the forecasters backup their forecasts using the previous forecast error. However in all three specifications the coefficient proves insignificant. As the forecast error from the previous year has no important effect on the forecast error from this year, we cannot reject the hypothesis that this type of information is used efficiently.

Another piece of information which might be taken into account by the forecasters is the difference between the federal government GDP growth rate forecasts and that of the independent research institutes. If the government sets growth prospects strategically, this difference should be related with the forecast error. However, specifications (2) and (7) show that this is not the case as the coefficient is not significant and shows a value close to zero.

However, only with regard to the election year the revenue forecast shows some inefficiency as revenues tend to be underestimated in federal election years, at least in the case of the current forecast (*cf.* columns (3) and (4) as well as (8) and (9)). We have tested whether an

Table 3: Results on Forecast Efficiency

	<i>Current-Year Forecast</i>				<i>Next-Year Forecast</i>				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	.073 (.078)	.066 (.079)	.039 (.068)	.050 (.077)	-.152 (.210)	-.012 (.220)	-.140 (.235)	-.022 (.221)	.082 (.253)
(log) Tax Revenue Forecast	-.006 (.007)	-.006 (.007)	-.004 (.006)	-.005 (.007)	.013 (.018)	.001 (.019)	.011 (.020)	.001 (.019)	-.008 (.021)
Lagged Forecast Error (t-1)	-.057 (.243)			-.096 (.235)	-.032 (.185)	.052 (.187)			.011 (.221)
Difference GDP Growth Rate Forecasts		.001 (.004)		.004 (.004)			.006 (.016)		.011 (.017)
Election Year			.012 *	.013 *				.020	.013
Dummy for August Forecast			(.006)	(.006)		-.067 (.041)		.001 (.027)	-.070 (.037)
R ²	.029	.029	.130	.162	.018	.106	.016	.062	.215
adj R ²	-.034	-.033	.075	.047	-.050	.010	-.070	-.032	.019
Observations	34	34	35	34	32	32	26	34	26

Dependent variable: Tax revenue forecast error (fe). Standard errors in parentheses. An asterisk indicates significance at the 5% level.

electoral cycle can be found also for the second or third year of a federal government's term but did not detect any significance. Hence, a possible interpretation is that forecasters do not take sufficiently into account the possibility that the federal government exerts a positive stimulus on growth in election years.

5 Conclusions

Despite recent critique of the quality of tax-revenue forecasts and of a possibly distorting influence of the federal government, no serious attempt has been made so far to evaluate German tax-revenue forecasts. This paper aims at filling this gap and provides an investigation into German tax-revenue forecasts in the period from the early 70's until today. Following standard literature on forecast evaluation we develop an investigation approach designed to consider possible biases as well as possible inefficiencies in the forecast.

Our results indicate that the forecasts do not show significant biases. A substantial part of the forecast error can be attributed to uncertainty about the growth rate. Moreover, there are only few signs that available information at the time of the forecast is not utilized in an efficient way. The analysis, therefore, suggests that official tax revenue forecasts in Germany do not show significant systematic errors.

Only with regard to what appears to be political business-cycle effects our results suggest that there might be some room to improve the forecast. More specifically, we find that tax

revenue is underestimated in federal election years. This might capture a positive stimulus of the federal government on growth in election years.

Datasources and Definitions

Federal Tax-Revenue Forecast in €, nominal. Source: German Federal Ministry of Finance, press releases for the results of the official tax revenue forecasts.

Federal Tax Revenue in €, nominal. Source: German Federal Statistical Office, Fachserie 14 Reihe 4.

GDP Growth Rate in nominal value. Source: German Federal Statistical Office, Fachserie 18 Reihe 1.5.

GDP Growth Rate Forecast of the Federal Government in nominal value. Source: German Federal Ministry of Finance, press releases for the results of the official tax revenue forecasts.

GDP Growth Rate Forecast of the “Gemeinschaftsdiagnose” in nominal value. Source: “Die Lage der Weltwirtschaft und der deutschen Wirtschaft”, various issues.

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