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The effect of tax revenue budgeting errors on fiscal balance: evidence from the Swiss cantons

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Abstract This study is an empirical analysis of the impact of direct tax revenue budgeting errors on fiscal deficits. Using panel data from 26 Swiss cantons between 1980 and 2002, we estimate a single equation model on the fiscal balance, as well as a simultaneous equation model on revenue and expenditure. We use new data on budgeted and actual tax revenue to show that underestimating tax revenue significantly reduces fiscal deficits. Furthermore, we show that this effect is channeled through decreased expenditure. The effects of over and underestimation turn out to be symmetric.

Keywords Fiscal deficits · Tax revenue budgeting errors · Swiss cantons · Simultaneous equations model with panel data

JEL Classification C12 · C33 · H71 · H72

1 Introduction

Over the past 40 years, most countries have experienced repeated public deficits and accumulated large public debts. Such changes in public deficits and public debt have

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varied widely between countries.[1] Furthermore, subnational levels of government have not been immune to this phenomenon.[2] In consequence, the theoretical and empirical literature devoted to better understanding the role of fiscal deficits and debt accumulation has flourished. Moreover, the current crisis of public finances in some European countries highlights the need for improved understanding of the determinants driving fiscal deficits and debt accumulation.

By emphasising the role played by tax revenue budgeting errors in the determination of fiscal outcomes, the current empirical analysis contributes to the literature on determinants of fiscal deficits and builds a bridge to the currently blossoming empirical literature on tax revenue predictions. This latter stream of literature actually provides insights into the effect of tax revenue budgeting errors on fiscal deficits. In their empirical analysis of tax revenue projections in Flemish municipalities, Goeminne et al. (2008) recently suggested, without testing it explicitly, that revenue forecasts can be used as a tool to prevent excessive deficits. In this paper, our objective is to test for this effect. Furthermore, if an effect of tax revenue budgeting errors on deficits is observed, we argue that it is channeled through a reduction in expenditure. Indeed, underestimating future tax revenue may be used to put pressure on expenditure and to curb politicians' financial appetite, thereby decreasing deficits.

Using panel data from 26 Swiss cantons over the 1980–2002 period, we estimate the ceteris paribus effect of tax revenue budgeting errors on deficits with a single equation model of fiscal deficits and with a simultaneous equations model of revenue and expenditure by two-stage and three-stage least squares, respectively. First, our estimations show that underestimating tax revenue significantly reduces fiscal deficits. Then we demonstrate that this effect is clearly channeled through a decrease in expenditure. Finally, we also find that under and overestimation affect deficits in a symmetric way. These results are robust to different estimation procedures.

The remainder of the paper is organized as follows. In the next section, we provide a discussion of the literature related to our research and present the hypothesis we intend to test empirically. In Sect. 3, we present the dataset on Swiss cantons used to test our hypothesis. Section 4 is devoted to the econometric models and the estimators used, as well as to the main results obtained. In Sect. 5, we discuss the results and conclude.

2 Related literature and testable hypothesis

The current empirical analysis is a study of the relationship between tax revenue budgeting errors and fiscal outcome. It lies at the crossroad of two areas of research. First, it is a contribution to the traditional literature on the determinants of fiscal deficits and

[1] For example, while the debt to GDP ratio increased from 14.10% to 103.15% in Greece over the 1965–2007 period, it increased only from 30.50% to 48.05% in Sweden during the same period. Source: OECD.

[2] At the subnational government level in Switzerland, while the level of debt per capita ranged from 1,697 to 11,238 CHF in 1980, it rose to a range of 2,457 to 41,851 CHF in 2002.

debt. Beyond the well-known normative models of tax smoothing and stabilization policy, there exist numerous positive approaches concerning budget deficits and public debt.[3] Among the latter, some authors (e.g., von Hagen and Harden 1995; Poterba 1996, or Alesina and Perotti 1999) have emphasized the role played by budgetary institutions, among which is the tax revenue budgeting process. On the one hand, some authors argue that incumbent politicians may have the incentive to manipulate public budgets in order to achieve their own objectives. In particular, Alesina and Perotti (1999) suggest that in practice politicians may deliberately overestimate tax revenue, thereby creating higher deficits. This strategy allows politicians to attribute deficits to the technical difficulty in predicting future revenue. On the other hand and more recently, van der Ploeg (2010) has theoretically showed that deliberately underestimating the tax base may be desirable to curb spending ministers' financial appetites, and to reduce debt. By setting a higher tax rate and lower level of public spending, the government builds a precautionary buffer against future shocks, reducing debt in this way. In the current study, we argue that such buffer may be created by underestimating and underbudgeting tax revenue in order to put pressure on expenditure, and subsequently to create a revenue windfall, thereby reducing the deficit. However, the creation of a precautionary buffer may be subsequently used to increase expenditure in an election year (Bischoff and Gohout 2010; van der Ploeg 2010). Thus, the prudent budgeting of tax revenue does not guarantee to result in reduced deficits and debt. In the current research, we therefore propose to test empirically whether underestimating tax revenue actually results in lower deficits.

We then also go on to extend the currently flourishing empirical literature on tax revenue prediction errors. In 1989, Feenberg et al. applied rational expectations theory to develop a rigorous econometric framework that makes it possible to test the rationality of tax revenue predictions. Some authors have applied this method to national and subnational jurisdictions and have shown that conditions for rational predictions fail most of the time (see, for example, Feenberg et al. 1989; Mocan and Azad 1995; Auerbach 1999). This appealed to some with more positive approaches to trying to understand the determinants of tax revenue prediction errors.[4] Most of these studies take the fact that tax revenue budgeting errors affect fiscal balance for granted, without ever testing it explicitly. Nonetheless, they provide some evidence on what type of tax revenue budgeting errors are empirically observed and some perspectives on how it may affect fiscal balance.

Among most recent studies, Bischoff and Gohout (2010) show that West German states tend to (weakly) overestimate their tax revenue projections. They argue that incumbent politicians in state governments may do so in order to increase expenditure—thereby increasing deficit—and eventually their reelection prospects. Conversely, Goeminne et al. (2008) have recently argued that prudent revenue fore-

[3] According to Alesina and Perotti (1995) and Pinho (2004), theoretical budget deficit models can be classified by different categories: models of the political business cycle with fiscal illusion (Nordhaus 1975), partisan cycles theory (Hibbs 1987), models of debt used as a strategic tool by incumbent policy makers (Persson and Svensson 1989), models of redistribution conflicts and models of conflict between political parties (Roubini and Sachs 1989).

[4] For an extensive review of this literature, see Goeminne et al. (2008) and Couture and Imbeau (2009).

casts may be used as a tool to prevent excessive deficits. Indeed, they provide an empirical analysis of the relationship between political fragmentation and tax revenue budgeting errors, using data on Flemish municipalities. Although their data also exhibit a tendency of Flemish municipalities to (slightly) overestimate tax revenue, they show that coalition governments—with at least three parties in power—tend to overestimate tax revenue less than single-party and two-party coalitions—whereas Bischoff and Gohout do not find any significance for the coalition variable.[5] Comparing their results to what Serritzlew found in the Danish case,[6] Goeminne et al. (2008, p. 311) conclude that "*to the extent that there is indeed a systematic relation between revenue forecasting behaviour and public debts* (*or deficits*)*, this should translate into a better financial performance of highly fragmented governments in the Danish setting* (*much like the one observed here for Flanders*)*. As such results are not provided in Serritzlew* (2005)*, it is left to future research in the field to assess the extent to which our results—and the ensuing alternative explanation for government debts and deficits—generalise over different settings, or what drives possible deviations.*" The main result found and the conclusion drawn by Goeminne et al. are of direct interest for the present study. First, while in the Flemish case the occurrence of coalition governments is increasing over time and becoming more prevalent, data on Swiss cantons show that coalitions are the rule and single party governments the exception.[7] In addition, data show that Swiss cantons turn out to be very cautious in the way they predict tax revenue since, on average, underestimated tax revenue is observed (see Table 1). Unlike Goeminne et al., we do not test the relationship between fragmentation and prediction errors explicitly; however, the Swiss case offers an ideal setting to extend Goeminne et al. work and to test part of what they suggest in their conclusion, which is to say: (1) to test whether prudent tax revenue prediction translates into a better financial performance of highly fragmented governments and (2) to test whether this relationship generalizes over different settings in our case Swiss cantons. Thus, in a more concise formulation, we propose to empirically test the following hypothesis.

Hypothesis By reducing expenditure, underestimating tax revenue decreases fiscal deficits.

The above hypothesis states a negative relationship between tax revenue underestimation and fiscal deficits, which will be assessed by econometric methods using data from the Swiss cantons. Before presenting the data and methodology in more detail, we note that the above expressed hypothesis begins with: *By reducing expenditure*. Indeed, in addition to arguing that prudent tax revenue budgeting decreases

[5] Goeminne et al. find a nonlinear effect of coalitions on tax revenue projection. While two party coalitions tend to be more optimistic about their forecast, governments with at least three parties turn out to be more cautious.

[6] Serritzlew (2005) provides an empirical analysis of budget overruns in Danish municipalities.

[7] Data on Swiss cantons show that coalitions with at least two parties in power occur in more that 95% of the cases. Coalitions with at least three parties occur in more than 75% of the cases.

Table 1 Tax revenue budgeting errors in the Swiss cantons (1980–2002)

	Mean	sd	min	max
Bern (BE)	33.097750	79.94247	−130.4519	195.3134
Schaffhausen (SH)	−6.058505	70.88950	−101.9767	167.774
Appenzell Ausserrhoden (AR)	−21.16736	55.66625	−95.56966	122.1079
Uri (UR)	−21.22310	134.0090	−296.4199	236.6541
Solothurn (SO)	−23.16581	127.6487	−225.1344	294.9495
Jura (JU)	−24.60964	60.33362	−139.0612	64.00689
Thurgau (TG)	−28.76536	83.43697	−183.1832	142.6931
Sankt-Gallen (SG)	−28.89539	67.30484	−167.4951	151.4163
Zürich (ZH)	−33.04345	144.7140	−432.4096	174.6628
Neuchâtel (NE)	−37.46447	100.5035	−199.5525	216.8463
Obwald (OW)	−39.71332	83.81209	−193.8892	178.6296
Aargau (AG)	−41.95892	108.9408	−233.4848	195.3342
Luzern (LU)	−45.38220	86.22625	−239.8802	62.91078
Valais (VS)	−62.84744	93.46271	−243.8814	183.7683
Nidwald (NW)	−65.19043	115.7389	−538.5290	39.08583
Vaud (VD)	−66.60113	147.1721	−278.4558	290.3864
Graubünden (GR)	−80.89374	56.41266	−188.2635	45.78116
Fribourg (FR)	−85.30994	72.98334	−230.3515	63.86345
Genève (GE)	−94.37503	401.0994	−1167.721	602.6343
Schwyz (SZ)	−95.57028	69.48521	−260.0174	82.54814
Baselland (BL)	−98.26155	144.4911	−433.2656	150.8883
Baselstadt (BS)	−102.2706	411.8105	−1035.104	545.078
Appenzell Innerrhoden (AI)	−117.9050	109.2565	−344.7328	99.05705
Glarus (GL)	−144.8706	174.0521	−415.2252	107.9505
Ticino (TI)	−170.8208	214.3000	−574.9767	265.8552
Zug (ZG)	−235.1116	165.5196	−569.8398	8.026999
All	−66.73260	163.9699	−1167.721	602.6343

deficits, we tend to think that this effect (if observed) is mainly channeled through reduction in expenditure. This argument is in line with budgetary practices observed in the Swiss cantons where tax revenue is initially determined, and budget allowance for expenditure is then allocated accordingly. Furthermore, this idea seems to be supported by authors of other empirical studies who think that revenue prediction errors have a direct effect on expenditure. For instance, while Bischoff and Gohout (2010, p. 133) state that "*…biased tax projections help governments to bring forward favorable expenditures and to burden their successors,*" Goeminne et al. (2008, p. 310) mention that "*They* [broad-based coalitions] *might thus be less prone to threats of minor interest groups, limiting increases in expenditures and thereby the need to present* *optimistic budgets*." To the extend that this might hold for Flemish municipalities, we are inclined to think that this is the case for the Swiss cantons as well, and we propose to test this hypothesis explicitly. Data used to carry out such tests are presented in the next section.

3 Data

To test the hypothesis presented in Sect. 2, we rely on panel data from the 26 Swiss cantons between 1980 and 2002.[8] This database contains data on revenue and expenditure and a complete set of explanatory variables that are usually encountered in empirical studies on fiscal deficits. Our main explanatory variable is drawn from a new database that contains actual and budgeted tax revenue in the 26 cantons over the 1980–2002 period.

3.1 Tax revenue budgeting errors

To test our hypothesis empirically, we need to choose an appropriate measure of tax revenue budgeting errors. In the literature treating tax revenue forecasting accuracy,[9] absolute errors are often used as an indicator in order to avoid positive and negative errors that offset each other. In this paper, however, we want precisely to obtain information about the sign of the budgeting error. Thus, as the numerator of our indicator, we chose the difference between the budgeted amount of tax revenue and the actual amount. Since variables in our model will be expressed in per capita terms, the cantonal population has been chosen as the denominator. This specification allows us to make tax revenue budgeting errors comparable between cantons. Our indicator measuring tax revenue budgeting errors may be expressed as follows:

$$Error = \frac{(R_b - R_a)}{P} \tag{1}$$

where R denotes *direct tax revenue*, the subscript a stands for *actual*, the subscript b stands for *budgeted*, and P denotes the cantonal population. To compute this indicator, we collected budgeted and actual revenue that are reported in public accounts of Swiss cantons over the period.[10] The usual summary statistics are reported in Table 1.

In Table 1, the cantons are ranked according to their mean budgeting error. This ranking shows that all but one of the cantons (BE) have tax revenue budgeting er-

[8]The choice of this time span is justified as follows: we start in 1980 because in 1979 the last Swiss canton (JU) was created by partition from the canton of Bern, thereby rendering the sample of cantons before and after 1979 incomparable. Then we stop in 2002 because the database of control variables is incomplete for subsequent years.

[9]See, for example, Mocan and Azad (1995), p. 419.

[10]Between 1945 and 2007 and over the 1980–2002 period of interest, public accounts do not distinguish between personal and corporate tax revenue for every canton and/or every time span. For this reason, we used what we call "direct taxes," i.e., the addition of both personal and corporate taxes. The use of this aggregate enables us to exploit a complete and homogenous dataset across both cantons and years.

rors below zero on the average. Thus, we clearly observe a tendency to underestimate tax revenue. T-tests performed on the mean show that tax revenue budgeting errors are systematically and significantly underestimated in the majority of cantons, and in Swiss cantons as a whole. We note further that, with an average error per capita ranging from 33,098 Swiss francs (CHF) for Bern (BE) to −235,112 CHF for Zug (ZG), tax revenue budgeting errors exhibit strong heterogeneity among cantons. Moreover, standard deviations suggest that tax revenue budgeting errors also have strong intertemporal variability. In consequence, variability in budgeting errors can be exploited to try to quantify their potential effect on fiscal deficits. In this respect, the interesting question that arises is: do cantons also exhibit strong differences in terms of fiscal deficits (per capita) on the average? The next subsection shows that this is in fact the case.

3.2 Fiscal balances

To estimate the marginal effect of tax revenue budgeting errors on fiscal deficits, we need to measure the latter variable. In this study, we define fiscal balance as the difference between revenue and expenditure, and we use the data for cantonal revenues and expenditure that are computed and provided by the Federal Department of Finance. Table 2 presents summary statistics for cantonal deficits per capita over the 1980–2002 period.[11] As in the case of budgeting errors, cantons are ranked according to their mean.

First, we note that over the period considered, Geneva (GE) has a deficit which is more than twice as large as the canton that has the second largest deficit on the average, which is the canton of Vaud (VD). This difference justifies the inclusion of a dummy variable for this canton in the set of control variables (see Sect. 3.3). Similar to what is observed for average budgeting errors, deficits exhibit considerable heterogeneity among cantons, ranging from −734 CHF per capita for GE to 123 CHF per capita for AI. We can see that some cantons such AI, SZ, or ZG, which have generated surpluses on the average, belong to the cantons that are substantially underestimating their tax revenue. Conversely, the reverse observation cannot be made. Thus, a mere glance at summary statistics is insufficient to draw clear-cut conclusions about the correlation between tax revenue budgeting errors and public deficits. To do so, more rigorous econometric tools are required.

3.3 Control variables

In order to isolate precisely the effect of our variable of interest (*Error*), we need to control for the effect of other variables on cantonal deficits. In line with previous work on fiscal deficits, we control for the growth rate of cantonal incomes (as a proxy for GDP growth) and the unemployment rate (see, e.g., Kirchgässner and Pommerehne 1997). We also include potentially important political determinants of deficits such

[11] For measures of revenue and expenditure, we use the separated series from the Federal Department of Finance. Summary statistics are provided in Appendix A.

Table 2 Fiscal balances in the Swiss cantons (1980–2002)

Canton	Mean	sd	min	max
Genève (GE)	−734.3611	826.8167	−2513.386	607.9089
Vaud (VD)	−305.3086	436.913	−1134.335	284.1735
Jura (JU)	−269.7521	263.4787	−660.1033	284.8849
Neuchâtel (NE)	−244.673	332.3113	−1045.022	142.7332
Baselstadt (BS)	−230.4947	798.2137	−1854.755	1296.544
Bern (BE)	−196.5969	318.0202	−803.3543	353.4736
Appenzell Ausserrhoden (AR)	−141.0955	301.8264	−711.6563	355.0611
Zürich (ZH)	−129.0238	431.273	−809.0168	825.5766
Glarus (GL)	−124.8607	389.5551	−1309.669	452.2523
Valais (VS)	−109.7136	277.2125	−635.4553	448.3997
Luzern (LU)	−103.6451	325.0108	−607.4554	596.7086
Thurgau (TG)	−89.79546	284.568	−585.5226	454.0573
Uri (UR)	−84.70413	526.7713	−1111.767	1067.085
Solothurn (SO)	−78.21859	247.6831	−634.895	239.3287
Obwalden (OW)	−32.73404	312.3124	−610.627	733.8257
Sankt-Gallen (SG)	−10.30338	194.1256	−389.1809	275.0618
Graubünden (GR)	11.15879	247.7473	−362.364	444.9858
Ticino (TI)	16.02092	474.9252	−768.3969	906.9489
Schaffhausen (SH)	21.86632	230.7747	−546.6951	335.9798
Nidwalden (NW)	31.23354	289.6734	−456.059	724.5751
Aargau (AG)	38.08353	169.1206	−346.9848	321.304
Fribourg (FR)	41.48465	338.358	−835.9874	613.8598
Baselland (BL)	46.04834	343.6327	−683.9509	616.8721
Zug (ZG)	86.92754	642.557	−1433.325	1219.716
Schwyz (SZ)	121.7364	325.1743	−263.8192	1071.407
Appenzell Innerrhoden (AI)	123.3337	262.6828	−288.4537	634.8669
All	−90.28412	431.5964	−2513.386	1296.544

as the political leaning of the government measured by the proportion of right-wing members among cantonal executives (cf. Hibbs 1987),[12] political concordance (see Niskanen 1971 and Velasco 2000) measured by the percentage of the seats in the legislature that are occupied by members of parties represented in the executive, an election dummy equal to 1 for the years when elections are held and zero otherwise (cf. Nordhaus 1975), and the number of Spending Ministers measured by the number of departments in the cantonal administration as a proxy (see Velasco 2000; Wehner 2010). We also include an indicator of political fragmentation measured by the number of parties in the government cabinet (see, e.g., Roubini and Sachs 1989;

[12]This variable is used as a proxy for voters' fiscal preferences.

Ashworth et al. 2005, or Wehner 2010).[13] To control for institutional determinants of deficits, we include categorical variables measuring the stringency of referendums and initiatives (using the indices devised by Frey and Stutzer 2005). In some cases, institutions turn out to be endogenous in the sense that they are themselves influenced by fiscal variables.[14] To control for this endogeneity problem, we instrumented the referendum and initiative variables using their lagged values (Matsusaka 1995; Feld and Matsusaka 2003). We also include several structural variables such as the age structure of the population[15] measured by the rate of elderly in the cantonal populations (see, e.g., Feld and Matsusaka 2003; Garand and Kapeluck 2004) or a dummy variable for the canton of Geneva.[16] Finally, to take into account the fact that revenue and expenditure do not fully adjust from year to year and exhibit inertia, we include lagged values of dependent variables as explanatory variables. This procedure also has the advantage of removing autocorrelation from the series. In the following section, we describe how the above data are used to test our hypothesis, and we present our main findings.

4 Empirical analysis

To test the hypothesis formulated in Sect. 2, we use two complementary approaches: direct modeling of the fiscal deficit (surplus), and modeling through a system of two equations, one for expenditure and one for revenue.

4.1 Single equation model: methodology and results

The first approach consists of estimating the effect of tax revenue budgeting errors directly on fiscal balance. Such a model considers fiscal deficit or surplus as the explained variable and can be expressed as follows:

$$B_{it} = \alpha + Error'_{it}\mu + X_t\delta + \epsilon_{it} \tag{2}$$

where i and t are the subscripts for the individual canton and time period, respectively, B denotes fiscal balance, α is the constant term, *Error* denotes our variable of interest and μ its associated coefficient, X is a vector of control variables and δ its corresponding vector of coefficients, and ϵ is the error term.[17] Given that *Error*

[13] This is the variable called COALITION in Appendix A.

[14] For a discussion, see Alesina and Perotti (1999), p. 14.

[15] Note that we also use the average population in the cantons not as an explanatory variable, but in order to express some variables in per capita terms. Doing so, allows us to wash out size effects and to reduce heterogeneity.

[16] This is a common practice in empirical studies on Swiss cantons. For instance, Pommerehne et al. (1996) include such a variable in their study of tax harmonization and tax competition in the Swiss cantons. Geneva is known to be quite different fiscally from other cantons and to be, by far, the most spendthrift Swiss canton, with much higher deficits than the others (see Table 2).

[17] Although it would theoretically make sense to expect μ to vary among cantons, the small number of periods observed (22) does not allow us to estimate a SUR model consistently. Thus, μ does not have i subscripts.

is a variable that assumes negative values when tax revenue are underestimated, we expect to find a value of $\hat{\mu}$ that is significantly different from zero and negative. This would mean that underestimating tax revenue increases fiscal surpluses and decreases fiscal deficits, respectively.

To provide a good estimate of μ and to make correct inferential statements, it is necessary to take into account several characteristics of our model. First, let us point out that Swiss cantons are very heterogenous in terms of budget size. Thus, although heterogeneity can be partially reduced by expressing our model in per capita terms, ϵ still exhibits strong heteroscedasticity. Then, given the variables included in X_t,[18] some endogeneity problems arise. Since $E[X_t \epsilon_{it}] = 0$ does not hold, the OLS estimator will no longer be unbiased and consistent. Finally, in most of the cantons, time series exhibit AR(1) autocorrelation. In order to remove autocorrelation and also because it theoretically and empirically makes sense, we include a lagged dependent variable in X_t.

To estimate our econometric model consistently, the literature usually recommends the use of difference GMM (Arellano and Bond 1991) or of system GMM (Arellano and Bover 1995; Blundell and Bond 1998). For instance, Goeminne et al. use a system GMM type of estimator in their empirical analysis on Flemish municipalities. However, given the nature of our data, this method may not be the most appropriate approach. Indeed, several regressors in X_t are almost time-invariant. Since GMM estimators for panel data explicitly model individual effects, parameter estimates tend to be inflated because of the high degree of collinearity between the time-invariant variables and the fixed effects.[19] Thus, since unit heterogeneity is already captured by the time-invariant regressors, we used an instrumental variables approach and estimated the model by two-stage least squares (2SLS). We instrumented referendum and initiative with their lagged value.[20] Remaining heteroscedasticity is handled through the White correction for standard errors.

Estimation results from the single equation model of fiscal deficits are reported in Table 3. First, we note globally that although some of the control variables are individually not significant, joint tests of significance (row "Joint") show that the coefficients are jointly significant. Column (2) reports the estimate obtained using two-stage least squares (2SLS).[21] It shows that the parameter associated with the tax revenue budgeting error indicator is strongly significant. Furthermore, as expected, the coefficient has a negative value. Given that our indicator of *Error* assumes a negative value when tax revenue is underestimated, this result means that

[18] The explanatory variables *referendum* and *initiative* are considered as endogenous to the model (see Sect. 3.3).

[19] Random effects are inappropriate in our case since we analyse the full sample and not a random draw from the population.

[20] In the case where autocorrelation had not been completely removed by the lagged dependent variable, this condition would cause the lagged dependent variable to be endogenous to the model as well. To check the robustness of our results with respect to this case, we also instrumented alternatively the lagged dependent variable with its lagged value. Results turned out to be robust.

[21] This column reports the estimates obtained using the 2SLS estimator without instrumenting the lagged dependent variable (NILDV).

Table 3 Single equation estimation: results

	(1) GMM	(2) 2SLS NILDV	(3) 2SLS ILDV
Error	−0.857***	−0.767***	−0.785***
	(0.0704)	(0.0780)	(0.0823)
Balance(−1)	0.595***	0.586***	0.513***
	(0.0283)	(0.0352)	(0.0569)
Initiative	25.28	−11.29	−12.30
	(27.99)	(12.13)	(12.97)
Growth	38.82***	31.78***	38.84***
	(6.820)	(6.741)	(7.415)
Unemployment	9.617	2.486	−6.745
	(8.140)	(8.048)	(8.514)
Referendum	2.096	26.25**	27.12**
	(19.61)	(9.430)	(10.45)
Concordance	5.106**	1.261	1.247
	(1.774)	(1.382)	(1.436)
Elderly	−4.300	−6.987	−7.752
	(12.47)	(6.662)	(6.908)
Right-wing	0.363	0.156	0.0763
	(1.513)	(0.958)	(1.024)
Coalition	−11.05	−25.97	−28.65
	(32.73)	(14.49)	(15.06)
Departments	−13.85	−11.72*	−13.80**
	(9.414)	(4.956)	(5.126)
Election	−19.32	−22.26	−15.74
	(25.88)	(28.35)	(29.38)
Geneva		−251.1**	−289.3***
		(84.19)	(87.17)
Intercept	−552.2	−28.34	18.85
	(320.8)	(163.0)	(172.5)
R^2		0.642	0.641
Joint	0.0000	0.0000	0.0000
N	571	595	570

Note: Parameter values appear without parentheses, and standard errors within. Asterisks denote the level of significance of parameter values: *** indicating significance at the 1% level, ** at the 5% level, and * at the 10% level. The *Joint* statistic tests the hypothesis that all coefficients are jointly equal to zero using the F-test or Chi-squared tests underestimating tax revenue increases fiscal surpluses or decreases deficits. When the per capita tax revenue budgeting error is underestimated by one additional Swiss franc, fiscal surplus (deficit) per capita increases (decreases) by about 0.77 CHF. One may wonder whether under and overestimation have an impact on fiscal balance of the same amplitude. We have formally tested this issue and found that the effect is statistically symmetrical.[22] To check for the robustness of our results, we estimated our model using alternative estimators. Among others, we report, in column (1), the results obtained using system GMM since it is prevalent in the literature. Results turn out to be robust.[23] However, due to high collinearity, some parameters tend to be inflated. Thus, 2SLS provides a more accurate estimate. Finally, in column (3), we report the estimate obtained from 2SLS when we also instrument the endogenous lagged variable. Again, our results are robust, and the value of our parameter of interest is only marginally affected. While the direct approach using a single equation model allows one to isolate the effect of tax revenue budgeting errors on fiscal balance, it has the drawback of not showing the impact on expenditure that eventually determines the effect on fiscal balance. Consequently, adopting a simultaneous estimation of expenditure and revenue enables us to overcome this limitation.

4.2 Simultaneous equations model: methodology and results

By definition, fiscal balance (B) is determined by revenue (R) and expenditure (E). Thus, fiscal balance can be modeled using two equations, one for revenue and the other for expenditure, as follows:

$$R_{it} = \alpha_R + \gamma_R E_{it} + W_t \beta^R + \epsilon_{it}^R, \tag{3}$$

$$E_{it} = \alpha_E + Error'_{it} \mu_E + \gamma_E R_{it} + Z_t \beta^E + \epsilon_{it}^E \tag{4}$$

where R denotes revenue, E denotes expenditure, α_R and α_E are the intercepts, γ measures the marginal effect of expenditure (revenue) on revenue (expenditure), W_t and Z_t are the sets of control variables explaining revenue and expenditure, respectively, with β^R and β^E the associated vectors of coefficients. Although they include the same set of control variables, W_t and Z_t are still different since they each include the lagged dependent variable of their respective equations. Finally, ϵ^R and ϵ^E denote the error terms.

This simultaneous equations model enables us to distinguish the respective determinants of revenue and expenditure that eventually affect fiscal balance. According to our hypothesis, we expect tax revenue budgeting errors to affect expenditure. Therefore, the variable *Error* and its associated coefficient μ appear on the right-hand side of (4). Assuming that *Error* is a variable that takes on a negative value when tax

[22] The results of the tests for symmetry are reported in Appendix C. These test results are robust to different estimation strategies and over both models.

[23] The dummy variable for Geneva does not appear since it is already accounted for by fixed effects. Its inclusion would be redundant.

revenues are underestimated, we expect $\hat{\mu}_E$ to be significantly positive. This result would mean that underestimating tax revenue reduces expenditure, and subsequently increases surpluses or decreases deficits.

To produce consistent estimates of the parameters, and especially of $\hat{\mu}_E$, we took into account the different characteristics of our model. As for the single equation case, heteroscedasticity is treated using White correction for standard errors. As in the previous model, some regressors in W_t and Z_t are correlated with ϵ_{it}. Furthermore, as R and E are simultaneously determined, they are endogenous to the system, and we have $E[R_{it}\epsilon_{it}^E] \neq 0$ and $E[E_{it}\epsilon_{it}^R] \neq 0$. Subsequently, the existence of endogeneity necessitates the use of an estimator of the IV class. Given that we now have a system of two simultaneous equations, $E[\epsilon_{it}^R\epsilon_{it}^E] = 0$ does not hold, and an estimator is required that also takes into account the correlation between error terms. Since the set of instruments is the same across equations, we chose the three-stage least squares estimator to estimate our parameters (Hayashi 2000).

Estimates for the simultaneous equations model are reported in Table 4.[24] In particular, the estimation of the expenditure equation shows that the coefficient associated with tax revenue budgeting error is strongly significant. Furthermore, it has a positive value. This result indicates that underestimating tax revenue notably reduces expenditure. When tax revenue is underestimated by 1 additional CHF, expenditure per capita decreases by about 0.47 CHF. From the parameter estimates in columns (1) and (2), we can recover the parameters of a hypothetical underlying single equation model by computing the parameters of the reduced form of the system.[25] As for the coefficient of tax revenue budgeting errors, it indicates an estimate of about −0.47 CHF since the effect of expenditure on revenue is not significant. Although this roughly corroborates the single equation model, we can be confident that this measure of the effect of tax revenue budgeting errors on fiscal deficit is more precise because the simultaneous equations model allows us to partial out the effects of the control variables on expenditure and revenue more precisely. As in the single equation model, the effect of under- and overestimation on expenditure turns out to be symmetrical.[26] As expected, our results provide some evidence that, if tax revenue budgeting errors have an impact on fiscal deficits, this impact is channeled through a reduction in expenditure.

5 Conclusion

Contributing to the literature on the determinants of fiscal deficits and extending Goeminne et al. empirical study on tax revenue projections, the present study pro-

[24] As for the single equation model, we estimated the simultaneous equations model once with an instrumented lagged dependent variables, column (2), and once without, column (1). Results turned out to be robust.

[25] The reduced form of the simultaneous equations model expresses expenditure and revenue only in terms of exogenous variables.

[26] See Appendix C, columns (1) and (2) under simultaneous equations.

Table 4 Simultaneous equations estimation (3SLS): results

	(1)		(2)	
	Revenue	Expenditure	Revenue	Expenditure
Error		0.465***		0.497***
		(0.0749)		(0.0844)
Revenue		0.360***		0.440***
		(0.0340)		(0.0531)
Revenue(−1)	0.950***		1.139***	
	(0.0460)		(0.0923)	
Expenditure	0.0510		−0.141	
	(0.0477)		(0.0953)	
Expenditure(−1)		0.653***		0.554***
		(0.0345)		(0.0542)
Growth	27.16***	−13.70*	27.03**	−18.90*
	(7.301)	(6.881)	(8.981)	(7.516)
Unemployment	23.14*	18.58*	46.41***	27.66***
	(9.375)	(7.559)	(14.04)	(7.882)
Initiative	11.06	18.27	15.16	17.61
	(13.52)	(12.33)	(15.09)	(11.72)
Referendum	1.013	−22.74*	−1.952	23.18*
	(12.04)	(11.06)	(13.51)	(10.67)
Concordance	0.831	−1.416	0.733	−1.251
	(1.510)	(1.384)	(1.756)	(1.381)
Right-wing	−1.535	−1.027	−1.721	−0.866
	(1.039)	(0.959)	(1.215)	(0.971)
Election	17.61	38.01	25.89	27.81
	(27.09)	(24.87)	(31.52)	(24.84)
Coalition	−12.28	16.16	−8.232	19.49
	(17.29)	(15.98)	(20.02)	(16.12)
Departments	1.263	12.75*	6.775	14.41**
	(5.927)	(5.338)	(7.183)	(5.376)
Elderly	−0.0937	10.73	4.307	11.56
	(7.617)	(6.885)	(9.289)	(7.033)
Geneva	69.86	302.1***	207.7	344.8***
	(91.88)	(79.25)	(122.9)	(83.42)
Intercept	70.44	71.04	−15.96	1.971
	(182.3)	(168.4)	(214.8)	(171.4)
R^2	0.9893	0.9916	0.9860	0.9917
Ftest (p-value)	0.0000	0.0000	0.0000	0.0000
N	595	595	571	571

Note: Parameter values appear without parentheses, and standard errors within. Asterisks denote the level of significance of parameter values : ***indicating significance at the 1% level, **at the 5% level, and *at the 10% level. The F-test tests the null hypothesis that all coefficients are jointly equal to zero poses to test explicitly the potential relationship between tax revenue budgeting error and fiscal deficits. Referring to the Swiss context, we argue that underestimation of direct tax revenue reduces public deficits and that this effect is driven by a decrease in public expenditure. Using panel data for the 26 Swiss cantons over the 1980–2002 period, we first estimate a single equation model of fiscal deficit by two-stage least squares and show that tax revenue budgeting errors have a significant negative effect on fiscal balances (i.e., underestimation reduces deficits). Then we estimate a simultaneous equations model of revenue and expenditure by three-stage least squares and find a positive coefficient measuring the effect of tax revenue budgeting errors on expenditure (i.e., underestimation reduces expenditure). These econometric results confirm the hypothesis we sought to test, i.e., by reducing expenditure, underestimating tax revenue decreases fiscal deficits. Moreover, the effect on expenditure and deficit turns out to be symmetrical for underestimation and overestimation. Thus, this study provides evidence that prudent tax revenue budgeting not only reduces deficits but also supports the symmetrical argument that overestimating tax revenue creates additional deficit.

In general, however, we would not advocate deliberate underestimation of tax revenue as a policy tool to curb fiscal deficits. An important drawback of tax revenue underestimation is that it detracts resources from the democratic debate. Consequently, a risk exists that the use of these resources would not correspond to voters' fiscal preferences but rather to some budget officials' or elected politicians' personal interests. Indeed, politicians may be merely seeking to create a buffer in order to increase expenditure subsequently for re-election purposes (Bischoff and Gohout 2010; van der Ploeg 2010). Moreover, in some weak and corrupted institutional settings with poor checks and balances, underestimating tax revenue may even be a way for incumbent politicians and officers to conceal the extraction of resources from public budgets (Danninger 2005). Ideally, we would prefer to argue that the budgeted amount of tax revenue should equal tax revenue optimal forecast and explicit fiscal rules brought into law through a democratic process should be privileged in order to avoid deficits and to cope with economic uncertainty.

Nonetheless, when such explicit rules are lacking or their design turns out to be suboptimal, underestimating tax revenue may be an effective alternative way for policymakers to keep expenditure under control and to reduce deficits. But even in such a case, whether underestimating tax revenue is fiscally and/or economically desirable depends on the respective fiscal situation and economic environment of the public entities concerned—the Swiss cantons in our case. Fiscally, we can distinguish two clear-cut cases. On the one hand, in cantons with a relatively high level of public debt and persistent deficits, systematically underestimating tax revenue turns out to be a fiscally sound practice since it reduces the size of these deficits, and in consequence the rate of debt accumulation. On the other hand, in cantons with a relatively low level of public debt and persistent surpluses, it cannot be concluded that systematically underestimating tax revenue is fiscally sound. In these cantons, the low level of public debt is often due to a lack in long-term investment (typically infrastructure) needed to implement public policies. In this case, underestimating tax revenue contributes to the concealment of some resources that would be needed to support a higher rate of public investment and thereby a quicker catch-up with respect to other cantons. In the cases that are not clear-cut (high debt/surpluses and low debt/deficits), drawing conclusions is more fastidious since the creation of surpluses (deficits) may be optimal (without underestimating tax revenue) with respect to the current rate of debt accumulation in the canton. From the perspective of stabilization policy, underestimating tax revenue during periods of weak economic growth or recession could be harmful since it reduces expenditure that would be needed to increase global demand. Conversely, in a period of high economic activity, reducing public expenditure by underestimating tax revenue could be desirable since it may help to avoid economic overheating.

To conclude, it is important to remember that, even in the cases when underestimating tax revenue would be wise and desirable, conditions for its implementation might not be fulfilled. Consequently, it is necessary to know more about the determinants driving tax revenue budgeting errors. Recent studies have emphasized the important role of political determinants. In particular, Goeminne et al. have shown that large coalitions tend to be more cautious in their tax projections. Given the prevalence of large coalitions in Swiss cantons, we would not be surprised to find a similar effect. Some authors have also suggested, without testing it explicitly, that the finance minister may play a central role in the implementation of prudent tax revenue budgeting (Goeminne et al. 2008; van der Ploeg 2010). Given the characteristics of the budgeting process in Swiss cantons, we also tend to think that the finance minister may play a key role in the determination of tax revenue budgeting errors. Since such an investigation was not our goal, our estimations do not provide any evidence about these relationships in the Swiss context. Thus, the attempt to explain the variability of cantonal tax revenue budgeting errors by identifying their (political) determinants turns out to be a natural question to explore in future research.

Appendix A: Revenue and expenditure: summary statistics

Table 5 Cantonal revenue and expenditure in real CHF per capita over 1980–2002

Canton	Revenue				Expenditure			
	Mean	sd	min	max	Mean	sd	min	max
AG	5015.384	710.5594	4087.634	6301.105	4977.300	746.4878	4099.783	6128.389
AI	6735.898	941.486	5083.075	8253.094	6612.564	945.6279	5318.897	8541.548
AR	5287.862	1200.143	3891.616	7203.918	5428.958	1095.988	3914.904	7233.634
BE	6200.800	1088.415	4811.023	8368.874	6397.397	1080.012	4896.537	8411.978
BL	6916.597	1152.641	5449.983	9107.365	6870.549	1163.477	5570.413	8919.044
BS	15935.96	2145.625	13051.88	20734.09	16166.46	1998.802	13437.30	20296.12
FR	6743.588	1076.687	5022.41	8510.944	6702.104	1220.859	4977.789	8433.949
GE	12922.87	1614.766	10000.55	16080.99	13657.23	1597.303	10526.85	15876.66
GL	7457.922	1025.488	5823.063	8921.749	7582.783	1251.027	5533.799	9494.221

Table 5 (*Continued*)

Canton	Revenue				Expenditure			
	Mean	sd	min	max	Mean	sd	min	max
GR	7171.030	1232.859	5538.316	9327.953	7159.871	1352.176	5480.771	9529.598
JU	6673.068	1510.690	4434.991	9665.524	6942.820	1443.545	4589.529	9380.639
LU	5455.992	1191.130	4063.364	7578.604	5559.637	1078.827	4140.649	7340.158
NE	6539.801	1405.199	4498.059	8861.885	6784.474	1498.824	4488.560	8772.98
NW	5249.295	1034.496	3557.105	8269.055	5218.062	1074.516	3290.795	7910.633
OW	5582.069	1149.789	3937.727	7741.923	5614.803	1129.461	4014.742	7464.314
SG	5236.472	1140.167	3739.511	7196.129	5246.776	1201.734	3673.273	7370.006
SH	5776.799	1050.944	4541.584	7826.609	5754.933	1033.157	4459.804	7633.352
SO	4835.597	733.8441	3867.085	6318.657	4913.816	776.6350	3942.69	6124.056
SZ	4513.717	873.6606	3415.338	6127.334	4391.981	671.7830	3436.821	5972.051
TG	4953.364	748.7518	4150.928	6347.234	5043.160	746.1833	4034.496	6081.947
TI	6921.790	987.8556	5117.452	8206.998	6905.769	1051.988	5398.620	8213.416
UR	7571.280	1308.656	5192.997	9087.474	7655.984	1342.850	5333.400	9453.874
VD	7339.849	1073.150	5835.963	9634.512	7645.157	1161.993	5885.842	9991.569
VS	5959.142	1003.294	4695.405	8176.016	6068.856	947.0116	4919.074	7728.980
ZG	6323.445	1039.847	4528.51	8304.04	6236.517	1387.902	4143.831	8202.335
ZH	6295.357	1023.407	5061.018	8329.325	6424.381	857.3253	5009.492	7980.288
All	6754.421	2671.347	3415.338	20734.09	6844.705	2773.077	3290.795	20296.12

Appendix B: Control variables: summary statistics

Table 6 Summary statistics of control variables

Variable	Unit/Domain	Min	Max	Mean	Sd
Growth	%	−1.33	4.55	1.67	1.65
Unemployment	%	0.00	7.80	1.80	1.79
Referendum	[0–6]	0.00	6.00	3.96	1.32
Initiative	[0–6]	1.67	6.00	4.46	1.31
Departments	R+	5.00	13.0	7.66	2.33
Coalition	R+	1.00	5.00	3.31	0.92
Right-wing	[0–100]%	33.3	100	78.3	16.0
Concordance	[0–100]%	53.3	100	86.5	10.3
Election year	0 or 1	0.00	1.00	0.23	0.42
Elderly	[0–100]%	10.3	21.0	14.6	2.10

Appendix C: Tests for the symmetry of the effect of tax revenue budgeting errors

Table 7 Tests of symmetry: test statistic and p-value

	Single equation			Simultaneous equations	
	(1)	(2)	(3)	(1)	(2)
	GMM	2SLS	2SLS	3SLS	3SLS
Chi2	0.01	0.01	0.05	0.47	0.44
p-value	0.933	0.932	0.8271	0.4919	0.4919

H_0 assumes the symmetry of the effect. H_0 can never be rejected

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