Discussion Paper No. 14-122

Real-Time Macro Monitoring and Fiscal Policy

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Economic Research

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Version: December 19, 2014 — 1:35 P.M.

Abstract: This paper considers the effects of inaccurate real-time output data on fiscal policy, both with respect to budgetary planning and fiscal surveillance. As newer and better information becomes available, output data available in real time get revised and are likely to conflict with final figures that are only released some years later. By contrast, fiscal policy is inevitably based on real-time figures. The paper develops a simple but comprehensive modeling framework to formalize the linkages between output data revisions and fiscal policy and combines it with a newly compiled dataset from the International Monetary Fund's World Economic Outlook, comprising final and real-time output data for 175 countries, over a period of 17 years. Based on a simulation exercise, it finds that output data revisions alone may significantly undermine the reliability of real-time estimates of the overall and structural fiscal balances, and that output data revisions may result in unplanned and substantial debt accumulation. The paper also shows that there are significant differences across country income groups.

Keywords: Real-time Output Data, Fiscal Policy, Data Revisions, Public Debt

JEL Codes: E01, E62, H68

We thank Gerhard Kempkes, Jeffrey D. Lewis, Lukas Reiss, the participants of the 68^{th} Congress of the International Institute of Public Finance (IIPF) held in Dresden, Germany, and participants of a workshop organized by the National Bank of Slovakia held in Bratislava, Slovakia, for their useful comments. Financial support from a World Bank Research Support Budget grant is gratefully acknowledged. We thank the IMF for support with the compilation of the dataset. An earlier version of this paper is available as World Bank Research Working Paper No. 6303.

"It does make economic sense to target cyclically adjusted rather than actual deficits. But the improvement in economics is at the cost of a reduction in precision. Nobody knows what a structural deficit is." —Martin Wolf, *Financial Times*, March 6, 2012.

"The most important product of knowledge is ignorance." —David Gross, 2004 Physics Nobel laureate.

1. Introduction

This paper assesses the implications of output data revisions for fiscal policy. For budgetary planning and fiscal surveillance, it is imperative to correctly project and estimate the overall fiscal balance and the structural balance. The overall fiscal balance drives public debt dynamics and is therefore the main reference indicator in assessing fiscal sustainability. The structural balance, in turn, relates to another central aspect of assessing the government's fiscal policy stance and is a key ingredient of fiscal surveillance because it separates the effect on the budget of changes in the cyclical position of the economy from the effect of other factors. However, fundamental data uncertainty, resulting in frequent output data revisions, may impede budgetary planning and fiscal surveillance. As new and better information becomes available, GDP figures are revised so that real-time GDP figures rarely correspond to final GDP figures.

Previous papers have documented revisions of real-time GDP estimates and their implications for output gap estimates; in some cases output data revisions are so large that governments are unaware whether their country is in a recession or not, or what the sign of the growth rate is.[1] Conceptually, there are several channels through which such revisions translate into revisions of real-time estimates of the overall and structural balances prior or even during to the fiscal year. First, changes in output automatically induce changes in the volume of public spending and revenue. Even if spending and revenue output elasticities are known with complete certainty, inaccurate real-time output growth estimates therefore mean that it is not possible to correctly estimate fiscal revenue and expenditure

[1] See for instance Orphanides and van Norden (2002) using U.S. data, Marcellino and Musso (2011) using Euro area data, and Ley and Misch (2013) using IMF World Economic Outlook (WEO) data covering a large number of countries.

streams. Second, fiscal indicators are frequently reported as shares of GDP. As output data revisions occur, the denominator of these ratios changes as well. Third, decomposing the overall balance into the cyclical and structural balance requires estimates of the output gap, and these too are subject to revisions.

Potentially, revisions of output data are therefore a major concern for fiscal policy. Revisions of the overall balance which output data revisions may trigger imply that governments inevitably miss deficit or surplus targets. In turn, this means that depending on the nature of output data revisions, fiscal policy is either too tight or results in unplanned debt-to-GDP accumulation. In addition, fiscal surveillance becomes considerably more difficult and less reliable, especially when estimates of the structural balance turn out to be inaccurate.

There is rapidly growing literature focusing mostly on developed countries that documents revisions of fiscal data, *i.e.*, the difference between fiscal projections or forecasts, and outcomes in terms of actual spending and revenue. Recent evidence suggests that such revisions may in some cases be sizable; see for instance Beetsma *et al.* (2012) who report that on average, the overall budget balance is downward revised by 0.5% of GDP. Hallett *et al.* (2011) find that real-time estimates of structural balances that are published by the OECD for 19 countries are a poor predictor of episodes of significant fiscal loosening. Much of the earlier literature including for instance Heinemann (2006) that is summarized in great detail by Leal *et al.* (2008), discusses the properties of fiscal forecasts and in particular examines whether there is a systematic bias, whereas the more recent literature summarized by Cimadomo (2011) also includes an assessment of why such revisions occur.

Obviously, there may be many reasons of why such observed revisions of fiscal data occur. In this paper, we solely focus on one particular cause, namely output data revisions, which is the central impediment of the ability of governments to correctly report and project fiscal indicators in real time. This cause contrasts with other political or institutional factors for revisions that relate to the willingness of governments, such as strategic and deliberate misreporting or misprojecting fiscal indicators. Auerbach (1995) distinguishes three types of factors that result in fiscal data revisions: economic errors which relate to forecast errors of macroeconomic variables used, policy errors which are mainly of political nature, and technical errors which relate to the forecasting model used including its underlying assumptions about behavioral responses. Most existing papers that examine the determinants of revisions to fiscal data attribute these to the first two factors, namely both budgetary institutions and other political factors as well as to revisions of GDP growth projections; see for instance Strauch *et al.* (2004), Pina and Venes (2011), and de Castro *et al.* (2011) for evidence from developed countries and Lledó and Poplawski-Ribeiro (2011) and Frankel (2011) for rare examples that cover both developed and developing countries. Easterly (2012) suggests that growth slowdowns coupled with overoptimistic growth projections are key to explain the rapid accumulation of debt in Europe and the U.S..

Similarly to Kempkes (2012) and González-Mínguez *et al.* (2003), we exclusively use real-time and final output data as well as the discrepancy between the two to simulate revisions of the overall balance and the structural balance.[2] Using estimates of the bias of the real-time output gap of the EU-15 countries, Kempkes (2012) roughly estimates the implications for deficits in a hypothetical scenario in which a fiscal rule prescribes a deficit target that is inversely related to the output gap (*i.e.*, that allows a higher deficit in times of recession and vice versa). He multiplies the estimated bias with country-specific cyclical elasticities of the budget balance and finds that under these assumptions, the deficit projected using real-time data would on average exceed the deficit under final data by 0.5 to 0.6 percent of potential output in the EU-15 countries. Similarly, González-Mínguez *et al.* (2003) discuss the effects of revisions to the output gap to revisions of the structural balance.[3]

Our approach differs from these papers, and we make two contributions. The first one is an analytical one: we develop a simple but comprehensive modeling framework to study

[2] We express all fiscal indicators including their revisions as a share of GDP. This allows us to ignore the effects of revisions of other macroeconomic variables, such as inflation, in our analysis.

[3] Other papers focus on different aspects that affect output gap estimates and that thereby have implications for fiscal surveillance. Larch and Langedijk (2007) for instance discuss the implications of using alternative smoothing parameters for output gap estimates in the context of EU budgetary surveillance.

the effects of output data revisions on deviations of the overall balance and the structural balance from original estimates or projections, and on unplanned debt accumulation or reduction as a result of mistakes in budgetary planning. This framework reflects all three transmission channels through which output data revisions affect estimates of the overall and the structural balances prior to the fiscal year, namely (i) revisions in growth which affect estimates of the magnitude of the cyclical component of revenues and expenditures, (ii) revisions of the level of GDP as the denominator which affects the shares of fiscal variables in GDP, and (iii) revisions of the output gap which impact on the decomposition of the overall balance into the cyclical and structural balances.

An important assumption of the model is that the government anchors its estimate of a period's fiscal balance on the previous period's fiscal balance which limits the effects of output data revisions and thereby makes our results more credible. We essentially distinguish two 'release' dates of fiscal data which differ with regard to the availability of final output data. We then compare the concurrent estimates of the overall and structural balances using output estimates available at the time of budget preparation with the ones computed when all final release output data are available; in addition, we derive an expression about how revisions of the overall balance affect public debt over time.

The theoretical framework will set the groundwork for the simulation exercise to quantify the effects of output data revisions on the overall balance, the structural balance and debt accumulation using a novel dataset which is our second contribution. Our data come from the IMF's World Economic Outlook (WEO), comprising real-time output growth and gap data for 1990–2007 and final output data from 2012 covering 169 countries.[4] These data allow us to obtain for every country and every year during the 1990–2007 period real-time and final estimates of output growth and of the output gap, which together with a few assumptions on structural parameters, enables us to compute revisions of fiscal balances and to simulate debt accumulation. We essentially assume that the government is benevolent and mechanically uses output data available in real time to make their predictions. We

[4] In a companion paper (Ley and Misch, 2013), we present the dataset in detail and include various more detailed descriptive statistics on output growth and output gap revisions.

find that while on average revisions of fiscal balances are small, in a relatively high share of cases, these revisions are nevertheless likely to create significant challenges for budgetary planning and fiscal surveillance.

The advantage of this type of simulation exercise is that we are able to evaluate the effects of one particular and potentially important cause of fiscal revisions that determines government ability and 'switch off' all other factors, in particular strategic and political considerations that may cause governments to deliberately provide wrong estimates of fiscal indicators. WEO data are probably the best comparable source of real-time data available for a large number of countries which we discuss more in detail in the next section. The high quality of WEO data allows us to obtain credible measures of government ability (in contrast to willingness) to correctly project fiscal balances. Given the large number of country-year observations, we are able to draw general conclusions for different country groups. The results have important policy implications. For instance, the results suggest that countries may deviate from fiscal plans even if governments are benevolent and want to stick to fiscal targets, which is important in the context of multilateral fiscal surveillance for instance. In addition, our results provide guidance for fiscal contingency plans in terms of safety margins.

The paper is organized as follows. Section 2 contains a description of the data. Section 3 develops the conceptual framework. Section 4 presents the simulation results and Section 5 concludes.

2. A First Look at the Data

As noted, the data come from the IMF World Economic Outlook and consist of output data from 1966 to 2012 for 169 countries.[5] For our purposes, WEO data are particularly suitable, even though governments of more advanced countries are more likely to use higher frequency data from national sources for fiscal policy. The WEO predictions are the result

[5] We discard 9 countries where output figures appear to systematically not be revised for several years or where the output series from different vintages do not allow us to compute all variables required for the simulation in Section 4.

of a comprehensive and systematic procedure. The country desks, in consultation with country governments and other observers, submit their forecasts to the WEO division. The WEO division makes sure that 'the pieces fit in', checking the compatibility of the forecasts between countries that have significant trade, or share significant trade partners. Several iterations with individual desks may occur before it is settled on the published WEO (spring and fall). In addition, compared to government GDP forecasts, WEO data are likely to be less affected by political interference.[6] Together with the fact that release dates are identical across countries, this implies that WEO data are therefore probably the best comparable source of real-time data available for a large number of countries.

The dataset contains output figures released in spring and fall from 1990 to 2012—*i.e.*, real-time output figures from 24 different vintages where we consider the one from fall 2011 as the one that contains final figures, with some exceptions. We clean the data for outliers to ensure that our simulation results are not driven by extreme output revisions or output gaps.[7]

We use the perspective of the previous-year fall WEO which is the latest data available for the preparation of the budget (provided that the fiscal and calendar years are congruent) to appraise the current year's GDP. Thus, for example, for 1991, we focus on the fall 1990 forecast for 1991 which we shall call *concurrent* estimate. In a robustness test however, we use same-year spring estimates which should, in principle, be more accurate. The justification for using the same-year April WEO vintage would be that if the level of economic activity could be reliably assessed from this perspective of the first quarter,

[6] There are no systematic differences between WEO data and other sources that are deemed reliable; Timmermann (2007) and Abreu (2012) for instance suggest that the quality of consensus forecasts and WEO forecasts is similar. Irrespective of the relatively high quality of WEO data, Aldenhoff (2007) and Dreher *et al.* (2008) still find evidence of political interference, and recently, Blanchard and Leigh (2013) show that during the global financial crisis, WEO forecasters underestimated the magnitude of fiscal multipliers.

[7] For instance, due to unusually large shocks such as wars or natural disasters, revisions may be unusually high. In particular, we discard all observations where the absolute estimated and final output gap is larger than 25 percent, and where the absolute deviations of the final growth rate and the estimated concurrent growth rate from the median of the final growth rate are larger than 25 percentage points. In addition, we discard vintages with fewer than 30 observations which we consider as reasonable to compute trend output which amounts to less than 0.2% of observations in our dataset.

then corrective measures could perhaps be implemented to re-direct fiscal policy for the remaining year. We shall see that is not so. Final estimates are assumed to be available five years later, so the 1990–2012 data allow us to study the reliability of the 1990–2007 concurrent estimates.

The left panel in Table 1 summarizes descriptive statistics of final growth rates by country groups. During the period considered, namely from 1991 (first year for which previous year fall forecasts are available) to 2007 (latest year for which growth figures can be verified), overall growth averages to an annual four percent, with significant smaller dispersion among high-income OECD countries, and larger dispersion among low-income countries. The right panel in Table 1 summarizes the revisions of the growth rate in percentage points which is the difference between the final figure and concurrent estimates. Given that positive and negative revisions tend to cancel each other out, the mean is close to zero in most instances, but in 50% of the cases, that is below the 25th and above the 75th percentiles, the absolute revision is above 1.75%. The median revision in absolute value is almost 1.82% (not shown here). The standard deviation of the revisions for all country groups is about the median value of the final growth rates, almost the same order of magnitude as the standard deviations of the final growth figures, and larger than the standard deviations of the real-time growth projections.

Table 1. Final growth rates and growth revisions
(169 countries: 1991-2007; $N = 2621$)

	Final growth rates (in %)					Revision to growth rates, in perc. points				
	Quartiles			Moments		Quartiles			Moments	
Country Group	25	50	75	Mean	StDev	25	50	75	Mean	StDev
High income: OECD	1.74	3.11	4.30	3.08	2.48	-0.97	0.10	1.18	0.01	2.18
High income: nonOECD	2.02	4.73	7.28	5.13	5.05	-1.62	0.72	2.70	0.85	4.44
Upper middle income	1.43	4.08	6.40	3.67	4.52	-2.36	0.24	2.49	-0.14	4.37
Lower middle income	2.24	4.41	6.60	4.45	4.52	-1.83	0.06	1.78	-0.04	4.09
Low income	1.67	4.37	6.46	3.77	5.32	-3.04	-0.60	1.25	-1.15	5.19
All countries	1.85	4.00	6.21	3.95	4.50	-1.86	0.05	1.79	-0.19	4.21

Source: WEO data and own compilation

We compute the output gap for each vintage.[8] While there are alternative filtering methods, we use the Hodrick-Prescott (HP) filter, which is the most common method used,

[8] Trend output is estimated here with a Hodrick-Prescott filter and a parameter value of $\lambda = 6.25$. The

to extract the trend from a time series. In addition, we show in Ley and Misch (2013) that differences across filters tend to be fairly small. The left panel in Table 2 summarizes descriptive statistics of the final output gaps—*i.e.*, the gaps calculated using data from the latest vintage. Ignoring the sign, and just looking at their absolute value, the median values would be about one percentage point of GDP. However, there is some variation from 0.7 percentage points of GDP for high-income OECD countries to 1.3 percentage points of GDP for upper-middle income countries (not shown here).

Table 2. Final output gaps and output gap revisions
(169 countries: 1991-2007; $N = 2621$)

	Final output gaps (in % of GDP)					Revision to output gaps (in % of GDP)				
	Quartiles			Moments		Quartiles			Moments	
Country Group	25	50	75	Mean	StDev	25	50	75	Mean	StDev
High income: OECD	-0.83	-0.12	0.80	-0.03	1.48	-0.50	0.10	0.91	0.21	1.27
High income: nonOECD	-1.44	-0.06	1.38	-0.07	2.84	-1.26	0.15	1.18	-0.24	2.86
Upper middle income	-1.50	-0.05	1.57	-0.06	2.69	-1.04	0.11	1.51	0.19	2.38
Lower middle income	-1.00	-0.05	0.99	-0.04	2.60	-0.78	0.16	1.12	0.13	2.37
Low income	-0.95	-0.02	1.16	-0.02	3.01	-0.82	0.18	1.27	0.12	2.94
All countries	-1.09	-0.05	1.14	-0.04	2.57	-0.80	0.15	1.17	0.12	2.40

Source: WEO data and own compilation

The right panel in Table 2 represents the summary statistics of the revisions to the output gap. Most of the statistics are of the same order of magnitude than those in the left panel. This is a confirmation of the finding, for the U.S., by Orphanides and van Norden (2002), namely that the uncertainty in the real-time estimates of the output gap is about the magnitude of the gap itself. In absolute value, roughly for a gap around one percentage point of GDP, the typical revision will be ± 1 percentage points of GDP.

Figure 1 illustrates the uncertainty intrinsic in output-gap estimates. The concurrent output gaps correspond now to the previous-year's fall WEO data while 'final' output gaps correspond to the most recent WEO in the sample. The correlation coefficient is a rather low (0.39). Note that the concurrent estimates are computed with the data that become available at the end of the first quarter of the same year. In more than one-third

results are similar when other standard univariate filters are used to estimate trend output.

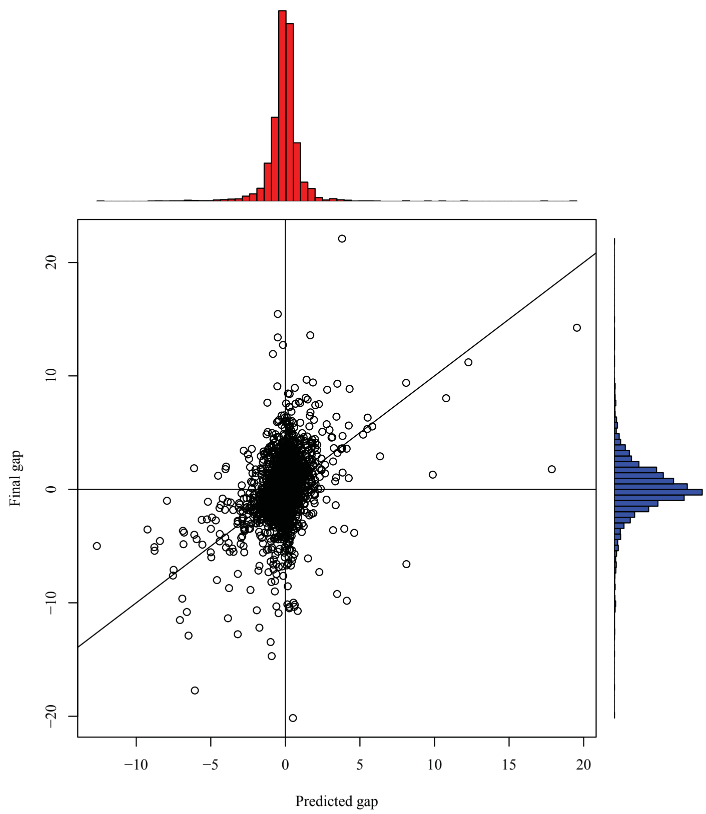

Fig. 1. Scatter Plot of the Output Gap: Concurrent vs Final (169 countries: 1990-2010)

Predicted Output Gap
- ⊕ 44% time; of which, the **Final** Gap is
  - ⊕: 64% cases
  - ⊖: 36% cases (changes sign)
- ⊖ 56% time; of which, the **Final** Gap is
  - ⊕: 39% cases (changes sign)
  - ⊖: 61% cases

Fig. 2. Effect of GDP Revisions on the Output Gap: Concurrent *vs.* Final (169 countries 1990-2010)

of the cases, the output gap changes its sign from the concurrent estimate to the final one (Figure 2).

One important reason behind these revisions in the output-gap estimates is, of course, that GDP growth projections get substantially revised. This is shown on the right panel of Table 1, which presents statistics on growth revisions. Apart from the preliminary nature of output data available in real time which naturally results in output gap revision, output gap estimates are also affected by methodological difficulties. Virtually all methods for estimating trend or potential output at time t require future observations for a number of periods beyond t (*i.e.*, the methods are based on backward- and forward-looking symmetric filters). In order to estimate the output gap in real time, the government therefore has to rely on truncated filters which are suboptimal, and as more observations become available, the past trend (and gap) gets revised, often substantially. As a result, the government may even misperceive whether actual output is above or below potential output.

3. Modeling Framework

3.1. Economic Fluctuations and Fiscal Policy

In our model economy, aggregate output, y_t, grows over time at rate γ_t, thus $y_t = (1 + \gamma_t)y_{t-1}$, and is subject to short-run, exogenous shocks so that actual output fluctuates around potential output represented by its trend, $\bar{y}_t$, giving rise to an output gap, z_t:

$$z_t \equiv \left(\frac{y_t - \bar{y}_t}{\bar{y}_t}\right) \times 100 \approx [\log(y_t) - \log(\bar{y}_t)] \times 100 \tag{1}$$
$$= \begin{cases} > 0 & \text{economic activity is over potential} \\ < 0 & \text{economic activity is below potential} \end{cases}$$

The output gap, z_t, defined in (1), reflects the cyclical position of the economy: when it is positive then economic activity is above potential, whereas when it is negative then output is below potential, and there are unemployed resources in the economy.

We assume that the government spends on public services and social transfers and raises taxes to finance these expenditures. Let e represent government expenditure, and let r represent its revenue. The resulting budget balance b is simply $b_t = (r_t - e_t)$, which can be negative or positive, depending on whether the government runs a deficit or a surplus. Parts of expenditure and revenue automatically respond to changes in output: an increase in economic activity results in higher tax revenue and lower social expenditure, for instance due to a decrease in unemployment benefits. The elasticity (strictly, buoyancy) of revenue, ρ, and of expenditure, ϵ, can be written as

$$\rho = \frac{\Delta r}{\Delta y} \div \frac{r_{-1}}{y_{-1}} = \frac{\Delta r}{r_{-1}} \times \frac{1}{\gamma} \tag{2}$$

$$\epsilon = \frac{\Delta e}{\Delta y} \div \frac{e_{-1}}{y_{-1}} = \frac{\Delta e}{e_{-1}} \times \frac{1}{\gamma} \tag{3}$$

The change of the budget balance as a result of changes in output can be written as

$$\Delta b = \Delta r - \Delta e = (\rho\, r_{-1} - \epsilon\, e_{-1})\gamma \tag{4}$$

3.2. Information Available in Real Time

Key to our modeling framework is the assumption that governments are imperfectly informed about the state of the economy at the time when they need to project future expenditure and revenue streams. In or shortly prior to period t, available output data referring to period t is inaccurate, and final figures become only available ex-post, *i.e.*, a couple of periods after t. As a result, estimates of y_t, γ_t and z_t denoted by $\hat{y}_t$, $\hat{\gamma}_t$ and $\hat{z}_t$, respectively, made in real time need to be revised later on as more information becomes available. We assume that revisions occur at least within four years after period t implying that the final figures y_t, γ_t and z_t are only available in $t+5$ (*i.e.*, five years in the future).

Obviously, the magnitude of the revisions depends on in which period the output data were released, *i.e.*, when the estimates of y_t, γ_t and z_t were made. For the purpose of this paper, we focus to what we refer to as *concurrent* or *real-time* estimates and assume that $\hat{y}_t$, $\hat{\gamma}_t$ and $\hat{z}_t$ are released approximately at the end of the third quarter of period $t-1$ for two reasons, although we slightly relax this assumption as part of the robustness checks discussed below. On the one hand, supposing that the fiscal year is congruent with the calendar year, this is most likely to be the newest information that governments may use to prepare the annual budget. On the other hand, in our data, these dates roughly correspond to the release dates of the fall estimates of the World Economic Outlook.

Revisions to these estimates are typically non-negligible as for instance Figures 1 and 2 suggest, and result in final figures to differ significantly from concurrent estimates. We express revisions of concurrent output in relative terms: $\hat{y}_t$ gets revised by $\phi_t \times 100$ percent so that $y_t = \hat{y}_t(1+\phi)$. By contrast, and in line with the literature, we express revisions of the growth rate and of the gap in absolute terms, namely as $(\gamma_t - \hat{\gamma}_t)$ and $(z_t - \hat{z}_t)$, respectively.

As a result of preliminary and possibly inaccurate estimates of γ_t, the government is unable to correctly project revenue and expenditure for t in real time. In particular, it estimates revenue, $r_t(\gamma)$, and expenditure, $e_t(\gamma)$, using growth estimates, $\hat{\gamma}_t$, as actual expenditure and revenue flows occurring in t are not yet observed. In order to make these estimates more reliable, the government uses revenue and expenditure figures from $(t-1)$ as an anchor which we assume is observed with reasonable accuracy towards to the end of this period.[9] While this assumptions may seem optimistic as growth in $t-1$ and thereby revenue and expenditure streams are still uncertain, it lowers the effects of output data revisions implying that our simulation results below are not overly pessimistic. Using equations (2)–(3), real-time estimates of revenue and expenditure may therefore be written as

$$\hat{r}_t = \hat{r}_t(\hat{\gamma}_t) = r_{t-1} + \hat{\Delta} r = r_{t-1} + \rho\, \hat{\gamma} r_{-1} \tag{5}$$

and

$$\hat{e}_t = \hat{e}_t(\hat{\gamma}_t) = e_{t-1} + \hat{\Delta} e = e_{t-1} + \epsilon\, \hat{\gamma} e_{-1} \tag{6}$$

so that

$$\hat{\Delta} b = \hat{\Delta} r_t - \hat{\Delta} e_t = (\rho r_{t-1} - \epsilon e_{t-1})\hat{\gamma}_t \tag{7}$$

By contrast and for simplicity, we assume that there is complete certainty with respect to the magnitude of the revenue and expenditure elasticities.

3.3. Revisions of the Overall Balance

This sub-section derives the effects of output level and growth revisions on the ability of the government to correctly project the overall balance which coincides with the ability of governments to meet a given target for the overall balance. The magnitude of the revision

[9] We implicitly assume that the government uses cash accounting. Under accrual accounting, this assumptions would not be reasonable.

of the overall budget balance in terms of GDP is the variable of interest and can be written as as the difference between the actual balance, (b/y), and the projected / targeted balance, $(\hat{b}/\hat{y})$, in t:

$$\left(\frac{b_t(\gamma_t)}{y_t} - \frac{\hat{b}_t(\hat{\gamma}_t)}{\hat{y}_t}\right) = \frac{b_t(\gamma_t)\hat{y}_t - \hat{b}_t(\hat{\gamma}_t)y_t}{y_t\hat{y}_t} \tag{8}$$

Equation (8) shows that we take into account another transmission channel through which inaccurate concurrent output estimates affect revisions of the budget balance, in contrast to existing papers. In addition to automatic changes in the budget induced by changes in output which the government estimates based on preliminary growth figures, we also consider the effects of revisions to the level of output. The underlying assumption here is that targets of the overall balance are typically expressed in terms of GDP. There is also another difference to Kempkes (2012): he assumes that the target of the overall balance itself is wrongly specified as a result of the forecast bias of output gap estimates, and then implicitly considers the revisions of the original target. By contrast, we essentially consider the deviations from a given (and implicitly correctly set target) using differences between predicted growth rates (and output levels) available at the time of budget preparation and final figures released ex-post.

Using $b = b_{-1} + \Delta b$ and $y_t = (1+\gamma_t)y_{t-1}$, (8) can be re-written as

$$\left(\frac{b_t}{y_t} - \frac{\hat{b}_t}{\hat{y}_t}\right) = \frac{(b_{t-1} + \Delta b_t)\hat{y}_t - (b_{t-1} + \Delta\hat{b}_t)y_t}{(1+\gamma_t)y_{t-1}\hat{y}_t} \tag{9}$$

$$= \frac{\Delta b_t - (1+\phi_t)\Delta\hat{b}_t}{(1+\gamma_t)y_{t-1}} - \frac{\phi_t}{1+\gamma_t}\cdot\frac{b_{t-1}}{y_{t-1}} \tag{10}$$

where $y_t = (1+\phi_t)\hat{y}_t$. Substituting for Δb and $\Delta\hat{b}$ using (4) and (7) yields

$$\left(\frac{b_t}{y_t} - \frac{\hat{b}_t}{\hat{y}_t}\right) = \frac{\gamma_t - \hat{\gamma}_t - \hat{\gamma}_t\phi_t}{1+\gamma_t}\cdot\left(\rho\frac{r_{t-1}}{y_{t-1}} - \epsilon\frac{e_{t-1}}{y_{t-1}}\right) - \frac{\phi_t}{1+\gamma_t}\cdot\frac{b_{t-1}}{y_{t-1}} \tag{11}$$

This expression represents the effects of output level and output growth revisions on revisions of the overall budget balance when expenditure and revenue streams of $t-1$ are certain and those of t are not observed. These revisions may either be positive implying that the final deficit is smaller than projected, or negative, implying that the final deficit is larger than projected.

3.4. Revisions of the Structural Balance

This sub-section derives the effects of output level, growth and gap revisions on the ability of the government to correctly report the structural balance in real time. We therefore further split the overall balance into the cyclical balance, $b^c(z)$, that depends on the cyclical position of the economy, and the structural balance, b^s, that depends on discretionary fiscal policy and coincides with the overall balance when $z = 0$. The structural balance cannot be observed and therefore must be calculated as a residual:

$$b_t^s(\gamma_t, z_t) = b_t(\gamma_t) - b_t^c(z_t) \tag{12}$$

Note that we assume that structural balance is both driven by output growth which affects the overall balance and by the output gap which affects the cyclical balance. Using (2) and (3), the cyclical balance can be expressed as

$$b_t^c(z_t) = z_t \cdot [\rho\, r_t(\gamma_t) - \epsilon\, e_t(\gamma_t)] \tag{13}$$

so that the structural balance is a function of γ *and* z. Changes in the growth rate γ induce automatic changes to public spending and revenue and thereby the overall balance, and changes in the gap z affect the cyclical balance.

The difference, as percentage of GDP, between the actual and the estimated structural balance can be written as

$$\left(\frac{b_t^s}{y_t} - \frac{\hat{b}_t^s}{\hat{y}_t}\right) = \left(\frac{b_t}{y_t} - \frac{\hat{b}_t}{\hat{y}_t}\right) - \left(\frac{b_t^c}{y_t} - \frac{\hat{b}_t^c}{\hat{y}_t}\right) \tag{14}$$

where the first difference on the RHS can be obtained from (11). The second difference on the RHS may be written as[10]

$$\left(\frac{b_t^c}{y_t} - \frac{\hat{b}_t^c}{\hat{y}_t}\right) = z_t \frac{\rho\, r_t - \epsilon\, e_t}{y_t} - \hat{z}_t \frac{\rho\, \hat{r}_t - \epsilon\, \hat{e}_t}{\hat{y}_t} \tag{15}$$

[10] From (15) to (16), we substitute for r, e, $\hat{r}$, and $\hat{e}$ using (2), (3), (5) and (6). From (16) to (17), we substitute for $y = (1 + \gamma_t)y_{t-1}$ and $\hat{y} = y_t/(1 + \phi_t)$.

$$
\begin{aligned}
&= z_t \frac{\rho\, r_{t-1}(1+\rho\,\gamma) - \epsilon\, e_{t-1}(1+\epsilon\,\gamma_t)}{y_t} \\
&\quad - \hat{z}_t \frac{\rho\, r_{t-1}(1+\rho\,\hat{\gamma}_t) - \epsilon\, e_{t-1}(1+\epsilon\,\hat{\gamma}_t)}{\hat{y}_t} \qquad (16) \\
&= z_t \frac{\rho\, r_{t-1}(1+\rho\,\gamma_t) - \epsilon\, e_{t-1}(1+\epsilon\,\gamma_t)}{(1+\gamma_t) y_{t-1}} \\
&\quad - \hat{z}_t \frac{\rho\, r_{t-1}(1+\rho\,\hat{\gamma}_t) - \epsilon\, e_{t-1}(1+\epsilon\,\hat{\gamma}_t)}{(1+\gamma_t) y_{t-1}} (1+\phi_t) \qquad (17)
\end{aligned}
$$

Equation (14), together with (11) and (17), represents the magnitude of the revision of the structural balance that is required due to output data revisions. Again, these equations are based on the simplifying assumption that expenditure and revenue flows in $t-1$ are observed towards the end of $t-1$ when the projections are made. As a consequence towards the end of period t, b_t is known (as expenditure and revenue streams are known) so that $b_t = \hat{b}_t$. This implies that revisions of estimates of b_t^s made towards the end of t are only driven by revisions of z_t and y_t. Based on (14) and (15), revisions of estimates of the structural balance made towards the end of period t can therefore be written as

$$
\left(\frac{b_t^s}{y_t} - \frac{\hat{b}_t^s}{\hat{y}_t} \right) = b_t \left(\frac{1}{y_t} - \frac{1}{\hat{y}_t} \right) - (\rho\, r_t - \epsilon\, e_t) \left(\frac{z_t}{y_t} - \frac{\hat{z}_t}{\hat{y}_t} \right) \qquad (18)
$$

3.5. Debt Accumulation as a Result of Output Data Revisions

This sub-section examines the implications of output data revisions for debt accumulation over time. Mistakes in budgetary planning due to output data revisions have consequences for the level of public debt: unplanned debt accumulation (reduction) occurs if the planned balance exceeds (is below) the actual balance. In contrast to revisions of the overall balance, actual debt accumulation is not driven by the unit of measurement, *i.e.*, revisions to the level of GDP do not matter. By contrast, for the purpose of budgetary planning and fiscal surveillance, fiscal balances are mostly expressed in terms of GDP.

The change in debt due to output data revisions is simply $(\hat{b}_t(\hat{\gamma}_t) - b_t(\gamma_t))$. If the latter expression is positive, the stock of debt increases; in the opposite case, the level of debt falls. The change in the level of debt resulting from n of these revisions after period t_0, ΔD_{t_0+n}, expressed for convenience in terms of final GDP of the nth period, is

$$\frac{\Delta D_{t_0+n}}{y_{t_0+n}} = \frac{1}{y_{t_0+n}} \sum_{s=1}^{n} (\hat{b}_{t_0+s} - b_{t_0+s}) \tag{19}$$

Using (2), (3), (5), (6) to substitute for r_t, e_t, $\hat{r}_t$, and $\hat{e}_t$, respectively, yields

$$\frac{\Delta D_{t_0+n}}{y_{t_0+n}} = \frac{1}{y_{t_0+n}} \sum_{s=1}^{n} [(\rho r_{t_0+s-1} - \epsilon e_{t_0+s-1})(\hat{\gamma}_{t_0+s} - \gamma_{t_0+s})] \tag{20}$$

Using $y_{t_0+n} = y_{t_0+n-1}(1 + \gamma_{t_0+n})$ to express the latter expression in terms of r_{t-1}/y_{t-1} and e_{t-1}/y_{t-1} where $t = 1 \ldots n$ to facilitate the numerical simulation in the next section yields

$$\frac{\Delta D_{t_0+n}}{y_{t_0+n}} = \sum_{s=1}^{n} \left[\left(\rho \frac{r_{t_0+s-1}}{y_{t_0+s-1}} - \epsilon \frac{e_{t_0+s-1}}{y_{t_0+s-1}} \right) \cdot \frac{\hat{\gamma}_{t_0+s} - \gamma_{t_0+s}}{\prod_{k=1+s}^{n} (1 + \gamma_{t_0+k})} \right] \tag{21}$$

Whether over time debt increases or not is an empirical matter and driven by the nature of output data revisions, in particular the revisions of growth rates, which we turn to below.

4. Simulation

4.1. Parameters

This section assesses numerically the effects of output data revisions on revisions of the overall balance, revisions of the structural balance based and on unplanned debt accumulation or reduction. From equations (11), (14) and (21), this type of exercise requires assumptions about a few structural parameters including the magnitude of the overall balance, cyclical elasticities of revenue and expenditure, and revenue and expenditure shares in GDP. We obtain country-specific values on output level, output growth and output gap revisions for which we obtain country-specific values from our dataset (we generate output level revisions using the data on output growth revisions).

Unfortunately, reliable estimates of revenue and expenditure elasticities are scarce, notably for developing countries. In order to address this problem, we proceed as follows. For each of the four parameters and for each country group, we set lower and upper bounds.

We then assume that the parameters are equally distributed within this range (although later, we relax this assumption and we draw from a triangular distribution as a robustness check), and then draw values for each parameter and each country group 1,000 times. Note that for each draw, the resulting parameter values are identical across all countries within each country group contrary to the information on output data revisions for which we have annual country-specific observations.

With respect to the elasticities, expenditure elasticities are proportionally related to the level of income, given that social transfers are low or non-existent in many developing countries (Berg *et al.* , 2009). By contrast, the differences in terms of revenue elasticities between country income groups can be expected to be smaller because direct and indirect taxes always respond to changes in income, although administrative difficulties to exploit the full potential tax base in developing countries weaken the link between income and tax revenue.

There are a few papers available that present estimates. Girourard and André (2005) is the standard reference for OECD countries. For revenue elasticities in high-income OECD countries, their estimates range from 1.10 to 1.42. From this group of countries, we exclude Slovakia, Czech Republic, and Greece which are now classified as high-income countries but were likely to share critical features of middle-income economies in past at the time from which most of the data come that was used to estimate elasticities. In the latter group of countries, the estimates of Girourard and André (2005) range from 1.01 to 1.29. For expenditure elasticities in high-income OECD countries (other OECD countries), their estimates range from -0.23 to -0.02 (from -0.06 to -0.02). In Brücker (2012) who uses a novel instrument to estimate revenue elasticities in sub-Saharan countries the range is from 0.48 to 2.7. Berg *et al.* (2009) estimate that the elasticity of the overall budget is 0.2 for sub-Saharan countries. Finally, Martner (2006) estimates revenue elasticities for a number of Latin American countries which are probably somewhat representative for middle-income countries. The range is from 0.31 to 1.95. IMF (2009) makes the assumption that the revenue and expenditure elasticities for middle-income G-20 countries not covered by Girourard and André (2005) are one and zero, respectively, which provides additional guidance for our purposes.

We use these ranges as guidance for our simulation. However, the evidence base is sketchy, and the literature does not provide representative estimate ranges for the lower and upper bounds for each income group. We therefore have to make in part our own assumptions. We also adjust the ranges in a way that excludes the possibility to draw extreme values which would potentially inflate the size of fiscal revisions that we obtain. For instance, we consider the upper estimate by Brücker (2012) as unrealistically high. The ranges that we employ are summarized in Table 3.

Table 3. Ranges of parameter values for the simulations

	r/y		b/y		ρ		$\|\epsilon\|$	
Country Group	min	max	min	max	min	max	min	max
High income: OECD	0.25	0.55	-0.10	0.05	0.90	1.20	0.30	0.02
High income: nonOECD	0.20	0.50	-0.10	0.05	0.80	1.10	0.25	0.01
Upper middle income	0.15	0.40	-0.10	0.05	0.70	1.00	0.10	0.05
Lower middle income	0.10	0.30	-0.10	0.05	0.60	0.90	0.05	0.00
Low income	0.10	0.20	-0.10	0.05	0.60	0.80	0.00	0.00
All countries	0.10	0.55	-0.10	0.05	0.60	1.20	0.00	0.30

Source: based on own assumptions

We apply a similar procedure to obtain revenue and expenditure shares which are likewise not available for many country-year observations included in our dataset. We therefore assume a lower and upper bound for each country group and assume a uniform distribution. However, in contrast to elasticities, we do not draw revenue and expenditure shares independently which may result in unrealistic budget balances. Rather, we draw the revenue share and the overall balance and then compute the expenditure share. Table 3 summarizes the assumptions with respect to the range of each parameter and each country group. As a robustness check, we assume a triangular distribution which puts less weight on the extreme parameter values.

4.2. Results

What are the implications of inaccurate real-time output data for fiscal policy? Assume that the government is targeting a specific deficit/surplus, but that the information on the level of economic activity is uncertain and subject to revisions such as the ones reported in

Section 2, for each country-year observation in our sample. Assume further a distribution of the values of the revenue and expenditure elasticities as well as revenue and expenditure shares as described in the previous subsection. Drawing country group-specific values of these parameters for each country-year observation 1,000 times (so that values are always identical per draw within one country group) and calculating the revisions of the overall balance and the structural balance in each case according to equations (11) and (14) results in the data underlying Tables 4 and 5.

Table 4 presents descriptive statistics of the revisions of the overall balance. Overall, as positive and negative revisions tend to cancel each other out, the mean across all country groups is near zero. By contrast, the distribution of these revisions is widely dispersed: in 20% of the cases, that is below the 10th and above the 90th percentiles, the revision in absolute terms is at least 1.20% of GDP. The results show that if a government targets a deficit of 3% of GDP for instance, the chances are 10% that the deficit is indeed above 4.26% and 10% that the deficit is indeed below 1.80%. Both cases are significant deviations from the original target and are likely to represent significant policy challenges. These results appear to be consistent with existing evidence: using data from the WEO from 2002 to 2007, Cebotari et al. (2009) report that the 10th percentile of revisions of the overall balance is 1.7% across all countries. This implies that the simulated revisions of the overall balance are smaller than observed revisions which makes sense, given that in practice, other factors contribute to fiscal data revisions as well whereas we only consider output data revisions.

The revisions of the overall balance are a result of the nature of the output data revisions and the nature of elasticities where both larger output data revisions and larger elasticities imply larger revisions of the overall balance. As a result, there is also heterogeneity across country groups. Revisions of the overall balance are largest in high-income countries which are not members of the OECD. One underlying reason is that in these countries, revisions of growth rates are fairly large as a number of countries in this group are major exporters of oil and other natural resources whose prices are difficult to predict. In addition, given the stage of development, revenue and expenditure elasticities are likewise relatively large.

In upper-middle income countries, the dispersion as measured by the 10th and 90th percentiles is likewise relatively large, which is due to relatively large elasticities and significant output data revisions. By contrast, while real-time output data are also inaccurate in low-income countries, revenue and expenditure elasticities are likewise low implying that output data revisions do not translate into large revisions of the overall budget.

Table 4. Revisions of the overall balance, % of GDP

(169 countries: 1991-2007; $N = 2621000$)

	Percentiles					Moments	
Country Group	10	25	50	75	90	Mean	StDev
High income: OECD	-1.18	-0.48	0.07	0.61	1.18	0.01	1.20
High income: nonOECD	-1.84	-0.69	0.21	1.05	2.25	0.16	2.24
Upper middle income	-1.57	-0.61	0.05	0.69	1.37	-0.04	1.42
Lower middle income	-0.96	-0.36	0.02	0.39	1.03	0.08	1.36
Low income	-1.17	-0.48	-0.06	0.26	0.75	-0.16	0.92
All countries	-1.26	-0.48	0.02	0.52	1.20	-0.00	1.39

Source: WEO data and own compilation

Table 5 presents descriptive statistics of the revisions of the structural balance by country group in percent of GDP. Here, the picture is similar compared to Table 4. While revisions of the structural balance are also driven by revisions of the output gap, the mean and the dispersion of these revisions are not systematically larger than revisions of the overall balance. Indeed, the dispersion of revisions as measured by the 10th and the 90th percentiles of the structural balance across all countries is slightly smaller than the dispersion of revisions of the overall balance. This suggests that revisions of the output gap and of output growth may in some cases have different signs so that they cancel each other out, at least to some extent, and that growth revisions appear to be relatively more important for fiscal projections. There is a similar pattern of heterogeneity across country groups with high-income countries that are not members of the OECD and upper-middle incomes showing the largest dispersion of revisions of the structural balance, whereas low-income and lower-middle income countries showing the smallest dispersion.

As a final step, Table 6 translates the revisions of the overall balance into debt accumulation over a 10-year period. We proceed as follows: based on the dataset with 1,000 country group-specific parameter draws for each country-year observation, we draw all parameters

Table 5. Revisions of the structural balance, % of GDP

(169 countries: 1991-2007; $N = 2621000$)

	Percentiles					Moments	
Country Group	10	25	50	75	90	Mean	StDev
High income: OECD	-1.22	-0.58	-0.04	0.49	1.04	-0.07	1.02
High income: nonOECD	-1.53	-0.63	0.21	1.08	2.28	0.30	2.06
Upper middle income	-1.47	-0.65	-0.02	0.59	1.27	-0.07	1.25
Lower middle income	-0.89	-0.38	-0.03	0.37	1.00	0.06	1.33
Low income	-1.10	-0.51	-0.09	0.22	0.70	-0.18	0.86
All countries	-1.20	-0.52	-0.03	0.46	1.14	-0.02	1.28

Source: WEO data and own compilation

and output data revisions 10 times for each country group to calculate debt accumulation over a 10-year period using equation (21). We repeat this procedure 1,000 times.

Table 6 presents the change of government debt in percent of GDP. Compared to Table 4, the dispersion and the mean across all countries is significantly larger (note that whereas in Table 4, a positive sign denotes a surplus, in Table 6, a positive sign refers to increases in the stock of public debt). In 10% of the cases (*i.e.*, above the 90th percentile), the increase of the stock of debt is at least 3.17% of GDP, whereas in 10% of the case (*i.e.*, below the 10th percentile), the decrease of the stock of debt is at least 4.26% of GDP. While these changes of debt may appear to be small, they are nevertheless significant given that they are solely due to missing deficit or surplus targets as a result of inaccurate real-time output growth figures.

There is again heterogeneity across country groups. This time, the 90th percentile in high-income countries and upper-middle income countries is largest across all country groups suggesting that here, the risk of unwanted debt accumulation is largest. By contrast, relatively large surprise debt reductions may also occur: in high-income countries that are not members of the OECD, in 10% of the cases, a surprise debt reduction is at least 8.52% of GDP. The possibility of a surprise debt reduction tends to be lowest in low-income countries where in only 10% of the cases, such a debt reduction is above 0.94% of GDP.

Table 6. Debt accumulation over 10 years, in % of the 10th period's GDP

(169 countries: 1991-2007; $N = 50000$)

	Percentiles					Moments	
Country Group	10	25	50	75	90	Mean	StDev
High income: OECD	-3.96	-2.18	-0.26	1.63	3.78	-0.13	3.17
High income: nonOECD	-8.52	-5.27	-2.49	0.44	2.90	-2.66	4.60
Upper middle income	-3.88	-1.97	-0.06	2.03	4.42	0.16	3.26
Lower middle income	-1.98	-0.93	0.18	1.21	2.23	0.13	1.73
Low income	-0.94	-0.07	0.88	1.90	2.98	0.97	1.57
All countries	-4.26	-1.88	-0.01	1.54	3.17	-0.31	3.31

Source: WEO data and own compilation

4.3. Robustness Checks

We perform three robustness checks to test how vulnerable the magnitude and the dispersion of the revisions of the overall and structural balances are to our assumptions. First, in Tables 7 and 8, instead of using previous-year fall output data, we use same-year spring estimates to compute the revisions of the overall budget and the structural balance. This allows us to also include 1990 for which only same-year estimates are available. Here, the rationale for the virtual experiment is that the government could make use of more recent and hence more up-to-date output information released relatively early in the current fiscal year when corrective actions to the budget may still be feasible. For simplicity, we still maintain the assumptions that revenue and expenditure streams of $t-1$ are observed whereas those of t are not observed. However, our results suggest that even with same-year spring-WEO output data, the dispersion of the revisions of the overall budget balance and the structural balance remain large: in particular, in 20% of the cases, the revisions are above 1% of GDP in both cases. The dispersion slightly decreases.

Second, and similarly, we use same-year fall-WEO output data available for 1990 to 2007 to compute revisions of the structural balance according to (18) in Table 9. According to our (simplifying) assumptions, towards the end of any period t, expenditure and revenue streams of that period are known so that at this point in time, $\hat{b}_t = b_t$. Revisions of the structural balance fall, but they still remain large. In more than 20% of the cases, revisions exceed 0.74% of GDP.

As a third robustness check, we test whether our results are driven by extreme values of

Table 7. Revisions of the overall balance, in % of GDP, same-year spring output data

(169 countries: 1990-2007; $N = 2791000$)

	Percentiles					Moments	
Country Group	10	25	50	75	90	Mean	StDev
High income: OECD	-0.77	-0.31	0.19	0.65	1.14	0.15	1.01
High income: nonOECD	-1.65	-0.54	0.25	1.07	2.14	0.21	2.27
Upper middle income	-1.32	-0.50	0.09	0.65	1.38	0.05	1.29
Lower middle income	-0.87	-0.31	0.03	0.39	1.00	0.10	1.26
Low income	-1.01	-0.40	-0.04	0.26	0.73	-0.11	0.89
All countries	-1.06	-0.38	0.05	0.53	1.19	0.06	1.31

Source: WEO data and own compilation

Table 8. Revisions of the structural balance, in % of GDP, same-year spring output data

(169 countries: 1990-2007; $N = 2791000$)

	Percentiles					Moments	
Country Group	10	25	50	75	90	Mean	StDev
High income: OECD	-1.07	-0.48	0.06	0.56	1.09	0.00	1.03
High income: nonOECD	-1.50	-0.61	0.24	1.08	2.22	0.30	2.07
Upper middle income	-1.36	-0.58	0.00	0.59	1.28	-0.04	1.23
Lower middle income	-0.88	-0.34	-0.02	0.36	0.95	0.06	1.24
Low income	-1.00	-0.46	-0.09	0.21	0.67	-0.16	0.85
All countries	-1.12	-0.46	-0.01	0.47	1.13	0.01	1.25

Source: WEO data and own compilation

Table 9. Revisions of the structural balance, in % of GDP, same-year fall output data

(169 countries: 1990-2007; $N = 2639000$)

	Percentiles					Moments	
Country Group	10	25	50	75	90	Mean	StDev
High income: OECD	-0.85	-0.44	-0.06	0.28	0.63	-0.08	0.70
High income: nonOECD	-1.23	-0.56	-0.05	0.46	1.12	-0.07	1.48
Upper middle income	-0.97	-0.45	-0.03	0.34	0.84	-0.04	0.88
Lower middle income	-0.64	-0.25	-0.02	0.24	0.69	0.05	1.19
Low income	-0.73	-0.33	-0.04	0.21	0.61	-0.07	0.66
All countries	-0.85	-0.37	-0.03	0.28	0.74	-0.03	0.99

Source: WEO data and own compilation

the revenue and expenditure elasticities and shares in GDP. Instead of assuming a uniform parameter distribution, we assume a triangular distribution function which places less emphasis on the extreme parameter values, *i.e.*, the lower and upper bounds. Compared to Tables 4 and 5, the results of Tables 10 and 11 hardly change suggesting that our main results are not driven by extreme draws from the tails.

Table 10. Revisions of the overall balance, in % of GDP, triangular distribution

(169 countries: 1991-2007; $N = 2634000$)

	Percentiles					Moments	
Country Group	10	25	50	75	90	Mean	StDev
High income: OECD	-1.15	-0.48	0.08	0.62	1.14	0.01	1.17
High income: nonOECD	-1.93	-0.71	0.23	1.07	2.17	0.14	2.22
Upper middle income	-1.57	-0.64	0.07	0.72	1.38	-0.04	1.40
Lower middle income	-0.98	-0.38	0.03	0.42	1.02	0.06	1.21
Low income	-1.21	-0.49	-0.07	0.25	0.69	-0.19	0.89
All countries	-1.27	-0.50	0.03	0.54	1.18	-0.01	1.33

Source: WEO data and own compilation

Table 11. Revisions of the structural balance, in % of GDP, triangular distribution

(169 countries: 1991-2007; $N = 2634000$)

	Percentiles					Moments	
Country Group	10	25	50	75	90	Mean	StDev
High income: OECD	-1.22	-0.60	-0.04	0.48	0.99	-0.08	1.00
High income: nonOECD	-1.58	-0.66	0.23	1.10	2.23	0.30	2.00
Upper middle income	-1.47	-0.67	-0.01	0.62	1.27	-0.08	1.23
Lower middle income	-0.90	-0.41	-0.03	0.39	0.98	0.04	1.17
Low income	-1.11	-0.52	-0.10	0.19	0.63	-0.20	0.82
All countries	-1.20	-0.54	-0.04	0.46	1.11	-0.03	1.21

Source: WEO data and own compilation

As a final exercise, we empirically analyze more in depth the drivers of our results, *i.e.*, the role that different factors play for the magnitude and nature of the overall balance and structural balance revisions, using basic OLS regressions. To this end, we standardize the absolute value of the revisions of the overall and the structural balance and the variables and parameters that affect them, including the output growth, gap and level revisions, $(\gamma - \hat{\gamma})$, ϕ, and $(z - \hat{z})$, respectively, and of revenue and expenditure elasticities and shares in GDP, as a means, although an imperfect one, to linearize equations (11) and (14).

Table 12 presents the results. It shows that revisions of output growth, the level of output have a relatively large effect on the overall balance. With respect to the structural balance, these revisions together with revisions of the output gap are important relative to the remaining coefficients. The results further suggest that the expenditure elasticity, the revenue elasticity, and the share of expenditure in GDP hardly play any role for our results. The share of revenue in GDP lies somewhere in between these extremes, but the revenue elasticity appears to be also less important.

Table 12. Determinants of the revisions of the overall and the structural balances

	log of standardized absolute value of:	
	$[b/y - \hat{b}/\hat{y}]$	$[b^s/y - \hat{b}^s/\hat{y}]$
Constant	0	0
	(0)	(0)
$\gamma - \hat{\gamma}$	.499***	.354*
	(0)	(0)
ϕ	.487***	.518*
	(0)	(0)
ϵ	.035***	.019*
	(.001)	(.001)
ρ	.054***	.046*
	(.001)	(.001)
$\frac{r}{y}$	.182***	.172*
	(.001)	(.001)
$\frac{e}{y}$	.03***	.03*
	(.001)	(.001)
$z - \hat{z}$		.028*
		(0)

Standard errors in parentheses.

*$p < 0.01$

Standardized absolute value of all variables have been used

5. Conclusions

The difference between real-time GDP projections and the final figures released a few years later impairs the ability of policy makers to correctly project fiscal revenues and expenditures in real time, which, in turn, results in revisions of the overall and the structural fiscal balances. We develop a comprehensive theoretical framework that considers three transmission channels through which output data revisions matter for fiscal policy in practice, namely through (i) revisions to estimates of GDP growth which matter given that tax revenue and public spending automatically respond to changes in economic activity, (ii) revisions to the level of GDP which matter given that fiscal balances are typically reported as shares of GDP, and (iii) revisions to output gaps which matter for decompositions of overall balances into the cyclical and structural balances.

Our simulation results with respect to the magnitude of the revisions of the overall balance and the structural balance may be regarded as a lower bound because we eliminated outliers from the WEO data, and we excluded the recent period of global economic turmoil where output data revisions may have been particularly large. We also took care not to consider extreme values of revenue and expenditure elasticities, and we assumed that previous-year expenditure and revenue are observable at the time when the budget is prepared, or when the structural balance is estimated. Nevertheless, even under these assumptions, our simulation results suggest that revisions of the overall and the structural balance may be substantial and above 1 percent of GDP in absolute terms in more than one-fifth of the cases. These results are fairly robust to various changes in the underlying assumptions. Chances are similar that as a result of these revisions of the overall balance, unplanned debt accumulation or a surprise debt reduction over a period of 10 years of above 3.17 percent of GDP occurs. We have also explored differences between country income groups and found that they are significant. Our results with respect to the simulated overall balance appear to be consistent with evidence on actual revisions of the overall balance provided by Cebotari *et al.* (2009).

Future research could address various immediate extension of this paper: on the one hand, our model predictions with respect to the revisions of the overall balance as a function of output data revisions could be compared with actual revisions of fiscal indicators. Alternatively, our modeling framework could be extended to consider uncertainty about the exact magnitude of revenue and expenditure elasticities. For instance, when predicting the budget balance, governments could wrongly estimating these elasticities in addition to relying on potentially inaccurate output data. These model extensions would be likely to inflate simulated values of balance revisions, but at the same time, it would make our model more realistic.

The results presented here have important policy implications. On the one hand, they caution about taking real-time estimates about the structural balance for the purpose of fiscal surveillance at face value and suggest that they may be wrong by significant margins. On the other, the results suggest that in the context of budgetary planning, governments should take into account that they may miss fiscal targets due to output data revisions. This in turn implies that governments may set targets in a way that encompasses safety margins to reflect for instance the possibility that growth estimates are significantly revised. The results of this paper provide guidance about how to set such safety margins based on past experience. The bottom line of the paper is that, in real time, the overall and structural balances should be better considered as *known unknowns* instead of wishfully being treated as *known knowns* fiscal indicators.[11] What *you do not know* that *you do not know* may be sometimes more important that what you certainly know.

[11] U.S. Secretary of Defense, Donald Rumsfeld, insightfully remarked: “There are *known knowns*: there are things we know that we know. There are *known unknowns*: that is to say there are things that, we now know we don’t know. But there are also *unknown unknowns*: there are things we do not know we do not’t know.”

6. References

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