Forecasts in Times of Crises*

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August 16, 2017

Abstract. We assess the quality of IMF forecasts in times of crises, which pose unique challenges for forecast accuracy. Using the Monitoring of Fund Arrangement (MONA) database in the most comprehensive evaluation of forecasts in countries under IMF financial programs to date, we examine 29 macroeconomic variables in terms of bias, efficiency, and information content. We find that IMF forecasts add substantial informational content, as they consistently outperform naive forecast approaches. However, we also show that there is room for improvement in the forecasts as about half of these variables exhibit downward bias, and about two thirds suffer from inefficiency. One of the main drivers of forecast bias and inefficiency comes from the low-income countries sample reflecting perhaps larger shocks and lower-quality data. When we decompose the sources of forecast errors for several key macroeconomic aggregates it is shown that forecast errors for private consumption growth are the key contributor to forecast errors in GDP growth, while forecast errors for non-interest expenditures and non-tax revenues are the most important determinants of fiscal budget forecast errors. Lastly, balance of payments forecast errors are only significantly influenced by forecast errors for the growth rate of goods imports.

JEL Classification : C53, C55, F30, F47.
Keywords: Forecasting, IMF Programs, GDP Growth, Balance of Payments, Financial Accounts, Fiscal Accounts.

* We thank Andy Berg, Neil Ericsson, and Prakash Loungani for their valuable comments. We are particularly grateful to Herman Stekler who served as the discussant of this paper at the conference on *Forecasting Issues in Developing Economies* held at the IMF in April 2017 for his detailed and extremely constructive suggestions. Eicher thanks the IMF Institute for Capacity Development for its hospitality and financial support. Kuenzel thanks the IMF Research Department for its hospitality and financial support. Papageorgiou acknowledges support by the U.K.'s Department for International Development (DFID). The views expressed in this study are the sole responsibility of the authors and should not be attributed to the International Monetary Fund, its Executive Board, or its management.
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"A crisis is a terrible thing to waste."
—Paul Romer, 2004[1]

1. Introduction

Macroeconomic forecasts are hampered by three main sources of uncertainty: model uncertainty (the true model is unknown), parameter uncertainty (even when the model is known), and data uncertainty (systematic variations in data generating processes of underlying fundamentals). All forecast errors are exacerbated in times of crises, leading critics to lament that "there is almost no chance that the economists have simply been unlucky; they fundamentally overstate the reliability of their [GDP] predictions" (Silver, 2012). If inaccurate forecasts in times of crises are indeed the rule and not the exception in economics, the profession's ability to provide policy support is limited precisely at times when decisive policy guidance and actions are most required.

In this paper, we assess the accuracy of macroeconomic forecasts for countries that require financial support from the IMF, serving as the lender of last resort, in order "to create breathing room as [countries] implement policies to restore economic stability and growth" (IMF, 2016a). We focus on accounting identities that allow us to rule out model and parameter uncertainty, and identify the data uncertainties that contribute to IMF forecast errors of key economic variables during times of crises. We assess forecasts by employing three different measures: (i) *bias* (deviations of forecasts from realizations), (ii) *efficiency* (do forecasts contain all information available at the time of forecasts to render forecast errors unpredictable), and (iii) *information content* (do forecasts offer valuable information by outperforming naive forecasting models).

Previous studies of crisis forecasts focus largely on bias and program conditionality. We extend the analysis in four dimensions. First, we utilize the regression approach by Mincer and Zarnowitz (1969) to examine forecast bias and efficiency over a much large number of key economic variables to assess if the forecasts are optimal, i.e. unbiased and efficient. Second, our study is the first to examine the information content of IMF forecasts by identifying whether they outperform naive forecast models of directional changes (see Merton, 1981, Henriksson and Merton, 1981, and Schnader and Stekler, 1990). Third, we evaluate IMF crisis forecasts of 29 macroeconomic variables, and not only output and current account forecasts that were the focal

[1] Quotation attribution from Rosenthal (2009).

points of most prior studies. Fourth, our paper is the first to decompose the forecast errors for GDP, the balance of payments and fiscal accounts to identify which subcomponents require particular attention to improve future IMF forecasts (see, for instance, Sinclair and Stekler (2013) who highlight the importance of the quality of GDP component estimates for GDP forecasts).

Our main findings are threefold: First, we show that for nearly all variables IMF forecasts contain substantial informational value relative to naive forecasting models. Exceptions include the forecasts for inflation, government expenditure growth and net income growth, most likely because these variables tend to trend consistently in one direction for program countries.

Second, IMF growth forecasts of some key macroeconomic aggregates are subject to biases and/or inefficiencies in the global sample of program countries. Specifically, IMF forecasts of GDP, the current account and government revenues are all subject to a downward bias, perhaps reflecting a conservative approach to lending by the IMF during times of crises. On the upside, growth forecasts of prices, the financial account and all its subcomponents as well as government revenues are forecast without bias. On another positive note, we also find that IMF forecasts of key crisis recovery measures, such as nominal GDP and government revenue growth, are efficient even in the presence of bias. When separately examining crisis forecasts for Low-Income Countries (LICs) and Non-low-Income Countries (Non-LICs), IMF forecasts in LICs are shown to be substantially more biased and less efficient, perhaps due to data and information challenges in these countries during times of crisis.

Third, we decompose the forecast errors of key macroeconomic aggregates to identify their determinants based on accounting identities. GDP growth forecast errors are shown to be significantly affected by forecast errors in all of its major subcomponents (government, consumption, investment, net exports), but private consumption growth is by far the most important contributor. For fiscal budget forecasts, errors are driven by the growth rates of non-interest/net-lending expenditures, tax/non-tax revenues, and grants. Forecast errors for the balance of payments, on the other hand, can mostly not be linked to forecast errors in its subcomponents.

Previous evaluations of crisis forecasts focus squarely on bias and program conditionality. Ghosh et al. (2005) examine forecasts of key macroeconomic variables in program countries and find that IMF short-run forecasts do not exhibit any systematic biases. Their analysis does not track the sources of forecast errors. Baqir et al. (2005) analyze IMF forecasts of GDP growth, inflation, the current account and the fiscal balance to find systematic forecast errors for growth and inflation without identifying the underlying causes. Luna (2014) finds that IMF crisis forecasts for GDP growth and inflation are upward biased for program countries with "exceptional access" to Fund resources, while current account and government budget forecasts exhibit downward bias (without identifying the sources of the bias). Atoyan et al. (2004) and Atoyan and Conway (2011) also find substantial bias in fiscal and current account forecasts, and identify the IMF forecast model and poor measurement of initial conditions as major contributors to forecast bias in crisis countries.[2]

The remainder of the paper is structured as follows. Section 2 lays out how to forecast the growth rates of macroeconomic aggregates based on their individual subcomponents. Section 3 presents our approach to evaluating IMF forecasts for countries during times of crises. Section 4 discusses the data, and Section 5 reports our main results. Section 6 concludes and highlights the policy relevance of our findings.

2. Forecasting Based on Macroeconomic Identities

Our forecast models are motivated by macroeconomic identities. Specifically, we focus below on macroeconomic identities that are fundamental for structuring and assessing the success of IMF programs: aggregate demand, the balance of payments, and fiscal accounts. Our general focus in this paper is on forecasting the growth rates of nominal variables, since deflators are often non-uniform across countries, which would introduce confounding errors. Examining growth rates also allows us to circumvent potential issues relating to changes in currency denominations or unit changes that are frequently encountered during times of crisis.

[2] Other earlier studies of IMF forecast performance in crisis countries have a much narrower focus in terms of: (i) included variables, (ii) samples of included program countries, and (iii) time periods under consideration. See, e.g., Goldstein (1986), Musso and Phillips (2002), and Golosov and King (2002). Several studies also consider whether early data releases provide sufficiently accurate information about the state of the economy, especially prior to and during recessions. See, e.g., Dynan and Elmendorf (2001), Joutz and Stekler (1998), McNees (1986), and Swanson and van Dijk (2006).

We start with aggregate demand. According to IMF (2007), the national income identity for an open economy decomposes nominal GDP, *Y*, into final private and public consumption (C_p, C_g), private and public investment (I_p, I_g), and imports and exports (M, X):

$$Y = C_p + C_g + I_p + I_g + X - M \,. \tag{1}$$

Totally differentiating (1) yields:

$$y = \sigma_{y,c_p} c_p + \sigma_{y,c_g} c_g + \sigma_{y,i_p} i_p + \sigma_{y,i_g} i_g + \sigma_{y,x} x - \sigma_{y,m} m \,, \tag{2}$$

where small letters indicate growth rates and $\sigma_{i,j}$ represent elasticities. For instance, σ_{y,c_p} measures the percentage change in GDP growth due to a percentage change in private consumption growth.

Next, we consider the balance of payments (BOP), a variable of key interest as most IMF programs take place in countries that face foreign exchange reserve shortages generated by current account or financial flow deficits. We investigate the current and financial accounts separately to capture the potentially distinct impacts of international income and capital transactions. Using the IMF's (2015) decomposition of the current account, we obtain the following growth rate identity:

$$ca = \sigma_{ca,x_g} x_g + \sigma_{ca,x_s} x_s - \sigma_{ca,m_g} m_g - \sigma_{ca,m_s} m_s + \sigma_{ca,ni} ni + \sigma_{ca,nt} nt \,, \tag{3}$$

where *ca* is the current account growth rate, x_g and x_s are the growth of goods and services exports, respectively, and m_g and m_s are the corresponding measures for imports. *ni* and *nt* capture the growth in net income and net transfers of a country with the rest of the world.

Similarly, following again the IMF's (2009) official definition, the growth in the financial account (*fa*) is given by:

$$fa = \sigma_{fa,fdi} fdi + \sigma_{fa,pi} pi + \sigma_{fa,res} res + \sigma_{fa,ot} ot \,, \tag{4}$$

which is decomposed into the contributions of the growth rates in net foreign direct investment (*fdi*), net portfolio investment (*pi*), reserve assets (*res*), and other investment (*ot*).

Finally, as government budgets are a crucial element in evaluating the sustainability of IMF programs and countries' recoveries, we consider the IMF's (2014) official breakdown for both government expenditures and revenues:

$$gx = \sigma_{gx,\mathrm{int}} \mathrm{int} + \sigma_{gx,n\mathrm{int}} n\mathrm{int} + \sigma_{gx,cap} cap \tag{5}$$

$$gr = \sigma_{gr,tax} tax + \sigma_{gr,ntax} ntax + \sigma_{gr,grt} grt \ , \tag{6}$$

where government expenditure growth (*gx*) is decomposed into the growth rates of interest expenditures (*int*), non-interest expenditures (*nint*), and outlays on capital expenditure and net lending (*cap*). Similarly, government revenue growth (*gr*) can be decomposed into the growth rates of tax revenue (*tax*), non-tax revenue (*ntax*), and grants (*grt*).

Having discussed the growth rate decompositions of aggregate demand, the balance of payments, and fiscal revenues and expenditures, the next section lays out how we can evaluate IMF forecasts of these macroeconomic identities.

3. Methodology: Evaluating IMF Forecasts

To assess the accuracy of IMF forecasts, we rely on two complementary approaches frequently employed in the literature: Mincer-Zarnowitz regressions and Merton-Henriksson type timing tests. The Mincer-Zarnowitz regressions link actual (A_t) and forecasted ($F_{t,t-1}$) values for time *t* as follows:[3]

$$A_t = \alpha + \beta F_{t,t-1} + \varepsilon_t \ , \tag{7}$$

where the forecast is conditional on information available at time *t-1*. An unbiased and efficient forecast should generate coefficient values of $\alpha = 0$ and $\beta = 1$, respectively. Therefore, we implement below an F-test of this joint null hypothesis, with rejection indicating that forecasts are either biased and/or inefficient.

The Merton-Henriksson timing tests were originally designed by Merton (1981) and Henriksson and Merton (1981) to examine whether market-timing forecasts of asset returns add informational value. This methodology was adapted to macroeconomic variables by Schnader

[3] For applications of this methodology, see, for example, Sinclair et al. (2008, 2010).

and Stekler (1990) who introduced a 2 x 2 contingency table to determine whether the forecasts are independent of the observed events. Figure 1 below illustrates the general idea, where N1 (N2) captures the number of observed positive (zero or negative) changes, while n1 (n2) is the number of correct (incorrect) positive forecasts. To evaluate the IMF's performance in forecasting an economic variable, we consider how frequently the direction of the actual change is successfully forecast. Using a χ^2 test, we can formally test the null hypothesis that the observed events are independent of the forecasts.[4] In case of a rejection, the forecasts contain informational value.

Figure 1: Forecasts versus Actual Changes

	Actual > 0	**Actual ≤ 0**	
Forecast > 0	n1	n2	N
Forecast ≤ 0	N1-n1	N2-n2	N-n
	N1	N2	N

In a third step, we examine the sources of IMF forecast errors for key variables in crisis countries. Specifically, we consider to what extent forecast errors in subcomponents are responsible for forecast errors of the different macroeconomic aggregates outlined above. This approach also allows us to shed light on the question to what extent IMF forecast errors are driven by data uncertainty in specific variables. To that end, we regress the forecast error of our variables of interest on the left-hand side of the above identities, e.g., GDP growth, on the forecast errors of our explanatory variables on the right-hand side of the respective identities. In particular, for *S* explanatory variables, we regress:

$$\hat{y}_i - y_i = \alpha + \sum_{j=1}^{S} \beta_j \left(\hat{x}_{ij} - x_{ij}\right) + \varepsilon_i \,, \tag{8}$$

where $\hat{x}_{ij}$ and $\hat{y}_i$ are the forecasted growth rates of variables x_j and y in country i between years t-1 and t, while x_{ij} and y_i are the realized growth rates over the same time span. The coefficients in (8) have a straightforward interpretation: A 1% increase in the average forecast error of an

[4] Schnader and Stekler (1990), footnote 7, provide the test statistic.

explanatory variable x_j causes a $\beta_j\%$ change in the average forecast error of the macroeconomic aggregate *y*.

4. A Brief Look at the Data

We obtain all our data on forecasts and actual realizations of macroeconomic indicators in crisis countries from the IMF's Monitoring of Fund Arrangements dataset (MONA, IMF 2016b). While the original dataset covers 238 crisis countries since 2002, the data availability for even the broadest macroeconomic identities is limited to 156 observations (see Appendix). Observations are lost due to reporting, measurement and validation discrepancies.[5] We also exclude forecast errors that exceed the respective variable means by four standard deviations to ensure that our results are not driven by extreme outliers that may well be data entry errors.

To obtain data on forecasts and actual values from MONA, we proceed as follows for each given variable. Denote *t*, as the year when an IMF program is approved. At *t,* IMF country economists enter the respective program data into the MONA database for the years *t-3, t-2, t-1, t, t+1, t+2, t+3, and t+4*. In this sequence, *t* is the forecast for the current, first program year while *t-3, t-2, and t-1* are historical data (subject to revisions) and *t+1, t+2, t+3,* and *t+4* are 1-, 2-, 3-, and 4-year ahead forecasts, respectively. In this paper we examine the accuracy of the IMF forecast for year *t* to maximize the number of observations in the sample (the number of observations declines substantially with forecast horizon in MONA). For each country, we compare the growth rates of our variables of interest from *t-1* to *t* entered during the first review (at time *t* when the program is approved) with the realized growth rate for *t-1* to *t* that is reported in the last review (when the program is completed). Thus, the length of the forecast horizon is fixed and uniform across countries in crisis. To make sure that observations from the last review represent actual realized data, we only include programs running longer than 18 months in our sample. Table A1 in the Appendix provides detailed summary statistics of the forecast errors for the different macroeconomic variables used in the empirical analysis below.

5. IMF Forecast Errors: Decomposition and Determinants

[5] An older version of the MONA crisis dataset exists, covering countries from 1993 to 2003. However, the older MONA dataset is not compatible in terms of variable descriptions and no harmonization exists; hence, we focus on post 2002 data.

In this section, we evaluate IMF forecast accuracy for key macroeconomic identities and their subcomponents in crisis countries. Following the sequence of key macroeconomic identities discussed in section 2, we start by examining GDP growth forecasts, and then continue with an analysis of the current and financial accounts before considering fiscal revenues and expenditures. For each macroeconomic identity, we first employ the Mincer-Zarnowitz regressions as shown in equation (7), and then apply the Merton-Henriksson timing tests based on the approach outlined in Figure 1. In the final step, we estimate the empirical forecast error model as specified in equation (8). These regressions allow us to deduce to what extent forecast errors of our macroeconomic aggregates of interest can be traced back to subcomponents that serve as key inputs in the forecast. We also report in all cases separate results for both low-income countries (LICs) and more advanced economies (Non-LICs) to examine whether the IMF forecast errors are driven by different subsamples.

5.1 GDP Growth

The results from the Mincer-Zarnowitz regressions are reported in Table 1. The columns collect results for each variable included in the national income accounts identity, plus real GDP and average prices (based on the CPI). The upper panel reports full-sample results, while the middle and lower panels show estimates for the LIC and Non-LIC subsamples. In the full sample, real GDP forecasts are found to be biased and inefficient (the joint F-test and the individual t-tests reject their respective null hypotheses at least at the 5 percent significance level), a result which is completely driven by the LIC sample. However, this finding does not carry over to nominal GDP and to average prices – both key inputs in the Fund's program design – for which the F-tests indicate no forecast bias/inefficiency. Nevertheless, the positive and significant intercept for the former variable shows that estimates of nominal GDP growth are in fact subject to bias. In particular, the IMF underestimates, on average, GDP growth by 1.4 percent in the full sample, with an even greater downward forecast bias of 2.3 percent for the LIC group.

With regard to the GDP subcomponents, two interesting results emerge. First, except for private consumption, IMF forecasts are all significantly biased and/or inefficient in the full sample of crisis countries. Except for the growth forecasts of imports and public investment, not only the joint null hypothesis is rejected but also the individual t-tests of no bias ($\alpha = 0$) and efficient forecasts ($\beta = 1$). Second, the biased and/or inefficient forecasts of the different GDP subcomponents, except for public investment growth, are driven entirely by the LIC sample. In the Non-LIC sample, we only reject the joint null hypothesis of an unbiased and efficient forecast for the private consumption and public investment components of GDP. Note, however, that the individual t-tests in the Non-LIC sample still indicate inefficient public consumption forecasts and an upward bias in export forecasts.

Table 2 provides the Merton-Henriksson test results of informational value added by the IMF forecasts for GDP and its subcomponents (plus real GDP and average prices). For each variable, the test determines whether the IMF forecasts perform better than a naive model that always suggest a positive or negative forecast. The χ^2-statistics for the full sample in the upper panel reject the null hypothesis (at least at the 5 percent level) of independent forecasts and actuals for all variables except average prices. That is, IMF forecasts for most national income components contain significant informational value. This pattern is broadly mirrored by the Non-LIC sample in the lower panel of Table 2.[6] In contrast, the results for the LIC sample in the middle panel of Table 2 are more mixed. As in the full and LIC samples, we find that IMF forecasts for the growth rates of real GDP, nominal GDP, imports, and public investment all contain statistically significant informational value. However, forecasts of the remaining subcomponents of GDP as well as average price growth do not significantly outperform a naive forecasting model.

Finally, we explore to what degree the forecast errors in the growth rates of the different GDP subcomponents contribute to forecast errors of GDP growth itself.[7] Addressing this question can provide valuable insights for future IMF forecasts. In particular, we can identify variables for which improvements in forecast accuracy would benefit the precision of GDP growth forecasts the most. Table 3 presents regression results of the forecast error of GDP growth as a function of all explanatory variables motivated by the national income identity. The full sample results in column 3a indicate that forecast errors in every single subcomponent are significant predictors of IMF forecast errors in GDP growth. In terms of magnitudes, forecast errors in the growth rates of private consumption, imports and exports contribute the most to forecast errors in GDP growth. The LIC subsample results in column 3b mirror the full-sample

[6] Note that no test statistic can be computed for the growth rate of average prices in the Non-LIC case as the IMF did not forecast any deflationary periods for this subsample.

[7] As outlined in the methodology section, the determinants of the IMF GDP growth forecasts are strictly based on the national income identity. Hence, the only source of uncertainty in the forecast is data uncertainty.

estimates quite closely. Interestingly, for the Non-LICs subsample in column 3c, we observe that the role of forecast errors in private consumption growth is somewhat subdued compared to LICs, while forecast errors in imports take a more prominent role. At the same time, forecast errors in public consumption and investment growth play no role in explaining Non-LIC forecast errors in GDP growth.

Overall, the analysis reveals somewhat mixed results for IMF forecasts of GDP growth and its subcomponents. Problems identified in the earlier literature regarding the bias and/or inefficiency of GDP forecasts are confirmed, although inflation forecasts are in general not subject to the same caveat. As evident from the Mincer-Zarnowitz regressions, bias and/or inefficiency in IMF growth forecasts of GDP (both real and nominal) and most GDP subcomponents are driven by the LIC sample. Nonetheless, the Merton-Henriksson test results suggest that, in general, IMF forecasts possess significant informational value, although the evidence is again a lot more mixed for the LIC sample. Finally, the forecast error regression analysis reveals that forecast errors in all subcomponents contribute to forecast errors in aggregate GDP growth in the full sample, with private consumption, imports and exports taking the lead both in terms of statistical and economic significance.

5.2 Balance of Payments Growth

IMF forecasts for the balance of payments (BOP) in program countries are crucial for at least two reasons. First, the BOP forecasts are key in determining financial assistance and program design. Second, they are also subsequently used to assess countries' progress in closing BOP gaps by increasing buffers through the reduction in current and financial account deficits as well as increases in international reserves. In this section, we therefore assess the IMF's forecasts of both the current account and the financial account in program countries. As outlined in the identities above, the growth rate of the current account can be decomposed into six subcomponents: goods import and export growth, services import and export growth, as well as the growth rates of net transfers and net income. Similarly, financial account growth can be broken down into the growth rates of net direct investment, reserve assets, net portfolio investment, and "other investments".

Table 4a reports the Mincer-Zarnowitz regression results for the growth rates of the current account and all its subcomponents. For the full sample in the upper panel, we observe that the joint null hypothesis of unbiased and efficient IMF forecasts is rejected at least at the 5 percent level for all current account variables. In fact, the individual t-tests show that the forecasts for all variables are subject to both bias and inefficiency, except for the current account itself and net income for which we can detect no significant bias. Similar to the GDP growth forecasts in the previous section, these results are again mainly driven by the LIC sample, where all current account forecast variables are found to suffer from bias and/or inefficiency at the 1 percent significance level. While in the Non-LIC sample the null hypothesis of unbiasedness and efficiency of the forecast is also rejected for the overall current account forecast, the same is true for only two of its subcomponents, net transfers and net income.

The upper panel of Table 4b reports the full-sample Mincer-Zarnowitz regressions for the financial account. We only reject the null hypothesis (at the 1 percent significance level) of unbiased and efficient forecasts for two subcomponents, growth in net direct investment and growth in net portfolio investment. The individual t-tests for the two variables indicate that the rejection is due to inefficient forecasts ($\beta \neq 1$). We also find that the "other investments" component is subject to inefficient forecasts, although the joint F-test did not indicate rejection. The LIC sample results in the middle panel are similar to the full sample, except that the joint null hypothesis of unbiased and efficient forecasts is now rejected for all subcomponents (at the 1 percent significance level). This result is again driven by the fact that the IMF forecasts are inefficient but not biased. Interestingly, the forecasts of aggregate financial account growth itself are neither biased nor inefficient, suggesting that perhaps the subcomponent errors cancel each other out in this case. The findings in the Non-LIC sample in the lower panel of Table 4b are somewhat reversed. While only two subcomponents show significant evidence of biased and/or inefficient IMF forecasts, "other investments" and net portfolio investments, we also reject the joint null hypothesis of unbiased and efficient forecasts for financial account growth itself.

Turning to the Merton-Henriksson tests in Table 5a, the full-sample results for the current account and its subcomponents show that all forecasts, except for net income, contain statistically significant informational value. We observe a similar pattern for the LIC subsample in the middle panel of Table 5a, except that the forecasts of net income growth now manage to outpace significantly a naive forecasting model. At the same time, IMF forecasts of net transfer growth in LICs have become statistically indistinguishable from a model that forecasts throughout either positive or negative growth. In the Non-LIC sample in the bottom panel of

Table 5a, nearly the exact same results pattern emerges, with one exception. Both net transfers and net income growth forecasts are not providing any statistically significant informational value relative to a naive forecasting model in the Non-LIC sample.

The Merton-Henriksson tests for the financial account and its subcomponents in Table 5b stand in stark contrast to our prior findings for the GDP and current account identities. Considering the full-sample results in the upper panel, only IMF forecasts of financial account growth itself and of net direct investment growth add any significant informational value. In fact, except for financial account growth for the LIC group, none of the remaining variable forecasts can significantly outperform a naive forecasting model in any of the samples. This result suggests that the IMF's forecasting approach for the financial account and its subcomponents in crisis countries is in need of improvement.

In the next step, Table 6 seeks to identify whether the forecast errors in current and financial account growth are driven by forecast errors in their respective subcomponents. Using the regression approach outlined in equation (8), panel A reports results for the current account, while panel B focuses on the financial account. Remarkably, of all explanatory variables only one regressor in the full sample, the forecast error in the growth rate of goods imports, can be linked to aggregate balance of payments forecast errors. These results are without doubt a consequence of the immense variances from which the growth rate forecasts for the current and financial accounts as well as their subcomponents suffer (see Table A1). These findings further reinforce the potential need to adjust the IMF's forecasting approach for balance of payments subcomponents in program countries.

5.3 Government Revenue and Expenditure Growth

Finally, we consider the IMF's forecast accuracy for the growth of government revenues and government expenditures in crisis countries. As laid out above in the government finance identities, three subcomponents drive government expenditure growth: the respective growth rates of interest, non-interest and capital expenditures. Government revenue growth, on the other hand, can be decomposed into the growth rates of grants, tax revenues and non-tax revenues. We start again by assessing the IMF forecast errors for both government expenditure and revenue growth via Mincer-Zarnowitz regressions and Merton-Henriksson tests, and then examine to what extent forecast errors in the respective subcomponents drive forecast errors of the aggregate expenditure and revenue variables in crisis countries.

Table 7a reports Mincer-Zarnowitz regressions for government expenditure growth and its subcomponents. The joint null hypothesis of unbiased and efficient government expenditure forecasts cannot be rejected for the full sample in the upper panel. The same is true for the LIC and Non-LIC subsamples in the middle and lower panels. However, when considering the individual t-tests, we find evidence that IMF forecasts of aggregate government expenditure growth are indeed inefficient ($\beta \neq 1$). The null hypothesis of efficient forecasts is also rejected for the interest and capital expenditure components in both the full and the LIC samples. In both cases, the joint hypotheses that the forecasts are unbiased and efficient are rejected as well (at the 5 and 1 percent significance levels, respectively). Finally, there is no evidence of forecast bias or inefficiency for any of the variables in the Non-LIC sample, which, however, consists only of five observations.

Table 7b considers Mincer-Zarnowitz regressions of government revenue growth and its subcomponents. While the joint null hypothesis of unbiased and efficient forecasts cannot be rejected for overall government revenue in any of the samples, the individual t-tests find significant downward bias ($\alpha \neq 0$) in the full and LIC samples. With regard to the subcomponents of government revenue, the F-tests indicate significant biases and/or inefficiencies for all variables in the full and LIC samples. Specifically, the t-tests show that forecasts for grants suffer from inefficiency, tax revenue forecasts are biased, and non-tax revenues are subject to both of these caveats. In contrast, in the Non-LIC sample, forecasts of government revenue growth and its subcomponents, except for grants, seem neither to be biased nor inefficient. However, the Non-LIC sample is again somewhat restricted with 12 observations.

Two results emerge when turning to the Merton-Henriksson tests for government expenditure growth and its subcomponents in Table 8a. First, the full sample results in the upper panel indicate that IMF forecasts for aggregate government expenditure growth do not contain any statistically significant value. On the upside, however, the IMF forecasts for all government expenditure subcomponents are significantly outperforming naive forecasting models. Second, the full sample estimates are entirely driven by LICs as illustrated by the considerable overlap in results between the upper and middle panels in Table 8a.[8] When evaluating forecasts for government revenue growth and its subcomponents in Table 8b, we find instead much stronger evidence that IMF forecasts contain valuable information. Specifically, the forecasts for all variables in both the full and the LIC samples significantly outperform naive forecasting models. While the evidence is weaker for Non-LIC countries (bottom panel of Table 8b), the IMF forecasts for aggregate government revenues and its subcomponents still add significant informational value (at the 10 percent level). The exception here is government grants, which are arguably politically motivated and difficulty to forecast.

In Table 9, we examine again in a more structured way the forecast error contributions of the respective government expenditure and revenue subcomponents. Employing the error regression approach in equation (8), panel A presents the results with the forecast errors for government expenditure growth as dependent variable. Panel B shows the respective estimates for forecast errors in government revenue growth.

The estimates in panel A reveal that IMF forecast errors in the growth rates of non-interest expenditures as well as capital expenditures and net lending are both significant drivers of forecast errors in aggregate government expenditure growth. We also observe roughly similar estimates in both the LIC and Non-LIC samples. However, interest expenditure growth turns out to be only a significant contributor to forecast errors in government expenditure growth for Non-LICs. In contrast, the full-sample government revenue regression in panel B of Table 9 shows that forecast errors in all subcomponents are significant contributors to aggregate forecast errors. The coefficient magnitudes suggest, however, that forecast errors in tax revenue growth have by far the greatest economic impact. As taxes are the primary government revenue source in most countries, it is not surprising that forecast errors in this variable carry substantial weight. At the same time, forecast errors in the growth of grant money only matter as source for aggregate revenue forecast errors in LICs. The opposite holds for non-tax revenue in Non-LICs. These results are again in line with expectations as LICs are likely to depend more heavily on grants as revenue source than Non-LICs.

[8] Note that for the Non-LIC group no χ^2 statistics can be computed for government expenditure and two of its subcomponents as the IMF did not forecast any negative growth rates in these subsamples.

Overall, while most forecasts of fiscal aggregates and their subcomponents are biased and/or inefficient, the IMF forecasts still add informational value. At the same time, our analysis shows that forecast errors for most subcomponents also feed into forecast errors of aggregate fiscal accounts in crisis countries. Increasing the accuracy in fiscal subcomponent forecasts would therefore help the IMF to improve forecasts of aggregate fiscal balances in crisis countries more generally.

6. Concluding Remarks

Macroeconomic forecasts are fickle, even in ordinary times, but pundits level their most vocal criticisms of economic forecasts during times of crises. We assess IMF forecasts for countries that experience the deepest of all crises and require access to lending facilities offered by the lender of last resort. To evaluate forecasts, we assess their bias and efficiency as well as their informational content over naive forecasting models. Our methodology employs accounting identities to eliminate model and parameter uncertainty, which allows us to focus squarely on uncertainty stemming from the data generating process.

In contrast to the notion that IMF crisis forecasts are uninformative, we show that the forecasts for most aggregate macroeconomic variables hold substantial informational value. However, while a number of key variables are forecast with downward bias, we find that efficiency is perhaps the weakest link in IMF forecasts. Only a few key macroeconomic variables are forecast in a manner suggesting that the IMF uses all the information available at the time of the forecast. Our analysis also uncovers significant heterogeneity across LICs (low-income countries) and Non-LICs. In most cases, we can trace the biases/inefficiencies in the global sample directly to forecast errors originating in LICs.

Overall, the efficiency of nominal GDP and government revenue forecasts, as well as the unbiased and efficient forecasts of inflation and reserve asset growth in times of crisis are heartening. These are, after all, the most important proxies for welfare as countries recover from crises. Nevertheless, our analysis of IMF forecasts, in particular for the balance of payments, reveals substantial scope for improvements. Incorporating information from data revisions and adjustments in forecast horizons could provide helpful guidance for increasing the accuracy of future IMF forecasts during times of crises. These topics are a promising avenue for future research.

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Table 1: Mincer-Zarnowitz Regressions - GDP Growth

Full Sample

Dependent variable: Actual growth rate	Real GDP	Avg. prices	GDP	Private Cons.	Public Cons.	Imports	Exports	Public Inv.	Private Inv.
Forecasted growth rate, β	0.621♠♠	1.048	0.926	0.881	0.710♠♠♠	0.741	0.713♠♠♠	0.524♠♠♠	0.445♠♠♠
	(0.145)	(0.070)	(0.057)	(0.182)	(0.105)	(0.205)	(0.058)	(0.094)	(0.166)
Constant, α	0.016**	-0.002	0.014*	0.010	0.036***	0.045**	0.065***	0.010	0.092***
	(0.006)	(0.005)	(0.007)	(0.020)	(0.010)	(0.021)	(0.014)	(0.023)	(0.030)
Observations	110	106	110	110	110	110	110	110	110
R-squared	0.407	0.737	0.745	0.624	0.431	0.387	0.538	0.331	0.108
F-test (α = 0, β = 1)	3.460***	0.233	1.740	0.246	6.759***	2.603*	15.110***	17.110***	5.909***

LIC Sample

Dependent variable: Actual growth rate	Real GDP	Avg. prices	GDP	Private Cons.	Public Cons.	Imports	Exports	Public Inv.	Private Inv.
Forecasted growth rate, β	0.497♠♠♠	1.110	0.912	0.532♠♠♠	0.612♠♠♠	0.466♠♠♠	0.643♠♠♠	0.478♠♠♠	0.208♠♠♠
	(0.151)	(0.097)	(0.067)	(0.097)	(0.133)	(0.157)	(0.083)	(0.114)	(0.200)
Constant, α	0.028***	-0.004	0.023**	0.059***	0.052***	0.087***	0.076***	0.031	0.132***
	(0.007)	(0.007)	(0.009)	(0.014)	(0.011)	(0.022)	(0.019)	(0.028)	(0.037)
Observations	74	73	74	74	74	74	74	74	74
R-squared	0.470	0.641	0.725	0.286	0.294	0.190	0.504	0.305	0.027
F-test (α = 0, β = 1)	7.315***	0.811	4.082	11.700***	10.920***	7.961***	10.720***	12.110***	8.034***

Non-LIC Sample

Dependent variable: Actual growth rate	Real GDP	Avg. prices	GDP	Private Cons.	Public Cons.	Imports	Exports	Public Inv.	Private Inv.
Forecasted growth rate, β	0.955	0.998	0.923	1.075	0.823♠	1.240	1.070	0.658♠♠	1.130
	(0.201)	(0.107)	(0.079)	(0.169)	(0.100)	(0.142)	(0.062)	(0.157)	(0.177)
Constant, α	-0.005	-0.005	-0.002	-0.035*	0.014	-0.019	0.028*	-0.034	-0.022
	(0.008)	(0.006)	(0.009)	(0.017)	(0.014)	(0.016)	(0.016)	(0.035)	(0.026)
Observations	36	33	36	36	36	36	36	36	36
R-squared	0.321	0.905	0.811	0.835	0.690	0.806	0.704	0.389	0.514
F-test (α = 0, β = 1)	0.606	0.989	1.661	3.856**	1.568	1.555	3.064	5.037**	0.425

Notes: ♠♠♠, ♠♠, ♠ indicates rejection of the null hypothesis that the estimated coefficient equals 1 at the 10, 5, 1 percent significance level, respectively. ***, **, * indicates rejection of the null hypothesis that the estimated coefficient equals 0 at the 10, 5, 1 percent significance level, respectively.

Table 2: Correct and Incorrect Forecasts of GDP and Its Subcomponent Growth Rates

Full Sample

	Correct (in %)		Incorrect (in %)		Chi Square Value
	Forecast > 0 Actual > 0	Forecast ≤ 0 Actual ≤ 0	Forecast > 0 Actual ≤ 0	Forecast ≤ 0 Actual > 0	
Real GDP Growth	89.1	4.5	4.5	1.8	27.557***
Inflation (avg. prices)	89.6	0.0	8.5	1.9	0.189
GDP Growth	94.5	3.6	0.9	0.9	51.722***
Private Consumption Growth	90.0	3.6	5.5	0.9	23.514***
Public Consumption Growth	76.4	6.4	9.1	8.2	9.079***
Import Growth	81.8	7.3	8.2	2.7	26.006***
Export Growth	80.0	5.5	8.2	6.4	10.290***
Public Investment Growth	67.3	8.2	19.1	5.5	7.566***
Private Investment Growth	70.0	7.3	13.6	9.1	5.607**

LIC Sample

	Correct (in %)		Incorrect (in %)		Chi Square Value
	Forecast > 0 Actual > 0	Forecast ≤ 0 Actual ≤ 0	Forecast > 0 Actual ≤ 0	Forecast ≤ 0 Actual > 0	
Real GDP Growth	93.2	2.7	1.4	2.7	12.161***
Inflation (avg. prices)	89.0	0.0	8.2	2.7	0.184
GDP Growth	95.9	2.7	0.0	1.4	26.599***
Private Consumption Growth	93.2	1.4	4.1	1.4	1.544
Public Consumption Growth	78.4	4.1	6.8	10.8	1.903
Import Growth	83.8	5.4	8.1	2.7	11.223***
Export Growth	82.4	2.7	8.1	6.8	0.904
Public Investment Growth	70.3	6.8	14.9	8.1	2.836*
Private Investment Growth	68.9	5.4	12.2	13.5	0.659

Non-LIC Sample

	Correct (in %)		Incorrect (in %)		Chi Square Value
	Forecast > 0 Actual > 0	Forecast ≤ 0 Actual ≤ 0	Forecast > 0 Actual ≤ 0	Forecast ≤ 0 Actual > 0	
Real GDP Growth	80.6	8.3	11.1	0.0	8.528***
Inflation (avg. prices)	90.9	0.0	9.1	0.0	N/A
GDP Growth	91.7	5.6	2.8	0.0	12.321***
Private Consumption Growth	83.3	8.3	8.3	0.0	10.473***
Public Consumption Growth	72.2	11.1	13.9	2.8	6.251**
Import Growth	77.8	11.1	8.3	2.8	9.475***
Export Growth	75.0	11.1	8.3	5.6	6.952***
Public Investment Growth	61.1	11.1	27.8	0.0	4.474**
Private Investment Growth	72.2	11.1	16.7	0.0	8.000***

Notes: ***, ** and * indicate 1, 5 and 10 percent level of statistical significance, respectively.

Table 3: Contributors to GDP Growth Forecast Errors

Dependent variable: GDP growth (Forecast Error, FE)	**3a** **All**	**3b** **LICs**	**3c** **Non-LICs**
Private Consumption Growth (FE)	0.429*** (0.076)	0.484*** (0.071)	0.286** (0.108)
Public Consumption Growth (FE)	0.090** (0.041)	0.112** (0.042)	0.091 (0.068)
Import Growth (FE)	-0.200*** (0.066)	-0.195*** (0.071)	-0.253** (0.108)
Export Growth (FE)	0.171*** (0.049)	0.142** (0.056)	0.329*** (0.058)
Public Investment Growth (FE)	0.047*** (0.014)	0.054*** (0.014)	0.031 (0.028)
Private Investment Growth (FE)	0.092*** (0.016)	0.091*** (0.016)	0.123*** (0.040)
Constant	-0.006* (0.003)	-0.010*** (0.004)	0.012* (0.006)
Observations	110	74	36
R-squared	0.488	0.526	0.612

Notes: All variables are forecast errors of growth rates. Robust standard errors in parenthesis. ***, ** and * indicate 1, 5 and 10 percent level of statistical significance, respectively.

Table 4a: Mincer-Zarnowitz Regressions – Current Account Balance Growth

Full Sample

Dependent variable: Actual growth rate	**Current Account**	**Goods Imports**	**Goods Exports**	**Services Imports**	**Services Exports**	**Net Transfers**	**Net Income**
Forecasted growth rate, β	0.173♠♠♠	0.759♠♠	0.827♠♠	0.597♠♠♠	0.436♠♠♠	0.081♠♠♠	0.229♠♠♠
	(0.064)	(0.116)	(0.084)	(0.096)	(0.175)	(0.113)	(0.100)
Constant, α	-0.032	0.036**	0.055***	0.059***	0.078***	0.158***	0.064
	(0.082)	(0.015)	(0.016)	(0.016)	(0.021)	(0.035)	(0.058)
Observations	132	132	132	132	132	132	132
R-squared	0.045	0.389	0.430	0.182	0.048	0.004	0.143
F-test (α = 0, β = 1)	103.100***	3.383**	6.001***	11.280***	8.025***	39.560***	30.910***

LIC Sample

Dependent variable: Actual growth rate	**Current Account**	**Goods Imports**	**Goods Exports**	**Services Imports**	**Services Exports**	**Net Transfers**	**Net Income**
Forecasted growth rate, β	0.144♠♠♠	0.587♠♠♠	0.799♠♠	0.514♠♠♠	0.235♠♠♠	0.039♠♠♠	0.234♠♠♠
	(0.062)	(0.135)	(0.099)	(0.121)	(0.256)	(0.144)	(0.104)
Constant, α	0.064	0.068***	0.066***	0.077***	0.106***	0.115***	0.114
	(0.113)	(0.021)	(0.022)	(0.022)	(0.030)	(0.038)	(0.083)
Observations	86	86	86	86	86	86	86
R-squared	0.033	0.274	0.404	0.136	0.010	0.001	0.164
F-test (α = 0, β = 1)	136.700***	6.191***	4.928***	9.736***	7.038***	24.310***	30.030***

Non-LIC Sample

Dependent variable: Actual growth rate	**Current Account**	**Goods Imports**	**Goods Exports**	**Services Imports**	**Services Exports**	**Net Transfers**	**Net Income**
Forecasted growth rate, β	0.296♠♠♠	1.019	0.878	0.736	0.674	0.226♠♠♠	0.205♠♠♠
	(0.239)	(0.114)	(0.150)	(0.186)	(0.220)	(0.163)	(0.231)
Constant, α	-0.201*	0.005	0.037	0.035	0.040	0.252***	-0.027
	(0.106)	(0.022)	(0.024)	(0.023)	(0.028)	(0.071)	(0.060)
Observations	46	46	46	46	46	46	46
R-squared	0.110	0.535	0.464	0.250	0.214	0.030	0.035
F-test (α = 0, β = 1)	4.400**	0.0437	1.226	1.561	1.233	17.160***	6.215***

Notes: ♠♠♠, ♠♠, ♠ indicates rejection of the null hypothesis that the estimated coefficient equals 1 at the 10, 5, 1 percent significance level, respectively. ***, **, * indicates rejection of the null hypothesis that the estimated coefficient equals 0 at the 10, 5, 1 percent significance level, respectively.

Table 4b: Mincer-Zarnowitz Regressions – Financial Account Balance Growth

Full Sample

Dependent variable: Actual growth rate	**Financial Account**	**Net Direct Inv.**	**Reserve Assets**	**Other Inv.**	**Net Portfolio Inv.**
Forecasted growth rate, β	1.140	0.603♠♠♠	0.653	1.146♠♠	-0.156♠♠♠
	(0.387)	(0.021)	(0.445)	(0.069)	(0.239)
Constant, α	0.282	0.068	-0.290	1.395	-0.420
	(0.288)	(0.088)	(0.618)	(1.627)	(0.410)
Observations	61	61	61	61	61
R-squared	0.565	0.761	0.169	0.725	0.017
F-test (α = 0, β = 1)	0.477	217.400***	0.434	2.291	11.840***

LIC Sample

Dependent variable: Actual growth rate	**Financial Account**	**Net Direct Inv.**	**Reserve Assets**	**Other Inv.**	**Net Portfolio Inv.**
Forecasted growth rate, β	1.346	0.587♠♠♠	0.297♠♠♠	1.192♠♠♠	0.286♠♠♠
	(0.285)	(0.012)	(0.052)	(0.011)	(0.171)
Constant, α	0.266	0.125	-0.188	1.234	-0.118
	(0.322)	(0.120)	(0.650)	(1.229)	(0.635)
Observations	34	34	34	34	34
R-squared	0.781	0.844	0.074	0.940	0.029
F-test (α = 0, β = 1)	0.880	652.400***	119.600***	197.700***	8.782***

Non-LIC Sample

Dependent variable: Actual growth rate	**Financial Account**	**Net Direct Inv.**	**Reserve Assets**	**Other Inv.**	**Net Portfolio Inv.**
Forecasted growth rate, β	-0.046♠♠♠	1.042	1.109	-1.500♠♠♠	-0.471♠♠♠
	(0.109)	(0.489)	(0.768)	(0.489)	(0.076)
Constant, α	-0.149	-0.031	0.116	2.729	-0.948**
	(0.381)	(0.107)	(1.112)	(2.890)	(0.380)
Observations	27	27	27	27	27
R-squared	0.001	0.371	0.280	0.126	0.402
F-test (α = 0, β = 1)	57.930***	0.079	0.013	36.120***	216.200***

Notes: ♠♠♠, ♠♠, ♠ indicates rejection of the null hypothesis that the estimated coefficient equals 1 at the 10, 5, 1 percent significance level, respectively. ***, **, * indicates rejection of the null hypothesis that the estimated coefficient equals 0 at the 10, 5, 1 percent significance level, respectively.

Table 5a: Correct and Incorrect Forecasts of Current Account and Its Subcomponent Growth Rates

Full Sample

	Correct (in %)		Incorrect (in %)		
	Forecast > 0 Actual > 0	Forecast ≤ 0 Actual ≤ 0	Forecast > 0 Actual ≤ 0	Forecast ≤ 0 Actual > 0	Chi Square Value
Current Account Growth	34.1	34.1	19.7	12.1	16.754***
Goods Import Growth	66.7	19.7	9.8	3.8	54.081***
Goods Export Growth	73.5	12.1	7.6	6.8	34.893***
Services Import Growth	64.4	14.4	12.9	8.3	23.154***
Services Export Growth	69.7	12.1	11.4	6.8	25.460***
Net Transfers Growth	47.7	14.4	13.6	24.2	2.800*
Net Income Growth	34.1	23.5	21.2	21.2	2.114

LIC Sample

	Correct (in %)		Incorrect (in %)		
	Forecast > 0 Actual > 0	Forecast ≤ 0 Actual ≤ 0	Forecast > 0 Actual ≤ 0	Forecast ≤ 0 Actual > 0	Chi Square Value
Current Account Growth	40.7	23.3	24.4	11.6	5.544**
Goods Import Growth	74.4	14.0	8.1	3.5	31.439***
Goods Export Growth	77.9	7.0	8.1	7.0	10.255***
Services Import Growth	69.8	9.3	14.0	7.0	8.611***
Services Export Growth	70.9	8.1	14.0	7.0	6.930***
Net Transfers Growth	46.5	15.1	17.4	20.9	1.331
Net Income Growth	34.9	25.6	18.6	20.9	2.774*

Non-LIC Sample

	Correct (in %)		Incorrect (in %)		
	Forecast > 0 Actual > 0	Forecast ≤ 0 Actual ≤ 0	Forecast > 0 Actual ≤ 0	Forecast ≤ 0 Actual > 0	Chi Square Value
Current Account Growth	21.7	54.3	10.9	13.0	7.998***
Goods Import Growth	52.2	30.4	13.0	4.3	16.697***
Goods Export Growth	65.2	21.7	6.5	6.5	17.952***
Services Import Growth	54.3	23.9	10.9	10.9	10.288***
Services Export Growth	67.4	19.6	6.5	6.5	16.859***
Net Transfers Growth	50.0	13.0	6.5	30.4	1.416
Net Income Growth	32.6	19.6	26.1	21.7	0.038

Notes: ***, ** and * indicate 1, 5 and 10 percent level of statistical significance, respectively.

Table 5b: Correct and Incorrect Forecasts of Financial Account and Its Subcomponent Growth Rates

Full Sample

	Correct		Incorrect		Chi Square Value
	Forecast > 0 Actual > 0	Forecast ≤ 0 Actual ≤ 0	Forecast > 0 Actual ≤ 0	Forecast ≤ 0 Actual > 0	
Financial Account Growth	23.0	42.6	13.1	21.3	4.079**
Net Direct Investment	39.3	26.2	18.0	16.4	4.330**
Reserve Assets	14.8	52.5	14.8	18.0	2.415
Other Investment	14.8	44.3	19.7	21.3	0.270
Net Portfolio Investment	16.4	47.5	14.8	21.3	1.776

LIC Sample

	Correct		Incorrect		Chi Square Value
	Forecast > 0 Actual > 0	Forecast ≤ 0 Actual ≤ 0	Forecast > 0 Actual ≤ 0	Forecast ≤ 0 Actual > 0	
Financial Account Growth	23.5	35.3	17.6	23.5	0.405
Net Direct Investment	47.1	17.6	17.6	17.6	0.902
Reserve Assets	14.7	52.9	14.7	17.6	1.035
Other Investment	17.6	41.2	17.6	23.5	0.166
Net Portfolio Investment	23.5	38.2	20.6	17.6	0.863

Non-LIC Sample

	Correct		Incorrect		Chi Square Value
	Forecast > 0 Actual > 0	Forecast ≤ 0 Actual ≤ 0	Forecast > 0 Actual ≤ 0	Forecast ≤ 0 Actual > 0	
Financial Account Growth	22.2	51.9	7.4	18.5	3.694*
Net Direct Investment	29.6	37.0	18.5	14.8	1.782
Reserve Assets	14.8	51.9	14.8	18.5	0.555
Other Investment	11.1	48.1	22.2	18.5	0.089
Net Portfolio Investment	7.4	59.3	7.4	25.9	0.037

Notes: ***, ** and * indicate 1, 5 and 10 percent level of statistical significance, respectively.

Table 6: Contributors to Balance of Payments Forecast Errors

Panel A: Current Account Balance

Dep. variable: CA growth (Forecast Error, FE)	6a All	6b LICs	6c Non-LICs
Goods Import Growth	2.178***	1.555	3.199***
(FE)	(0.829)	(0.992)	(0.999)
Goods Export Growth	-0.664	-0.373	-1.342
(FE)	(0.542)	(0.773)	(0.952)
Services Import Growth	-0.254	-0.709	0.928
(FE)	(0.748)	(1.254)	(0.953)
Services Export Growth	-0.657	-0.656	-0.366
(FE)	(0.527)	(0.661)	(0.620)
Net Transfers Growth	0.133	0.412	0.181
(FE)	(0.491)	(1.027)	(0.167)
Net Income Growth	0.005	-0.023	-0.337**
(FE)	(0.082)	(0.124)	(0.151)
Constant	0.066	-0.009	0.243**
	(0.155)	(0.185)	(0.118)
Observations	132	86	46
R-squared	0.056	0.050	0.236

Panel B: Financial Account Balance

Dep. variable: FA growth (Forecast Error, FE)	6d All	6e LICs	6f Non-LICs
Net Direct Investment Growth	0.299	0.316	0.202
(FE)	(0.386)	(0.505)	(0.570)
Reserve Assets Growth	0.001	-0.094	0.069
(FE)	(0.046)	(0.061)	(0.050)
Other Investment Growth	-0.011	-0.014	-0.005
(FE)	(0.008)	(0.014)	(0.011)
Net Portfolio Investment Growth	0.008	-0.026	0.027
(FE)	(0.062)	(0.095)	(0.105)
Constant	-0.298	-0.323	-0.219
	(0.311)	(0.423)	(0.494)
Observations	61	34	27
R-squared	0.030	0.079	0.061

Notes: All variables are forecast errors of growth rates. Robust standard errors in parenthesis. ***, ** and * indicate 1, 5 and 10 percent level of statistical significance, respectively.

Table 7a: Mincer-Zarnowitz Regressions – Government Expenditure Growth

Full Sample

Dependent variable: Actual growth rate	Gov. Exp.	Interest Exp.	Non-interest Exp.	Cap. Exp. & Net Lending
Forecasted growth rate, β	0.769$^{\spadesuit}$	0.791$^{\spadesuit\spadesuit\spadesuit}$	0.963	0.499$^{\spadesuit\spadesuit\spadesuit}$
	(0.132)	(0.006)	(0.145)	(0.181)
Constant, α	0.020	-0.045	0.017	0.047
	(0.024)	(0.044)	(0.025)	(0.045)
Observations	34	34	34	34
R-squared	0.416	0.977	0.546	0.212
F-test (α = 0, β = 1)	1.686	1048.000***	0.381	4.062**

LIC Sample

Dependent variable: Actual growth rate	Gov. Exp.	Interest Exp.	Non-interest Exp.	Cap. Exp. & Net Lending
Forecasted growth rate, β	0.776	0.793$^{\spadesuit\spadesuit\spadesuit}$	0.977	0.415$^{\spadesuit\spadesuit\spadesuit}$
	(0.136)	(0.006)	(0.156)	(0.186)
Constant, α	0.015	-0.069	0.007	0.078
	(0.026)	(0.050)	(0.027)	(0.047)
Observations	29	29	29	29
R-squared	0.448	0.980	0.632	0.169
F-test (α = 0, β = 1)	1.693	1082.000***	0.041	4.966**

Non-LIC Sample

Dependent variable: Actual growth rate	Gov. Exp.	Interest Exp.	Non-interest Exp.	Cap. Exp. & Net Lending
Forecasted growth rate, β	1.810	0.843	1.447	0.804
	(1.570)	(0.343)	(2.181)	(0.403)
Constant, α	-0.045	0.081	0.039	-0.082
	(0.120)	(0.109)	(0.090)	(0.131)
Observations	5	5	5	5
R-squared	0.199	0.556	0.118	0.378
F-test (α = 0, β = 1)	0.162	0.287	2.532	0.300

Notes: ♠♠♠, ♠♠, ♠ indicates rejection of the null hypothesis that the estimated coefficient equals 1 at the 10, 5, 1 percent significance level, respectively. ***, **, * indicates rejection of the null hypothesis that the estimated coefficient equals 0 at the 10, 5, 1 percent significance level, respectively.

Table 7b: Mincer-Zarnowitz Regressions – Government Revenue Growth

Full Sample

Dependent variable: Actual growth rate	Gov. Revenue	Grants	Tax Revenue	Non-tax Revenue
Forecasted growth rate, β	0.867	0.798$^{\spadesuit\spadesuit\spadesuit}$	0.827	0.382$^{\spadesuit\spadesuit\spadesuit}$
	(0.080)	(0.033)	(0.112)	(0.075)
Constant, α	0.034**	0.008	0.043**	0.166***
	(0.016)	(0.065)	(0.020)	(0.043)
Observations	69	69	69	69
R-squared	0.767	0.893	0.613	0.209
F-test (α = 0, β = 1)	2.292	18.300***	2.397*	34.220***

LIC Sample

Dependent variable: Actual growth rate	Gov. Revenue	Grants	Tax Revenue	Non-tax Revenue
Forecasted growth rate, β	0.836	0.804$^{\spadesuit\spadesuit\spadesuit}$	0.752$^{\spadesuit}$	0.309$^{\spadesuit\spadesuit\spadesuit}$
	(0.099)	(0.029)	(0.132)	(0.067)
Constant, α	0.043**	0.027	0.060**	0.187***
	(0.021)	(0.067)	(0.025)	(0.048)
Observations	57	57	57	57
R-squared	0.751	0.919	0.531	0.177
F-test (α = 0, β = 1)	2.212	23.800***	3.059*	58.570***

Non-LIC Sample

Dependent variable: Actual growth rate	Gov. Revenue	Grants	Tax Revenue	Non-tax Revenue
Forecasted growth rate, β	1.190	0.135$^{\spadesuit\spadesuit\spadesuit}$	1.032	1.102
	(0.106)	(0.267)	(0.145)	(0.458)
Constant, α	-0.008	0.109	-0.006	0.163
	(0.017)	(0.223)	(0.019)	(0.133)
Observations	12	12	12	12
R-squared	0.930	0.015	0.902	0.456
F-test (α = 0, β = 1)	1.613	7.207**	0.061	2.060

Notes: ♠♠♠, ♠♠, ♠ indicates rejection of the null hypothesis that the estimated coefficient equals 1 at the 10, 5, 1 percent significance level, respectively. ***, **, * indicates rejection of the null hypothesis that the estimated coefficient equals 0 at the 10, 5, 1 percent significance level, respectively.

Table 8a: Correct and Incorrect Forecasts of Gov. Expenditure and Its Subcomponent Growth Rates

Full Sample

	Correct (in %)		Incorrect (in %)		
	Forecast > 0 Actual > 0	Forecast ≤ 0 Actual ≤ 0	Forecast > 0 Actual ≤ 0	Forecast ≤ 0 Actual > 0	Chi Square Value
Gov. Expenditure Growth	79.4	5.9	11.8	2.9	2.370
Interest Expenditure Growth	70.6	8.8	17.6	2.9	3.023*
Non-interest Expenditure Growth	76.5	11.8	8.8	2.9	8.754***
Cap. Expenditure & Net Lending Growth	70.6	11.8	14.7	2.9	5.707**

LIC Sample

	Correct (in %)		Incorrect (in %)		
	Forecast > 0 Actual > 0	Forecast ≤ 0 Actual ≤ 0	Forecast > 0 Actual ≤ 0	Forecast ≤ 0 Actual > 0	Chi Square Value
Gov. Expenditure Growth	79.3	6.9	10.3	3.4	2.517
Interest Expenditure Growth	69.0	10.3	17.2	3.4	2.831*
Non-interest Expenditure Growth	72.4	13.8	10.3	3.4	6.940***
Cap. Expenditure & Net Lending Growth	75.9	10.3	10.3	3.4	4.943**

Non-LIC Sample

	Correct (in %)		Incorrect (in %)		
	Forecast > 0 Actual > 0	Forecast ≤ 0 Actual ≤ 0	Forecast > 0 Actual ≤ 0	Forecast ≤ 0 Actual > 0	Chi Square Value
Gov. Expenditure Growth	80.0	0.0	20.0	0.0	N/A
Interest Expenditure Growth	80.0	0.0	20.0	0.0	N/A
Non-interest Expenditure Growth	100.0	0.0	0.0	0.0	N/A
Cap. Expenditure & Net Lending Growth	40.0	20.0	40.0	0.0	0.833

Notes: ***, ** and * indicate 1, 5 and 10 percent level of statistical significance, respectively.

Table 8b: Correct and Incorrect Forecasts of Gov. Revenue and Its Subcomponent Growth Rates

Full Sample

	Correct (in %)		Incorrect (in %)		Chi Square Value
	Forecast > 0 Actual > 0	Forecast ≤ 0 Actual ≤ 0	Forecast > 0 Actual ≤ 0	Forecast ≤ 0 Actual > 0	
Gov. Revenue Growth	81.2	7.2	5.8	5.8	12.463***
Grants Growth	52.2	15.9	24.6	7.2	5.419**
Tax Revenue Growth	85.5	8.7	1.4	4.3	29.493***
Non-tax Revenue Growth	62.3	15.9	5.8	15.9	12.821***

LIC Sample

	Correct (in %)		Incorrect (in %)		Chi Square Value
	Forecast > 0 Actual > 0	Forecast ≤ 0 Actual ≤ 0	Forecast > 0 Actual ≤ 0	Forecast ≤ 0 Actual > 0	
Gov. Revenue Growth	82.5	5.3	7.0	5.3	5.475**
Grants Growth	52.6	15.8	24.6	7.0	4.385**
Tax Revenue Growth	87.7	7.0	1.8	3.5	20.584***
Non-tax Revenue Growth	64.9	12.3	5.3	17.5	7.170***

Non-LIC Sample

	Correct (in %)		Incorrect (in %)		Chi Square Value
	Forecast > 0 Actual > 0	Forecast ≤ 0 Actual ≤ 0	Forecast > 0 Actual ≤ 0	Forecast ≤ 0 Actual > 0	
Gov. Revenue Growth	75.0	16.7	0.0	8.3	3.200*
Grants Growth	50.0	16.7	25.0	8.3	0.114
Tax Revenue Growth	75.0	16.7	0.0	8.3	3.200*
Non-tax Revenue Growth	50.0	33.3	8.3	8.3	2.831*

Notes: ***, ** and * indicate 1, 5 and 10 percent level of statistical significance, respectively.

Table 9: Contributors to Government Budget Growth Forecast Errors

Panel A: Government Expenditure

Dep. variable: Gov. exp. growth (Forecast Error, FE)	9a All	9b LICs	9c Non-LICs
Interest Expenditure Growth	0.003	0.000	0.143*
(FE)	(0.008)	(0.008)	(0.013)
Non-interest Expenditure Growth	0.644***	0.667***	0.548**
(FE)	(0.066)	(0.082)	(0.014)
Cap. Exp. & Lending Growth	0.254***	0.251***	0.284***
(FE)	(0.020)	(0.021)	(0.003)
Constant	0.008	0.011	-0.006
	(0.007)	(0.008)	(0.003)
Observations	34	29	5
R-squared	0.895	0.891	1.000

Panel B: Government Revenue

Dep. variable: Gov. rev. growth (Forecast Error, FE)	9d All	9e LICs	9f Non-LICs
Grants Growth	0.069***	0.082**	0.019
(FE)	(0.024)	(0.033)	(0.010)
Tax Revenue Growth	0.529*	0.513*	0.523***
(FE)	(0.274)	(0.288)	(0.140)
Non-tax Revenue Growth	0.045*	0.043	0.077***
(FE)	(0.025)	(0.028)	(0.021)
Constant	-0.007	-0.008	0.000
	(0.010)	(0.012)	(0.012)
Observations	69	57	12
R-squared	0.415	0.422	0.764

Notes: All variables are forecast errors of growth rates. Robust standard errors in parenthesis. ***, ** and * indicate 1, 5 and 10 percent level of statistical significance, respectively.

Appendix

Table A1: Summary Statistics Forecast Error (FE) Regressions (in %)

	Observations	Mean	SD	Min	Max
GDP Growth FE					
GDP Growth	110	-0.5	4.3	-14.7	8.7
Private Consumption Growth	110	0.4	8.2	-22.1	27.4
Public Consumption Growth	110	-1.3	9.8	-28.8	50.3
Import Growth	110	-1.5	13.6	-36.1	64.6
Export Growth	110	-2.6	13.3	-53.2	29.6
Public Investment Growth	110	8.6	24.5	-42.7	110.8
Private Investment Growth	110	-2.4	21.4	-65.1	60.6
Government Expenditure Growth FE					
Gov. Expenditure Growth	34	1.0	10.2	-20.9	22.9
Interest Expenditure Growth	34	16.0	48.7	-30.5	248.4
Non-interest Expenditure Growth	34	-1.4	9.3	-28.9	24.1
Capital Expenditure &Net Lending Growth	34	4.2	24.1	-37.1	66.7
Government Revenue Growth FE					
Gov. Revenue Growth	69	-1.4	11.8	-30.4	36.1
Grants Growth	69	11.2	69.2	-168.3	282.1
Tax Revenue Growth	69	-2.1	9.4	-36.2	20.4
Non-tax Revenue Growth	69	-7.9	43.1	-161.6	145.4
Current Account Balance Growth FE					
Current Account Balance Growth	132	7.8	139.0	-655.4	801.4
Goods Imports Growth	132	-1.5	16.1	-48.1	61.9
Goods Exports Growth	132	-3.6	17.6	-72.7	37.9
Services Imports Growth	132	-3.1	17.6	-72.3	54.0
Services Exports Growth	132	-4.2	20.8	-105.4	67.4
Net Transfers Growth	132	-10.6	50.8	-210.6	179.1
Net Income Growth	132	-9.6	112.3	-820.3	211.5
Financial Account Balance Growth FE					
Financial Account Balance Growth	61	-26.3	214.0	-922.9	502.0
Net Direct Investment Growth	61	9.6	109.7	-248.5	652.6
Reserve Assets Growth	61	13.2	525.5	-1903.4	1443.9
Other Investment Growth	61	-105.1	1253.1	-6661.0	3415.9
Net Portfolio Investment Growth	61	-67.7	437.5	-2254.5	818.1

Countries in Broadest Global Sample

Afghanistan (x2), Albania (x2), Angola, Antigua and Barbuda, Argentina, Armenia (x4), Bangladesh (x2), Benin (x2), Bolivia, Bosnia and Herzegovina (x2), Brazil, Bulgaria, Burkina Faso (x4), Burundi (x3), Cameroon, Cape Verde (x3), Central African Republic, Chad, Colombia (x2), Comoros, Croatia, Cyprus, Democratic Republic Congo, Djibouti, Dominica, Dominican Republic (x3), El Salvador, Gabon, The Gambia (x2), Georgia (x3), Ghana (x3), Greece (x2), Grenada (x3), Guinea (x2), Guinea-Bissau, Haiti, Honduras (x2), Iraq, Ivory Coast (x2), Jordan, Kenya (x2), Kosovo (x2), Kyrgyzstan (x3), Latvia, Lesotho, Liberia (x2), Macedonia (x2), Madagascar, Malawi (x2), Maldives, Mali (x3), Mauritania (x2), Moldova, Mongolia, Morocco, Mozambique (x4), Nepal, Nicaragua, Niger (x3), Nigeria, Pakistan, Paraguay (x2), Peru (x2), Portugal, Republic of Congo (x2), Romania (x3), Rwanda (x2), St. Kitts and Nevis, Sao Tome and Principe (x3), Senegal (x4), Serbia, Seychelles (x3), Sierra Leone (x3), Solomon Islands (x2), Sri Lanka, Tajikistan, Tanzania (x6), Togo, Tunisia, Turkey, Uganda (x4), Ukraine (x4), Uruguay (x2), Zambia (x2)