FISCAL AFFAIRS

Special Series on Fiscal Policies to Respond to COVID-19

This is one of a series of notes produced by the Fiscal Affairs Department to help members address the COVID emergency. The views expressed in this note are those of IMF staff and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

Challenges in Forecasting Tax Revenue

Forecasting tax revenue during the current COVID-19 pandemic is a challenging task. Traditional approaches to forecasting, based on simple tax buoyancy or macro elasticities, will likely lead to an underestimation of the revenue decline. As the current shock is highly asymmetric across sectors and by size of business, more plausible results can be obtained if revenue forecasts are broken down by sector and type of tax, making use of available sector-specific information. Forecasts need to be continually updated as new information about the pandemic and its countermeasures becomes available.

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I. INTRODUCTION

The COVID-19 pandemic will cause a major decline in tax revenue in most countries. This is caused both directly by the economic slowdown and indirectly by tax policy and administration measures taken in response. The implications for households and businesses cause a disruption of economic activity in ways that are unique to this crisis. For instance, the need for social distancing has distinct effects on the tax base, tax administration, and taxpayer compliance. Furthermore, the pandemic may affect the structure of economies more permanently. In some economies the external sector is also likely to come under pressure resulting in depreciations or devaluation, which may also affect tax revenues, with the sign of such effect dependent on the economic structure.

Forecasting government revenue under these circumstances is challenging, but critically important. Some uncertainty in forecasts[1] is unavoidable, given unknowns in the development of the pandemic and the length of restrictive measures, and uncertainty in the forecasts of key economic variables. However, it is important for revenue forecasts to make full and consistent use of assumptions about the pandemic and the resulting growth impact and to avoid adding unnecessary biases or relying on foreseeably inappropriate methods. Policy makers will have to keep making consequential policy choices, which will require the best possible information, including revenue forecasts.

[1] This note uses the term “forecast” for brevity, but it also applies to estimates of very recent or current revenue (also known as “nowcasts”).

Experience from past pandemics—such as SARS, H1N1, and Ebola—confirms that forecasting is challenging but offers only limited guidance, given their different nature. These outbreaks differed from COVID-19, with SARS having very limited community spread and H1N1 very low mortality, so neither led to widespread social distancing measures. Even the Ebola outbreak, which had significant impact on Sierra Leone, Liberia, and Guinea generally did not cause negative growth (except in Sierra Leone in 2015).

This note first discusses the main channels through which the pandemic will affect tax and nontax revenue and how those can be incorporated in forecasts. This is followed by several case studies, which show that simple traditional forecasting methods may cause significant errors. The note concludes with a list of lessons for forecasters.

II. COVID-19-SPECIFIC ISSUES FOR REVENUE FORECASTING

The frequently-used method of forecasting revenue by applying an aggregate tax buoyancy to GDP forecasts is usually reasonably reliable, but often likely to overestimate revenue during the pandemic. The buoyancy is the percent change in total tax revenue resulting from one percent change in GDP.[2] The buoyancy thus reflects both structural features of the economy and tax system and policy measures taken over the cycle. In exceptional times, including in the current pandemic, it is unlikely that the historical relationship remains unchanged. Making projections based on such relationship can thus lead to—often but not always upward—biased projections. This section discusses the issues that are important in forecasting revenue during the pandemic and how standard methods can be extended.

A clear distinction should be made between the containment phase with major restrictive measures, and the period thereafter. The aftermath will likely be more similar to other post-shock recoveries, although there are risks of renewed waves of infections and a return of restrictive measures. As estimates for the short-term will form the basis for outer years, it is worth spending effort in improving their quality. For forecasts beyond the second year, more standardized methods can be used, because the impact of COVID-19-specific issues declines. This is not to say that some impact may not be permanent, but that would be covered in the lower revenue base from which outer years are projected.

Accounting for Policy Measures

As many countries have taken exceptional tax policy and administration measures in response to the crisis it is important to take their costs into account when forecasting.[3] It is therefore even more important than usual to distinguish between the baseline forecast—which assumes constant policies—and the impact of new policy measures.[4] One refinement over the use of a tax buoyancy is to use a tax elasticity. This is defined as the percent change in tax revenue net of new measures with respect to a base. This approach is therefore more precise, as it provides a baseline projection to which new measures can be added. It requires, however,

[2] These can be obtained by using time series data to estimate country-specific buoyancy with a simple log-linear regression of revenue on GDP, either in levels or differences. Alternatively, estimates from the literature can be used or one could set a buoyancy at 1, as they often gravitate toward this number.
[3] For an overview of tax policy and administration measures that can be taken in response to the pandemic, see: FAD, 2020, Tax Issues: An Overview, Special Series on Fiscal Policies to Respond to COVID-19. For further details on tax administration see: FAD, 2020, Tax and Customs Administration Responses, Special Series on Fiscal Policies to Respond to COVID-19.
[4] It also is important to distinguish between cash (often used in budgeting) and accrual accounting, and to transform from one to the other as necessary to ensure consistency depending on the purpose.

that policy changes, including in the past, are known and quantifiable. Even if past measures and hence elasticities are unknown and hence only a buoyancy can be used, the current year forecast should still be adjusted for some of the COVID-19-specific measures, because those are often unusual in size or nature and hence not covered by buoyancy estimates.

Asymmetric Impact of the Shock by Business Sector and Size

As tax burdens and elasticities vary by sector, the unusually large change in the sectoral composition of GDP will have a profound impact on revenue. It is normal that sectors perform differently over the cycle, but this asymmetry is much greater during the current pandemic. For instance, the hospitality and transportation sectors are in significant decline and some subsectors, such as passenger aviation or gastronomy in complete shutdown in many countries. Other sectors, such as agriculture are much less affected or less relevant as paying little tax, and yet others, such as telecommunications and retail sectors reliant on delivery, may thrive. Using sector-specific estimates therefore improves the forecast quality. Depending on how highly taxed are the sectors most affected by the pandemic, more or less revenue will be at stake.

Businesses of different sizes could also be exposed differently, and experiences of large taxpayers can be especially important for revenue projections. Small businesses are less likely to be diversified into more than one sector. Size-specific elasticity estimates are probably less relevant than sector specific ones (and often not available), but would still provide an improvement over aggregate ones, where no sectoral data are available. In many countries tax receipts are dominated by a few large taxpayers and engagement with them can provide timely and likely more reliable information than historical relationships on expected receipts.

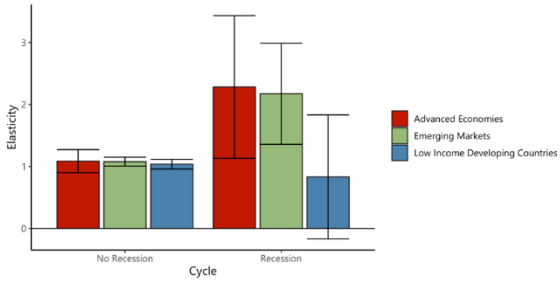
Different Impact Across Tax Bases

As the impact of the pandemic differs across tax bases, it is even more important than normally to forecast all major taxes separately. It is natural for tax revenue to differ by tax bases over the cycle, with, for example, profit-based taxes, such as the corporate income tax, much more volatile, than consumption or property-based taxes.[5] But these effects may be larger and different in this pandemic, with consumption tax revenue—normally relatively stable—strongly affected by social distancing measures. Some tax bases, such as those for air passenger duty or hotel room taxes, may even collapse (and while possibly insignificant in the aggregate, they may be important for the beneficiary of their revenue, such as municipalities). The performance of customs duties will depend on how the crisis affects trade and can change rapidly in case of exchange rate adjustments.

Nonlinearities

Tax revenue is unlikely to have a consistently linear or log-linear relationship with tax bases. The reasons include, for example, the progressivity of most personal income tax systems, which implies that tax revenue rises more than proportionally with income. In the case of the corporate income tax, headline rates are typically flat, but revenue is still likely to behave nonlinearly, because of the asymmetric treatment of losses, exemptions, and tax base

Figure 1. Responsiveness of VAT Growth to Changes in Final Consumption Growth



Sources: UNdata; IMF, World Economic Outlook; IMF, World Revenue Longitudinal Database, and IMF staff calculations.

[5] For tax-specific elasticities, see: Dudine and Jalles, 2017, "How Buoyant is the Tax System? New Evidence from a Large Heterogeneous Panel," IMF Working Paper, No. 17/4.

definitions. For instance, generous deductions, such as accelerated depreciation, have a fixed value and therefore reduce small profits proportionally more than large profits.

At a minimum, forecasts can be improved by using elasticities obtained from past recession episodes rather than averaged over all stages of the cycle. For VAT, for example, IMF staff estimated much greater elasticities for recessions, although it also depends on the income level of a country (Figure 1). Using elasticities from a similar cyclical position would still miss out any effect that is specific to the current crisis, but at least it would reflect some of the effects common to all cyclical downturns.

Where available, further insights can be gained from micro-data, such as firm-specific data. While resource intensive, this allows more precise modelling of the actual shocks hitting different individuals or firms taking into account the specific features of the tax system in a given country.

Commodity Price Effects

The sharp decline in many commodity prices, including crude oil, will have a profound impact on revenue for countries that are substantial producers.[6] These price declines are certainly driven by many factors rather than only or mainly the pandemic. Even for the part resulting from the pandemic, the effect of the price drop is in principle no different than in other times of low commodity prices—although it is exceptionally large—but it certainly means that resource and nonresource revenue should be forecast separately.

Compliance

The crisis will hamper administrations' ability to collect taxes and may affect taxpayer compliance. Analysis of the impact of the financial crisis[7] found that taxpayer compliance tends to decline during an economic downturn but recovers quickly thereafter. This indicates a cash-based compliance effect rather than a more persistent change in taxpayer behavior. In the current crisis, revenue will most certainly be affected as countries delay filing or payment dates, either to support taxpayer cashflow or—where filing still takes place in person—to allow for social distancing. It is therefore important to be aware of the collection mechanisms in place, and their potential impact on revenue.

High Frequency Data and Cross-Country Experiences

Given the high uncertainty surrounding tax forecasts, it is useful to closely examine high frequency data on collections and to adapt forecasts in light of any differences with previous projections. Given that countries are in different stages of the spread of the virus and the countermeasures, insights can also be gained from those countries that are similar in structure but ahead in terms of the pandemic. Similarly, information from taxes with rapid collection, such as VAT, can help in making projections for those with later collection, such as the corporate income tax, though of course after making adjustments for the differences in tax bases.

III. ILLUSTRATIVE EXAMPLES

This section provides some examples of how the methods discussed above can be used to improve forecasts compared to a simple buoyancy approach. The selection of countries was made to achieve broad

[6] See also Baunsgaard and others, 2020, "Natural Resource Fiscal Regimes: Tax Policy Response." Special Series on Fiscal Policies to Respond to COVID-19.
[7] IMF, 2015, Current Challenges in Revenue Mobilization - Improving Tax Compliance, Policy Paper.

coverage across key country characteristics—such as income level, region, and dependency on natural resources—while also reflecting readily available data.

Sectoral and Tax-Specific Breakdowns—Somalia

Using sector and tax-specific revenue forecasting methods almost doubles the decline in revenue forecasts compared to a standard buoyancy approach in Somalia. Somalia is a low-income country with a tax system that is heavily dependent on international trade taxes (69 percent of revenue) and taxes on goods and services (16 percent). The key sectors contributing to revenue—aviation, construction, energy, telecommunications and retail trading—are likely to be affected very differently by COVID-19, and projections should therefore be sector specific. While first quarter collection data from customs and tax administration are still in line with past trends, it would be misleading to ignore sector-specific information for the following quarters. Notably, given the closure of airports and facilities in the hospitality industry, related sales tax revenue has been projected to decline by 80 percent, while revenue declines in the telecommunication sector are limited. The forecast also differentiates by type of tax, with trade taxes declining in some areas (e.g., construction material imports from China), while the corporate income tax is largely unchanged in 2020, because current payments reflect the previous year's profits outcome, with some decline only due to expected deterioration in payment discipline. (The 2021 payments will of course therefore be lower, based on 2020 profits). Overall this sector and tax-specific revenue forecasting approach results in a 23 percent decline in revenue for 2020 relative to a 14 percent decline that would have been implied by using the standard buoyancy on GDP.

Microsimulations to Refine Corporate Income Tax Forecasts—Rwanda

Given a shock concentrated on a few sectors, a sectoral breakdown would already allow more precise revenue forecasts. The brunt of the pandemic in Rwanda is felt by its tourism and mining sectors. Tourism is affected by travel restrictions and social distancing, with all borders in Rwanda closed, whilst a slowdown in the importation of intermediary and capital goods (particularly from China) has affected mining.

A company-specific microsimulation model for Rwanda reveals revenue losses of almost twice the amount expected under a macroeconomic buoyancy estimate. For each firm, the expected tax liability during the pandemic is estimated using a microsimulation model (Table 1).[8] In line with WEO projections, turnover in the accommodation and restaurant sector, which contributes 3 percent to total corporate income tax revenue, is expected to contract by 10 percent compared to a situation without the pandemic. Firms in this sector are assumed to reduce variable expenses by 10 percent in response, but do not adjust their fixed costs, given the unexpected nature of the shock. The relatively low share of variable costs for accommodation and restaurants lead to a larger reduction in their profit and hence a disproportional reduction in tax revenue (21 percent). In comparison, the revenue reduction in administrative services of 3.6 percent, which has a high share of variable costs, is in line with the reduction in turnover of 3.2 percent. Overall, for the current scale of the pandemic, a 3.2 percent reduction in aggregate output/turnover from the pre-COVID-19 baseline is expected to lead to a 6.5 percent reduction in corporate income tax revenue. A much deeper slowdown, in which aggregate output is assumed to be reduced by 14 percent, would lead to a 24 percent reduction in revenue. In contrast during periods of normal economic activity, where firms are able to adjust their fixed costs, the microsimulation model yields a buoyancy of 1.1, consistent with buoyancies estimated using macroeconomic aggregates.

[8] The model utilizes administrative level data and an industry survey which allows identifying the economic sector, sales, variable expenses and fixed expenses at the firm-level. Fixed costs include depreciation, rents and interest payments.

Table 1. Effects of Pandemic on Corporate Income Tax Revenue (percent deviation from baseline)

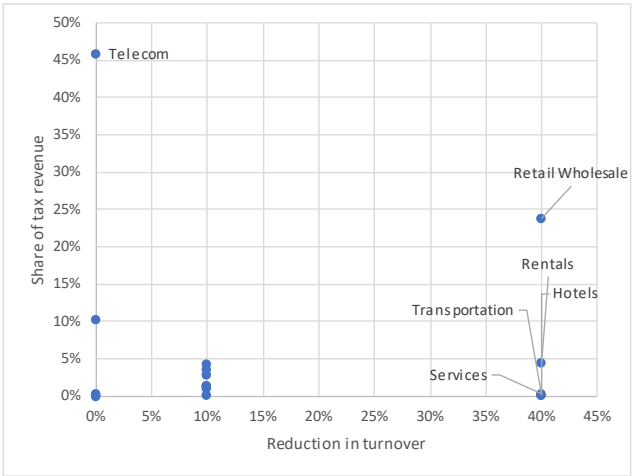
	Variable cost share	Share of tax revenue	Pandemic		Deeper slowdown	
			Output shock	Tax revenue effect	Output shock	Tax revenue effect
Agriculture	100%	0.8%	-2.2%	-3.9%	-9.9%	-15.4%
Mining and quarrying	88%	0.3%	-12.8%	-37.3%	-57.3%	-95.9%
Manufacturing	80%	9.2%	-2.9%	-8.2%	-13.0%	-33.8%
Electricity	97%	0.1%	-3.3%	-4.1%	-14.8%	-18.0%
Water supply	90%	0.2%	-3.3%	-7.2%	-14.8%	-27.2%
Construction	98%	6.4%	-8.0%	-11.9%	-35.8%	-18.7%
Wholesale and retail trade	75%	15.1%	-3.2%	-6.8%	-14.3%	-26.0%
Transportation and storage	75%	3.9%	-6.0%	-11.9%	-26.9%	-40.4%
Accommodation and restaurants	83%	2.9%	-10.0%	-21.2%	-44.8%	-72.2%
Information and communication	76%	9.5%	-3.3%	-6.6%	-14.8%	-29.1%
Financial and insurance activities	83%	41.8%	-3.0%	-3.9%	-13.4%	-17.4%
Real estate activities	33%	0.8%	0.0%	0.0%	0.0%	0.0%
Professional services	89%	2.2%	-3.2%	-4.4%	-14.3%	-18.7%
Administrative services	95%	3.1%	-3.2%	-3.6%	-14.3%	-14.2%
Public administration	0%	0.1%	0.0%	0.0%	0.0%	0.0%
Education	91%	1.1%	2.3%	2.1%	10.3%	11.4%
Health and social work	98%	0.5%	2.3%	4.4%	10.3%	20.1%
Other services	80%	0.2%	-6.5%	-30.1%	-29.1%	-68.8%
Total			-3.2%	-6.5%	-14.3%	-24.0%

Source: IMF staff estimates based on data from Rwandan authorities.

Microsimulations to Refine Corporate and Personal Income Tax Forecasts—Dominica

While the typical sectors are affected in Dominica, once company-specific tax regimes are taken into account, the revenue impact is very different. As a result of generous corporate income tax holidays and other preferential treatment for the tourism sector, transportation, hotels, rentals and other services contributed only 5 percent of total corporate income tax revenue (Figure 2) even though the sector contributes 20 percent of GDP. Using tax return data, the tax consequences of a 40 percent decline in turnover in the tourism and retail/wholesale sectors, as well as more modest declines of 0-10 percent in other sectors are calculated. In aggregate terms, turnover is forecast to decline by 15 percent, with corporate tax revenue down 20 percent—implying that the aggregate elasticity is much lower than in the Rwandan example. Without information on the generous tax provisions applying to the affected firms, and which therefore pay little tax both before and after the crisis, revenue estimates would likely be biased, although in this case downward.

Figure 2. Sectoral Sensitivity to Pandemic and Revenue Relevance



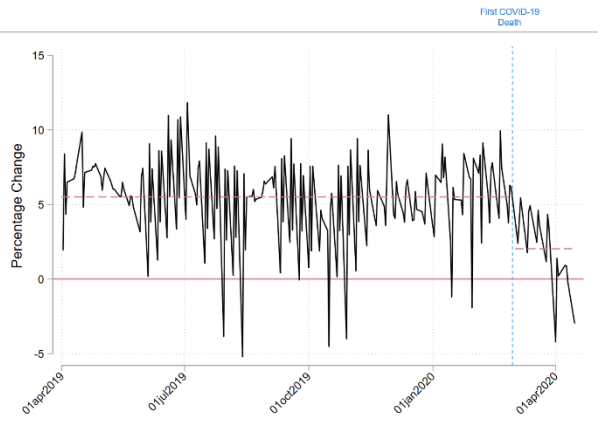
Source: IMF Staff calculations based on data from IRD.

With loss of employment income concentrated among low-income earners, the impact on the personal income tax forecasts is also more muted than what would have been assumed from the decline in aggregate incomes. The hotel and restaurant industry feature a relatively low average wages (ECD 9,000) at around half the economy wide average and below one third of the tax-free threshold (ECD 30,000). As a result, wage losses in this sector have very limited revenue consequences. As personal income tax returns do not specify the sector, a forecast was performed assuming that individuals are differentially affected depending on their income level, which proxies for the nature of their specific jobs:[9] those earning below ECD 45,000 face a 40 percent reduction in their income; those earning up to ECD 70,000 have a 10 percent reduction in income, and those earning above that level (top 12 percent of taxpayers) have no change in income. Under this scenario, taxable income falls by 20 percent whilst PIT revenue falls by 16 percent. In contrast, with a uniform 20 percent reduction in taxable income, revenue would fall by 42 percent, because around 19 percent of total taxable income would fall below the tax-free threshold. So, in this case simple forecasting methods would have under-, rather than overestimated, revenue.

High Frequency Revenue Data—United States

The daily revenue data published by the United States already show a COVID-19 impact. The United States publishes daily revenue data on a cash-flow bases with a lag of a few days. While subject to significant noise and complex seasonality, the COVID-19 impact can already be spotted. Figure 3 shows the decline in daily collections since the first COVID-19 death (the dashed red lines show the simple average before and after). Similar statistics on VAT collection for European and Latin American countries are available with lags of 1 to 3 months, so by the end of April and May, the first figures covering the Covid-19 period will be public and could provide further insights—while revenue authorities may see some internal data even earlier.[10]

Figure 3. Daily Change in Personal Income Tax Withholding Revenue



Source: US Treasury and IMF staff calculation.

Petroleum Sector Revenue Forecast—Ghana

For countries that depend on natural resource revenue, a project-level or sector-wide revenue forecasting model provides a more refined estimate of the impact of lower commodity prices during the crisis. A revenue model also facilitates preparing alternative scenarios under different price forecasts. An example is the petroleum sector fiscal model for Ghana prepared by FAD, which reflects both the timing of

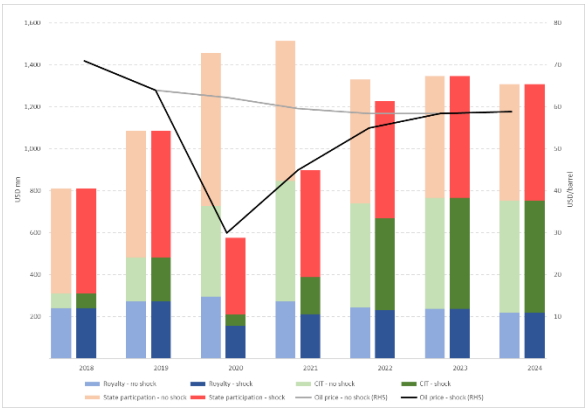
[9] This assumption is consistent with evidence in other countries. For example, based on evidence from the American Time Use survey, around 9 percent of workers who had earnings in the lowest 25th percentile can work from home, compared with 62 percent of workers in the highest 25th percentile. Full-time workers were twice as likely as part-time workers to be able to work from home, thus facing a much smaller risk of unemployment jobs if needed to be physically away from their official workplace.

[10] For other examples on the use high frequency fiscal data, see: F. Misch, B. Olden, M. Poplawski-Ribeiro and L. Kejji (2017), Nowcashing: Using Daily Fiscal Data for Real-Time Macroeconomic Analysis, IMF Working Paper No. WP/17/227.

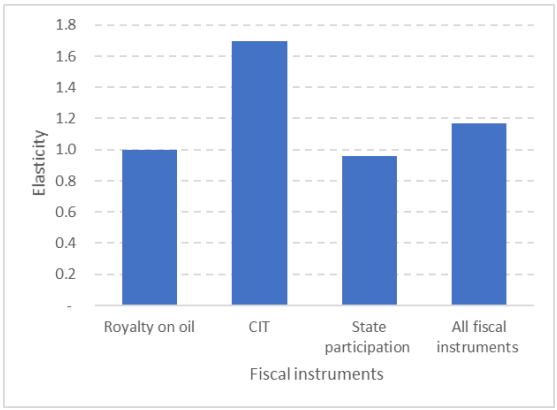
investment and production across three oil fields and differences in the price elasticities of the main fiscal instruments. Before the recent oil price collapse, petroleum revenue was forecast at $1.5 billion in 2020 or 2 percent of GDP.[11] After the significant decline in oil prices in 2020, petroleum revenue could fall by 60 percent ($880 million).[12] The revenue price elasticity in the petroleum fiscal regime at 1.2 is high, reflecting that the corporate income tax is more sensitive to changes in oil prices than the royalty (with price elasticities of 1.7 and 1.0, respectively). There are other impacts on the sector. For example, due to the uncertainty about future prices, investors have decided to postpone the investment decision for a new oil field, which will impact the potential petroleum revenue during the post-crisis economic recovery.

Figure 4. Ghana Petroleum Sector Revenue: FARI Fiscal Simulation

a: Revenue composition before and after the oil price shock



b: Elasticity of petroleum revenue to change in oil price



Note: The revenue forecast is for total petroleum revenue and not the benchmark petroleum revenue used for budget purposes (the latter also includes revenue transferred to the petroleum savings funds). The realized net benefits from state equity participation will actually be lower as the gross estimates here do no include financing cost associated with the equity participation.

IV. LESSONS FOR FORECASTERS

The most appropriate revenue forecasting strategy will depend on the country—and in practice on data availability. It seems clear that the most common forecasting approach—the use of an aggregate tax buoyancy—is now likely to lead to biased results. This bias will often—but not always—lead to overestimation of revenue. The strategies discussed in this note can improve forecasts and rather than picking one, they can be combined. For example, in a sectoral breakdown, for sectors that are not directly affected, a standard approach could still work, while in directly affected sectors, it would be better to replace elasticities estimated from past data by a judgmental value based on available information for that sector. More generally, forecasters may need to make (prudent) use of subjective adjustments to account for events which are likely to materialize, and which could be expected to impact revenue, but are not captured by the model (such as an increase or drop in

[11] This is an application of the Fiscal Analysis of Resource Industries (FARI) methodology. See https://www.imf.org/external/np/fad/fari/.
[12] There is also a risk that petroleum production may be impacted by the introduction of temporary public health related restrictions.

compliance). Transparency is the norm when it comes to incorporating subjective adjustments; forecasters should provide information as to the nature and magnitude of any such adjustment.

- Be prepared that revenue can be lower than implied by simple buoyancy approaches.
- Invest most effort into short-run forecasts, while longer-horizon forecasts (beyond 2 years) can for the present be based on standard methods.
- Take separate account of policy measures
- Update forecasts as more information about the pandemic and its countermeasures (for example, the length of lockdowns) becomes available.
- Use disaggregated elasticities where available. Break revenue down by tax, and ideally also by sector.
- Use judgement to override forecasts based on models or past data, especially where models cannot take account of COVID-19-related developments.