FORECASTING GOVERNMENT CASH FLOWS IN THE UK

Introduction

1. This note summarises the process of government cash flow forecasting in the UK.[1]

2. Best practice in government cash flow management requires accurate and timely estimates of the cash flows between government and the rest of the economy over a period ahead. The longer the period, and the finer the forecasts, the better. In countries where there is a well developed cash management system, daily forecasts are available for some months ahead – although those forecasts will be updated as the relevant days approach. The flows to be forecast include both government receipts and payments (i.e. those that contribute to the fiscal deficit) and financing transactions (i.e. those that finance the fiscal deficit).

3. Most countries prepare annual forecasts of the government's fiscal position for one or more years ahead. Such forecasts are needed both for macro-economic policy purposes and as part of internal budgeting and expenditure planning exercises. In practice the process of daily cash flow forecasting is done separately from, but constrained by, the annual forecasts. There is therefore a two part process:

   a. Forecasting annual revenue and expenditure and the net fiscal surplus and deficit. In the UK the primary focus is on an accruals-based concept – public sector net borrowing. But the process also generates a forecast for the relevant cash flow aggregate – the Central Government Net Cash Requirement (CGNCR).

   b. Forecasting the profile of flows within the year, consistently with the forecast for the year as a whole.

4. The way that the UK approaches these two exercises is summarised below.

Annual Forecasts[2]

5. Forecasts of the public finances in the UK are the responsibility of HM Treasury although a number of other government departments contribute, in particular the tax departments (Inland Revenue and Customs and Excise) who provide detailed, tax-by-tax projections of revenues. The approach is 'bottom-up' whereby forecasts of government deficits and borrowing are built up from

[1] This note has been prepared on the basis of the author's knowledge and published material; it has not been formally approved for publication by HM Treasury, and any use made of it should take this into account.

[2] This section and the annex rely heavily on: Tim Pike and David Savage "Forecasting the Public Finances in the Treasury" (Fiscal Studies, 1998).

forecasts of each of the individual taxes and non-tax receipts that make up total general government receipts, and from each of the main components of total general government expenditure.

6. Care is taken to ensure consistency between individual projections and the Treasury's aggregate economic forecasts. To take the example of tax receipts: the first step of the forecasting process is for the Treasury to prepare a preliminary economic forecast using its macro-economic model[3] and to send to the revenue departments projections of the economic variables (for example, consumers' expenditure, profits and wages and salaries) that they require to run their models. The detailed tax projections made by the revenue departments are, with any implications for other variables, fed back into the Treasury macroeconomic model, which contains some (fairly simple) tax equations. These tax variables then iterate as the economic forecast evolves.

7. More detail on the forecasting methods used for both revenue and expenditure is attached as an annex.

8. The government's net cash flow is a difficult variable to forecast because it is the difference between two very large numbers. So if errors of only 1 per cent are made on both expenditure and receipts, but they are differently signed (which is likely to be the case if they reflect errors in forecasting economic activity), then the error on the total borrowing requirement will be around 0.7% GDP. Average absolute errors have tended to be this order of magnitude, although there were somewhat greater in the late 1980s and early 1990s, a consequence of the economic turbulence of that period. Errors have tended to be cyclical, reflecting the failure of economic forecasts fully to capture the cycle in economic activity. But despite the large average errors, it is important to emphasise that the borrowing forecasts substantially outperform simple rules of thumb, such as assuming that borrowing always takes its mean value or is always equal to its value in the previous period.

Monthly and Daily Forecasts

9. Once a forecast is completed, the current financial year forecasts of the main fiscal aggregates are converted into consistent monthly profiles, in order to produce a monthly profile of the borrowing requirement. Monthly out-turns can then be compared against the profile, to help assess whether the forecasts are on track.

10. As with the forecast itself, the monthly profile of receipts is produced using 'bottom-up' methods. That is, with the help of the revenue departments, monthly profiles are produced for each of the main taxes, for other tax revenues (such as from the council tax and business rates) and for non-tax receipts (such as interest and dividends). The profiles take into account the regular seasonal variations in the tax yield. For example, a very high

[3] The Treasury uses a single macro-economic model for its preparation of both short-term and medium term forecasts of the public finances and other economic variables.

proportion of the full year's tobacco duty is received in just one or two months of the year, as manufacturers and importers can pay the duty on substantial amounts of product in advance of expected duty rate rises ("forestalling") and in subsequent months pay very little duty. The main spending departments are also asked to produce monthly profiles, for both their discretionary and non-discretionary expenditure.

11. Conversion of these monthly forecasts into daily profiles is done primarily by the small team in the Treasury who are responsible for assembling the daily forecasts that are passed to the UK Debt Management Office for their cash management operations. But the preparation of these daily forecasts will be done in close consultation with the spending or tax departments concerned; and there is a continuous process of updating in the light of information on actual receipts and payments.

12. Some daily flows are know with more precision that others. For example:

a. The timing and amount of some substantial transactions are known precisely some time in advance, such as bond redemptions, and the periodic payments from central government to municipal authorities. Some payments, e.g. grant payments to further and higher education authorities, may be known precisely, although only a few days in advance.

b. The timing of some flows may be known precisely although the amount is uncertain – e.g. receipts from major asset sales[4].

c. There is a marked monthly pattern to some flows. Income tax payments under the PAYE scheme are made by employers at the same time each month; as are payments out of government under a number of social security schemes.

d. Even where payments or receipts do not necessarily fall on one day, there will tend to be a well understood distribution across the month, or around a due date – this applies for example to receipts from most income taxes and from VAT. Sometimes simple rules of thumb are used (e.g. quarterly receipts from a tax might be split 20% T-2, 25% T-1, 40% T and 15% T+1), although more sophisticated patterns are also applied, and they will be revised if actual receipts fall into a different pattern.

e. In some areas of expenditure, there may be no better information or experience to assume anything but the flows are flat across the month. But the daily forecasts may be changed if, on the basis of

[4] Where such flows have been very large, e.g. following major privatisations, departments are required to consult the Treasury to ensure that the date chosen is sensible in terms of the cash flow profile

regular dialogue and updating with the major spending and tax departments, it appears that the monthly total is too high or too low.

13. This forecast information is continually updated in line with actual flows. This process becomes more intense the closer it gets to the day in question. On that day, and the day immediately before, updates from departments are enhanced with information coming directly from the office that manages the transactions of many departments, and from the Bank of England, the government's banker. Again various rules of thumb are applied to try and give accurate predictions for the government's position at the Bank of England at the end of the day – for example experience might suggest that by 2pm the government has received 60% of over-the-counter tax payments that it is likely to collect that day. At the end of every day there is a detailed reconciliation between what was expected to happen and what did happen – and in the light of that, subsequent days' forecasts may be modified.

14. During the year the Government's macro-economic forecasts for the year as a whole, and following years, may be revised. That in turn will require an update of the monthly and daily profiles for the remainder of the year, to ensure that they are consistent with the forecast for the year as a whole.

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ANNEX: FORECASTING METHODS

Government Receipts

1. The public sector receipts section of the Treasury's macroeconomic model has 44 behavioural or technical relationships, and 20 exogenous variables[5]. Most of the behavioural tax equations express the tax yield as some function of the tax base *times* the tax rate, where the tax base is proxied as closely as possible by appropriate income or expenditure variables on the model.

2. As the Treasury model is designed to simulate the effects of changes in policy instruments as well as to forecast, most major tax rates and allowances are identified. Some equations are highly non-linear; for example, the main income tax equation uses the gamma distribution: $n(x)=Ax2\exp(-BX)$, where $n(x)$ is the number of taxpayers with income x, and the parameters A and B are defined in terms of the number of employees and the level of average earnings.

3. Reflecting the wide range of economic transactions covered by the tax system, and hence the heterogeneity of tax bases, it is considered necessary to have a reasonably disaggregated treatment of tax receipts. For example, income tax is modelled by four behavioural equations, covering PAYE[6], taxes on self-employment income, net company tax on investment income, and other (net) taxes on personal incomes. Similarly, corporation tax is modelled by equations for advance corporation tax, onshore mainstream corporation tax, North Sea corporation tax, and payments of taxes on company gains. The model also has behavioural equations for equity and house prices, which provide the tax bases for capital taxes, such as capital gains and inheritance tax, and stamp duty.

4. Despite various slimming exercises, which reduced the total number of variables from over 1,000 in the late 1980s to about 350, the Treasury model continues to have well-defined income and expenditure accounts, which provide the tax bases for the direct and indirect taxes, respectively. Inevitably, however, the complexity of the tax system is such that some of the model equations do not perform particularly well. Corporation tax is especially difficult to model using macroeconomic variables. For example, companies can set-off past losses and interest payments against their taxable profits, and allowances and tax losses reduce the aggregate tax yield. The impact of these factors varies through the economic cycle, which in part explains the volatility of corporation tax receipts; and there is no clear relationship between

[5] A full description and listing of all the equations is given in the 'HM Treasury Macroeconomic Model Documentation', updated annually and available from HM Treasury.

[6] PAYE = Pay As You Earn. Employers are required to estimate the tax likely to be due on the salaries and wages paid to their employees, and pass that sum to Inland Revenue each month. There is then reconciliation with individual employees after the end of the tax year.

the tax yield and measures of companies' gross trading profits in the national accounts.

5. The Treasury relies a great deal on the expertise of Inland Revenue and Customs and Excise, which maintain forecasting models for each of their taxes. The corporation tax and North Sea oil models are by far the most complex. Both are micro-simulation models based on, respectively, the taxpaying history of a sample of about 15,000 non-North-Sea companies (including all of the largest 3,000 firms) and all companies operating in the North Sea. For corporation tax, many very large companies are modelled separately, using company-specific assumptions about their future prospects.

6. The income tax regime is also complex. For example, the self-employed have to follow similar rules to companies when computing their profits, and can also claim capital allowances and set off losses in much the same way, but, like all other income tax payers, their tax bill depends on a complicated regime of rates and personal allowances. There is, however, much less volatility from year to year in income tax receipts from employment, largely collected under PAYE, and most of Inland Revenue's income tax models are consequently much smaller.

7. Each of the excise duties — on alcohol, fuel and tobacco — is modelled as part of a consistent system of equations, with cross-elasticities of demand that allow consumption of beer, for example, to be a function not just of the price of beer but also of the price of close substitutes, such as cider and spirits. Some other taxes are forecast using single behavioural equations which have explanatory variables that are not included in the Treasury's macroeconomic model. For example, Customs' equation for value added tax (VAT – the UK's sales tax) includes the number of registered traders as an explanatory variable to allow for past increases in the real registration threshold. It has proved very difficult in recent years to model and forecast VAT receipts, partly because of the expansion of tax planning and avoidance and a worsening of traders' compliance.

8. There are 'top-down' checks to guards against the risk — with such a highly disaggregated approach — of losing the wood for the trees. To give an example: Inland Revenue's forecast of total income tax receipts is converted into a forecast of the effective tax rate, using the Treasury's forecasts of wages and salaries as the tax base. The forecast effective tax rate can then be split up into components that reflect the effects of real fiscal drag (the tendency because of the progressivity of the tax system, for tax receipts to grow faster than GDP as real GDP grows), the impact of all previous tax changes over the period and an underlying component (the residual). The profile of the underlying effective tax rate can then be assessed for consistency with the forecasts of other tax determinants, such as the level of employment and the growth of average earnings.

9. Treasury forecasters also check that the aggregate forecasts of tax revenues appear plausible, viewed against expected movements in the aggregate tax burden (the ratio of total tax accruals to GDP). Expected

movements in the tax burden take into account the effects of tax changes, real fiscal drag and the effects of the economic cycle.

Government Expenditure

10. A large part of government expenditure – mainly the discretionary elements – is determined in budgeting discussions between the Treasury and spending departments. These discussions give to the departments provisional authority to spend within an envelope stretching three years forward. For the purposes of Treasury forecasts, spending covered by this system has generally been projected at its planned level.

11. For demand determined or economically cyclical expenditure, the procedures are more complex. For example, expenditure on cyclical social security (CSS) is comprised of three components: income support to the non-elderly, unemployment benefit and income support to the unemployed.

12. The Department of Work and Pensions (DWP) forecasts this expenditure using the Treasury's assumptions for unemployment, and the retail price index. The DWP model is highly disaggregated, but essentially forecasts spending as the product of the expected average caseload in any one year and the average amount of benefit paid. Caseload is projected by looking at particular client groups (the short-term and long-term disabled, lone parents and others). The disabled group caseload is estimated using inflow and outflow models. The number of lone parents is forecast using a time-series model. Historical data on average payments are given in a quarterly statistical enquiry based on a sample of claimants. Again, modelling is done at a disaggregated level, looking at the recent trends in average benefit payments for different client groups.

13. The Treasury's macroeconomic model contains a simple econometric equation for cyclical social security expenditure as a function of unemployment, inflation and a time trend (proxying the trend in the non-unemployed caseload and any unidentified policy effects). For internal Treasury forecasts, the residual on the equation is set to generate an underlying trend in caseload consistent with the DWP numbers. The equation is then allowed to iterate with unemployment and inflation, as the forecasts for these diverge from those used for public expenditure planning.

Debt Interest

14. The forecasts of debt interest rely mainly on technical relationships of the following form:

Interest payments = Interest payments in the previous period + Rate of interest × New borrowing.

15. This assumes that payments on existing debt will continue at their present level (as most debt is issued at fixed rates), while new borrowing (including the refinancing of redemptions) will be at projected interest rates.

16. As well as borrowing and interest rates, levels of debt interest are also affected by the inflation rate and changes in the mix of debt. Issues of index-linked debt result in a greater sensitivity to the inflation rate and to lower cash payments in the short term (as the uplift is accrued and only paid upon redemption).

17. Most public sector interest payments are made by central government to the private sector and overseas. For forecasting purposes, they are split into four main types of payment: interest on conventional gilt-edged stock; interest and the inflation uplift on index-linked gilts; interest on retail savings; and interest on Treasury bills.

18. The forecast of interest paid on existing *conventional gilts* is based on a detailed analysis which identifies the coupon, redemption date and nominal value of every gilt in issue. The forecast of interest on new issues is done at an aggregate level, taking account of the likely path of gross new issues, the coupon on these issues and the time lag before interest starts to be paid. Given the overall borrowing requirement, new issues are projected so as to satisfy the government's funding policy. The coupon is projected in line with the interest rate assumptions in the economic forecast. The timing of interest payments depends on whether the gilts are new issues or further tranches of existing stock. All gilts are normally assumed to be issued at par. Interest on *index-linked gilts* is handled in a similar way, using a forecast of the retail price index. The forecast of interest on *Treasury bills* is based on assumptions about short-term interest rates and the size of the Treasury bill tender.

19. Projections are also needed of some financial transactions that will score as financing items in the national accounts. The most important of these transactions are asset sales, such as privatisations, and net lending. Projections of central government financial transactions are made in consultation with the relevant policy teams in the Treasury.