Office for
Budget Responsibility

Briefing paper No. 3

Forecasting the economy

October 2011

Any queries regarding this publication should be sent to us at: obrenquiries@obr.gsi.gov.uk

ISBN 978-1-84532-861-0
PU1203

Contents

1 Introduction

Aim and background

1.1 The Office for Budget Responsibility (OBR) was created in 2010 to provide independent and authoritative analysis of the UK's public finances. Twice a year we produce medium-term forecasts for the economy and the public finances, which we present in our *Economic and fiscal outlook* (EFO) publications. These forecasts allow us to judge the Government's progress towards the fiscal targets that it has set itself.

1.2 The aim of this paper is to describe the way in which we produce our economic forecasts. This reflects our determination to make our forecasts and methods of working as transparent as possible, so as to increase public confidence in our work (although people may well disagree with the particular assumptions we make and conclusions we reach). This paper represents our current forecast approach, but this will be modified and updated over time as we identify potential improvements. Any such changes will be set out in the OBR's annual *Forecast evaluation report* (FER) and in any future editions of this paper.

1.3 This paper is the third in a series of briefing papers, designed to describe and explain our work and the material we present. All are available on our website (www.budgetresponsibility.independent.gov.uk). *Briefing paper No. 1: Forecasting the public finances* describes and explains our approach to forecasting the public finances and *Briefing paper No. 2: Estimating the output gap* explains the way in which we estimate the amount of spare capacity or excess demand in the economy.

Nature of the OBR economic forecast

1.4 Since our economic forecast is tailored to the needs of our fiscal forecast it has some distinctive features when compared with most other forecasts of the UK economy:

- the Government's primary fiscal target – the fiscal mandate – is defined over a rolling five-year horizon and our fiscal and economic forecasts therefore extend over the same period. This is a longer horizon than forecast by the Bank of England in its *Inflation Reports* or the OECD in its *Economic Outlooks*. In any forecast over this horizon, the evolution of the supply potential of the economy is crucial in determining the scope for economic growth. An

assessment of supply potential therefore provides a medium-term anchor for the forecast;

- the Government's fiscal mandate targets a cyclically-adjusted measure of the current budget balance – in other words, an estimate of what the balance would be if output in the economy was equal to the level consistent with stable inflation (i.e. the 'output gap' was zero). This again makes the forecast of supply potential especially important. We need to estimate the current and future size of the output gap to assess whether or not the Government is on course to achieve the fiscal mandate;

- tax receipts and government spending are strongly influenced by variables such as wages and salaries and nominal GDP. This means that we need to produce a detailed forecast of both the income and expenditure sides of the economy. Indeed, we need to present detailed forecasts of over 100 economic determinants, which are used to construct the fiscal forecasts. This is in marked contrast to, say, the Bank of England's Inflation Reports, which include published forecasts for only two variables – GDP growth and CPI inflation. Given the role of the forecast primarily as an input into our aggregate UK fiscal projections, we do not produce a detailed regional or sectoral breakdown of the output side of the economy, important and valuable though these are for other purposes;

- we also need to assess the potential impact on the economic outlook of any policy decisions announced by the Chancellor alongside our forecasts. We need to do this before the measures have been announced and before financial market participants and other interested parties have had a chance to respond to them; and

- considerable uncertainty lies around all economic forecasts. So when we present our results we quantify the confidence that people might place in them judging from past forecast errors. We also test the significance that key judgements in our forecast have for the public finances by creating and presenting alternative scenarios as well as our central view.

The forecasting process

1.5 In constructing our economy forecast we consult widely with external forecasters and analysts in order to ensure we are aware of as much relevant data and evidence as possible. The forecast is then produced entirely by OBR staff using assumptions and judgements agreed by the Budget Responsibility Committee (BRC). This is a different process to the public finances forecast, described in *Briefing paper No. 1: Forecasting the public finances,* where individual forecasts of tax and expenditure are produced by experts in the relevant government departments, using models, assumptions and judgements agreed independently by the BRC, before being collated by OBR staff in order to construct forecasts of the fiscal aggregates.

1.6 Consistent with the *Charter for Budget Responsibility*, the date for publication of our economic and fiscal forecasts is set by the Chancellor. In the absence of exceptional circumstances, the Chancellor is required to provide us with at least 10 weeks notice of the publication date.

1.7 The economic forecasting process normally begins around two months before the proposed publication date. It starts with the production by OBR staff of an initial forecast that takes account of information that has emerged since the last published forecast. This includes ONS data, private sector survey evidence and developments in the domestic and international economic and financial environment. This initial view on the shape of the economic forecast - and of several key fiscal determinants (e.g. nominal GDP, consumption, wages and salaries) - allows us to start the process of producing the public finances forecast.

1.8 This is the start of an iterative process over several rounds - with subsequent economy forecasts incorporating the output from the previous public finances forecast and vice versa. The economy and public finances forecasts are interdependent so these iterations ensure that the effects of changes to one element of the forecast are fully reflected in the forecast as a whole. The steps involved in producing a round of the fiscal forecast are described in detail in *Briefing paper No. 1: Forecasting the public finances*. As this process continues, new economic data releases are incorporated, the list of any policy measures to be included evolves and the BRC takes all the key economic judgements that guide the forecast.

1.9 During the process we engage with other economic forecasters in focus groups and bilateral meetings to foster knowledge sharing and improve our understanding of the economy and forecasting tools. The discussions can be on specific economic issues, like the world economy and credit conditions, or

general knowledge-sharing sessions. We consult widely with representatives from the Bank of England, the National Institute of Economic and Social Research (NIESR), the European Commission (EC), the OECD and the IMF as well as government economists and other analysts. We are also active members of ONS expert groups, as well as of various working groups at the IMF, OECD and the EC.

1.10 We also assess the potential economic impact of any new policy measures that the Chancellor plans to announce alongside our forecast. It is for the BRC to judge whether these measures are likely to have a non-negligible impact on the economic outlook and, if so, how to adjust the forecast accordingly.

1.11 We aim to ensure that the final forecast incorporates as much information and data available at the time of publication. However, it is also important that we leave sufficient time after the forecast is finalised to allow us to produce the accompanying documentation to a high standard. This typically means finalising the forecast some days before publication, with the precise date typically depending on the timing of key data releases. If the Chancellor is announcing policy measures alongside our forecast, it is also important that we provide a stable final forecast in sufficient time to allow him to take his final policy decisions. Similarly, we need to know of any policy measures that may affect the forecast some days ahead of publication if they are to be properly incorporated.

2 Approach to economic forecasting

Introduction

2.1 The OBR economic forecast is tailored to help us produce a forecast for the public finances and thereby judge progress towards the Government's two fiscal targets. As explained in Chapter 1, this makes the forecast different from many other forecasts of the UK economy, with a greater range of economic variables and more focus on the supply and income side of the economy.

2.2 This chapter discusses how our forecast process combines the use of various economic models and statistical techniques with the application of judgement. Our main tool for producing the forecast is a large-scale macroeconomic model, but we also use various auxiliary analytical tools, examine recent data and assess alternative economic forecasts. As in all forecasts, models can only get you so far and judgement plays the vital role. The eventual judgements made are the responsibility of the members of the BRC.

2.3 The forecast process is not designed simply to result in a table of figures that satisfy the appropriate accounting identities. It is also designed to provide a narrative explaining how we think the economy will evolve and why. The use of the macroeconomic model helps to ensure that the forecast, and the narrative which explains it, are both internally consistent and consistent with economic theory.

The role of models

2.4 An econometric model describes how sets of exogenous variables (i.e. determined outside the model, such as the oil price), policy instruments and economic shocks determine a set of endogenous variables (e.g. inflation). An econometric model is not a prerequisite for producing a forecast, and given the way in which we emphasise the central role of judgement in the forecast process it might be deemed a distraction. But the use of a model as a forecasting tool is helpful for at least two reasons:

- first, it provides a formal representation of how the economy has worked in the past, and the ways in which different aspects of behaviour are related, thus providing a guide to future behaviour; and

- second, it provides a framework for bringing together, in a consistent and systematic way, a large amount of information. This second aspect is especially important for the OBR as we need to produce highly disaggregated forecasts of the economy in order to provide the revenue and spending projections that are important for fiscal policy decisions – see Chapter 1. It is essential that these are internally consistent.

2.5 Forecasting models can themselves be broadly split into two categories. Behavioural or structural models are based on economic theory about how agents in the economy operate. These models require assumptions about the nature of the economy. Statistical or technical models, on the other hand, rely more on statistical patterns in the data. These models in general require fewer assumptions about the structure of the economy.

Statistical or technical models

2.6 It is generally acknowledged that there is a trade-off in macroeconomic modelling between the theoretical coherence of a model (i.e. the assumptions it makes about how the economy functions) and its empirical coherence (i.e. how well it is able to replicate historical data).[1] More statistical approaches to forecasting, such as VAR and ARIMA models, can often perform well empirically and do better at fitting the data than models with stronger theoretical foundations, particularly over short-time horizons. However, they have the drawback of being less able to offer an intuitive economic explanation of the data/forecast.[2]

2.7 Unsurprisingly, forecasters involved in policy-making have therefore been more attracted to models towards the structure-based end of the trade-off than to statistical 'black boxes'. This is because they more readily lend themselves to telling an economic narrative and to answering 'what if?' questions.[3] In practice, our application of statistical models tends to be restricted to specific areas of the forecast, where there is a particular puzzle in the data that is not well explained by our macroeconomic model.

Structural or behavioural models

2.8 Structural models allow outputs in a given forecast to be traced back through the model's structure as the result of the interaction of a number of economic mechanisms and judgements. With structural models it is therefore possible to

[1] See, for example, Pagan (2003)

[2] Clements and Hendry (2002)

[3] See Smith (1998) for a discussion of this point.

assess the plausibility of the economic mechanisms from which the forecast stems and to assess whether the size and timing of the effects associated with the different model variables are consistent with past experience.

2.9 Structural models attempt to describe the behaviour of the economy, but to be useful they also need to be tractable – there is some trade-off between theoretical and variable completeness and the ability to understand and describe the results that emerge. There can be a temptation to add increasing layers to a single model to attempt to explain more and more of the data, but if a structural model is too sophisticated, it can end up becoming almost as intractable as a statistical model.

The OBR's macroeconomic model

2.10 We use a large-scale macroeconomic model as the main vehicle for the economic forecast. The model was originally designed and developed by the Treasury, but is now jointly maintained and developed by the Treasury and the OBR. In the event that our needs or views on what the model should contain diverged, the OBR would reserve the right to maintain an exclusive version. It very important to emphasise that the model is a tool to which considerable judgement is applied and that co-ownership of the model in no way compromises the ability of the OBR to undertake independent forecasts.

2.11 The model is principally a model of the economic activity described and recorded in the National Accounts published by the ONS. It is a set of relationships between various economic variables. Some of these relationships are accounting identities, some are technical relationships and the rest are behavioural (or econometric) equations. The behavioural equations are based on economic theory and statistical analyses of how the economy has behaved in the past. For example, the equation for households' spending says that such spending has responded in the past to changes in real incomes, interest rates and wealth.

2.12 The behavioural equations in the model are the main way in which information about how the economy has behaved in the past is taken into account in the forecast. Some variables in the model are determined neither by accounting identities, nor behavioural equations, but take values chosen by the forecaster and are often informed by the use of other analytical tools. Such variables are known as exogenous variables and include, for example, oil prices and debt interest payments, which are taken from futures curves and are modelled separately by the Debt Management Office (DMO) respectively.

2.13 Large macroeconomic models vary in their degree of sophistication and complexity. The structure of our model provides the flexibility we need to apply judgement to our forecasts in a tractable way. Annex A includes a

diagrammatical representation of the model's structure and interactions. The full public version of the model was last published by the Treasury in 2008,[4] although inevitably the published version is somewhat out of date as it takes time to document ongoing changes.

2.14 Our empirical analysis is also not confined to or constrained by the structure of our main model. An example is the interim OBR's assessment of the effect of oil prices on the economy, which was analysed using a smaller model.[5] Use of a dedicated small model can often be more appropriate when analysing a specific economic relationship than deployment of a full-scale model. The results of small model simulations can also be used as a cross-check against the plausibility of forecasts and analysis derived from the main model.

2.15 Insights from these more specific investigations are occasionally incorporated into the single main model. But often *ad hoc* adjustments of this sort would not be expected to improve the performance of the main model and it is probably better to use a variety of different models and apply judgement accordingly.

The role of judgement

2.16 Producing forecasts has never been solely a matter of cranking the handle of an econometric model. Models are an imperfect representation of the world. They are necessarily simplifications of reality. Forecasters are typically confronted with at least some key behavioural equations that do not explain the recent past well. The forecaster has first to try to identify the reasons for this, and then decide whether the unexplained element of behaviour – the equation 'residual' or 'error' – will stay the same, get bigger or get smaller.

2.17 A relatively straightforward example is the weather. If unseasonable weather was to be experienced at the time an economic forecast is being made, and as economic data is only reported with a lag, the effects on the economy would not be known for some time. The forecaster could make an adjustment to the model-produced forecast to allow for their judgement of the likely impact on the economy.

2.18 The most important parts of any forecast are the judgements that underpin it. But a model requires us to recognise the implications of each judgement throughout the economy. The model aids the forecasting process by imposing some discipline in the consistency of the judgements made. If an adjustment is made to

[4] HM Treasury (2008)

[5] OBR (2010)

the forecast path for a particular variable, the model forces us to acknowledge the possible implications for other behavioural relationships.

2.19 Because judgement is so central, the robustness of a forecast is as dependent on the economic reasoning underpinning it as on the data that has been used to construct it. A forecast should be evaluated against these judgements as well as the numerical size of any forecast error. For example, consumption may turn out to be weaker than forecast. As important as the size of the error is understanding the source of the error. Consumption may have been weaker because households decided to save more than forecast for a given income level, or incomes may have been weaker than forecast and the saving response correctly judged. It is therefore important to evaluate the forecast description of household behaviour as well as the size of the error.

2.20 There is evidence that the use of judgement generally improves forecasts.[6] This is at least in part because the forecasting process is distinct from the modelling process. Theory and experience tell us that the source of forecast failure is usually to be found in shifts in the means of equilibrium relationships and in the growth rates of exogenous variables.[7] Neither of these factors affect a model's usefulness in policy analysis, yet either can destroy the model's forecasts, unless the model user is able to correct them by applying judgement.

The accuracy of forecasts and the use of fan charts

2.21 HM Treasury has a long history of publishing assessments of its forecasting performance and average forecast errors for key variables were regularly published alongside its forecasts.[8] The OBR will build on this approach by publishing annual *Forecast evaluation reports*, which will assess our economic forecasting record transparently and in detail. Reflecting on the performance of past forecasts is a necessary, and sometimes cathartic, process that helps to direct model development work to the areas of the forecast that need it most. An examination of where errors were made and their causes also serves to improve our understanding of the economy.

2.22 One complication is that data are subject to revision, so it can be difficult to know the vintage of data against which to assess forecast performance. In practice,

[6] See, for example, Wallis and Whitley (1991). Also, Groen, Kapetanios & Price (2009) compare the Bank of England's Inflation Report quarterly forecasts for growth and inflation to real-time benchmark forecasts. They find that although the GDP forecasts are inferior, the Inflation Report inflation forecasts clearly dominate, and that: *"This result appears to reflect the importance of judgement."*

[7] Clements and Hendry (2002)

[8] Melliss and Whittaker (1998)

forecasts are often subject to considerable scrutiny using relatively early vintages of the data, which is not unreasonable given the importance of forecasts in shaping policymakers' actions. But our FER will generally evaluate forecasts against outturns once they have been through the main ONS Blue Book balancing process. In principle, we are attempting to forecast 'final' releases of the data, but the data is never really final – revisions in the Blue Books can go as far back as 1948. Furthermore, we do not assume that ONS data will be revised in a particular direction when we produce our forecasts. We forecast, but – unlike, say, the Bank of England - we do not backcast too.

2.23 The publication of a point estimate of GDP alone would tend to underplay the considerable uncertainties surrounding our central forecast. In order to emphasise this, we present our central forecasts with a fan chart showing the probability distribution of possible outcomes based on past forecast errors. In practice, the probability that any particular forecast will be precisely correct is close to zero. For the accuracy of the fiscal forecast, getting the key judgements underpinning the economic forecast roughly right – such as those surrounding the composition of growth (which is crucial for forecasts of tax revenue) can be as important as the precision of the headline GDP estimate.

3 Forecasting the economy

Introduction

3.1 This chapter explains how we produce our forecast of the UK economy in detail. We start with an explanation of how we obtain asset price and interest rate projections and the role of monetary policy in our forecast. This is followed by a description of how we estimate the cyclical position of the economy and its growth potential. We then set out the approach we take to forecasting GDP, drawing a distinction between our near- and medium-term approaches. A description of how we construct our expenditure and income measure forecasts follows, after which we discuss our approach to forecasting inflation and the nominal side of the economy. We then set out how we assess prospects for the labour market, the global economy and then the outlook for credit conditions. We conclude by explaining how we produce the economic scenarios we publish alongside our central forecasts.

3.2 Our main macroeconomic model helps to bring together all the different elements of the forecast to produce a consistent outlook. As described in this chapter, the forecast for each component is produced using a combination of judgement, the main model and other analytical tools.

Asset prices and interest rates

3.3 Each forecast requires assumptions to be made about a number of variables that we do not forecast directly. In general these are asset prices whose value is determined on, or influenced by, global markets. The main conditioning assumptions and data sources used in our forecast are:

- oil prices – path implied by the Brent crude futures curve on the collection date;[1]
- world interest rates – trade-weighted averages collected from interest rate futures markets on the collection date;

[1] The date that we use as a basis for a particular forecast.

- equity prices – the starting point is a 10 working day average of the FTSE all share index up to and including the collection date. Prices are then assumed to grow in line with nominal GDP;

- UK interest rates – the expected paths of a number of UK interest rate variables are derived from financial market instruments. For each variable we take an average of the market-implied path for each of the 10 days up to and including our collection date;

- exchange rate – the trade-weighted sterling effective exchange rate index (ERI) is assumed to follow a path implied by the uncovered interest parity condition (i.e. exchange rates are forecast to move such that interest rate differentials between the UK and the rest of the world are eliminated); and

- house prices – we use the median expectations in the Treasury's Comparison of Independent Forecasts for year-end (Q4) annual inflation of those external organisations who forecast Communities and Local Government (CLG) house price inflation. This is used for the first two years of the forecast. Thereafter house price inflation is assumed to rise broadly in line with the long-term average rate of earnings growth.

3.4 Modelling asset prices is very difficult, particularly in the short term, and it has been shown that economic models rarely outperform a random walk model.[2] Under this theory, the best forecast of the future price of an asset or currency is today's price. This is why we take a transparent and simple assumption-based approach to forecasting asset prices. Fluctuations in asset prices are unpredictable and can have significant effects on the accuracy of the economic forecast. Fair (2010)[3], suggests that between a quarter and a third of the two-year-ahead forecast error in GDP growth for the United States between 1954 and 2009, may be attributable to unpredictable asset price changes.

Monetary policy

3.5 An important anchoring assumption in our forecast is that monetary policy succeeds in bringing inflation back to target over the forecast horizon. When this is coupled with a view that, over the medium term, the most important driver of inflation is domestic price pressures, and that these are well-represented by the output gap, the implication is that monetary policy will act to close the output gap over time by acting to stimulate or soften aggregate demand.

[2] See Meese and Rogoff (1983)

[3] See Fair (2010)

3.6 In our model, there is no equation that captures the way monetary policy is implemented (i.e. it is 'exogenous'). Neither is there a direct linkage between policy rates and the output gap. Instead, our expectations of what the Bank of England will be able to do to return actual output to potential, while bringing inflation back to target, are implicitly incorporated into our forecast of the output gap. Of course, when we see market expectations of policy rates move between forecasts we take this on board in our assessment of the growth outlook.

3.7 For the purposes of producing the alternative economic scenarios we present in our *Economic and fiscal outlooks*, we use a simple rule to illustrate how monetary policy might react if the economy were to deviate from our central projection.[4] In principle, we could take a similar approach for our central forecast by estimating a central bank reaction function, such as a Taylor rule. However, it is likely that the forecast error introduced by the imprecise estimation of such a rule would outweigh the benefits of a forecast-consistent interest rate path. Furthermore, this approach would require us to model the effect of a different policy rate path on all the other financial market variables required to produce the economic and fiscal forecasts. In parallel, the DMO, which feeds debt interest projections into the public finances forecast, would have to do the same for a wide range of financial market instruments.[5]

3.8 We could potentially move away from our current approach if we believed that market expectations were not appropriate for use in our central projection. This could be the case ahead of significant fiscal adjustments, where the size or detail of the adjustment is unanticipated by market participants.

Potential output, trend growth and the output gap

The output gap

3.9 We begin the economic forecast process by estimating the size of the 'output gap' between the economy's actual output and the 'potential' level consistent with stable inflation. A negative output gap corresponds with low rates of capital and labour utilisation and spare capacity in the economy; a positive output gap is associated with high rates of resource utilisation and, in the event that the economy is operating significantly above trend, evidence of excess demand or 'overheating'. Further information on our approach to forecasting the output gap is set out in *Briefing paper No. 2: Estimating the output gap*.

[4] This is discussed further in the economic scenarios section of this paper.

[5] Market-derived measures of interest rate expectations will be inconsistent with our central forecast insofar as market participants may have different expectations of the outlook for GDP and inflation and the extent to which the Bank is able to offset demand shocks.

3.10 Estimating the size of the output gap is difficult because we cannot observe the supply potential of the economy directly. We need to do so, in part because we are required to judge whether the Government is on course to achieve a fiscal mandate expressed in cyclically-adjusted terms (i.e. adjusted for the size of the output gap). More fundamentally, we cannot assess the prospects for economic growth over a five-year period without taking some view – implicit or explicit – of the level of activity that the economy can sustain, how that is likely to change, and how far above or below it the economy is currently operating. A view of the likely evolution of potential output and the output gap is necessary to judge progress towards any medium-term target for the public finances, not just a cyclically-adjusted one.

3.11 As we cannot observe the level of potential output directly, we have to estimate the size of the output gap from cyclical indicators or assumptions about the path of potential output. Estimating the output gap in real time is particularly challenging: changes in data may reflect movements in potential output, cyclical fluctuations, or both.[6] Distinguishing between the underlying trend in potential output and cyclical fluctuations around it can be hard, even once a much longer run of data become available.

3.12 There are a number of different methods for estimating the size of the output gap. Our approach is based on an assessment of various indicators of resource utilisation, including survey indicators of capacity utilisation and recruitment difficulties, and ONS data, such as average earnings growth. We use two approaches to combine these indicators to produce an estimate of the output gap:

- **'aggregate composite'** estimates are based on a weighted average of survey indicators of capacity utilisation and recruitment difficulties, with the weights on each indicator based on factor income and sector shares from the National Accounts; and

- the indicators can also be combined using **'principal components analysis'**, a statistical technique that enables the identification of the common determinant of a number of variables. Unlike aggregate composite estimates, the principal components estimates take into account ONS indicators as well as survey-based measures.

3.13 One feature of this approach is that output gap estimates are independent of the latest National Accounts data, as they are based solely on an assessment of cyclical indicators. Accordingly, estimates of the output gap based on this

[6] Nelson & Nikolov (2003)

approach are likely to be less susceptible to revisions to National Accounts data.[7] In addition, the latest output gap estimate does not require an estimate of what trend growth has been over the recent past, or what the output gap was prior to the most recent observation.

3.14 The techniques used to construct these estimates are refined from forecast to forecast, so the precise variables and parameters may vary over time. It is also important to bear in mind that these techniques are used to inform the judgement that we make in our central forecast, but that we do not apply them without question. We recognise that it would be unwise to base an assessment of economic prospects on any single approach alone. So in forming a judgement we also assess how the estimates produced by the cyclical indicators method compare to those of other forecasters who may use different techniques, such as filters or production functions.

Decomposing the output gap

3.15 We can decompose the output gap estimate into four component gaps: an output per hour (productivity) gap; an average hours gap; an employment rate (16+ basis) gap and a population (16+ basis) gap. As with the output gap, each of these gaps represents the difference between the actual level of that component and its trend level.

3.16 As with aggregate output, we assume that each component moves back towards its trend level over time (so that the component gaps gradually close). Consequently, the gap between the component and its trend level, together with the assumed trend growth rate, (see next section) inform the forecast path of the actual level of that component over the projection period.

3.17 We use a number of approaches to estimate the decomposition of the output gap:

- the assumed **employment rate gap** is informed by an assessment of the cyclical indicators specific to the labour market. For example, survey indicators of recruitment difficulties, which form part of the 'aggregate composite' output gap estimate, can be interpreted as a measure of the degree of labour market slack at the hiring margin. A comparison of these indicators with non-recruitment survey indicators (i.e. capacity utilisation) gives an indication of how much of the total output gap could be attributable to the employment rate operating above or below trend. For example, if measures of recruitment difficulties were significantly below their

[7] However, the stability of the output gap estimate means that revisions to actual output data will instead be reflected in revisions to the implied potential output level.

long-term average while capacity utilisation measures were close to normal, then it might be plausible to attribute a large part of the (negative) output gap to the employment rate. Other proxies for labour market slack, such as average earnings growth, can also be used to evaluate the plausibility of the assumed employment rate gap;

- the employment rate gap can be further decomposed into an **unemployment rate gap** and a **participation rate gap**. The unemployment rate gap is derived by comparing the unemployment rate in a given quarter with the assumed Non-Accelerating Inflation Rate of Unemployment or NAIRU - see the next section for further details. The employment rate gap can then be derived as the sum of the participation rate gap and the unemployment rate gap;

- the **average hours gap** is constructed by comparing the level of actual average hours in the relevant quarter with an estimated trend level, where the trend is constructed by taking the level of average hours at a given point in the past and extrapolating this level forward at an assumed trend rate;

- as with the average hours gap, the **population gap** drops out from a comparison of the actual population level with an estimated trend, where the trend is derived by growing the population from a given point at a particular trend rate. In general we would expect this to be close to zero, as we would not expect the size of the population to be subject to large cyclical fluctuations; and

- the **output per hour (productivity) gap** is derived as the residual between the aggregate output gap and the sum of the employment rate, average hours and population gaps.

Trend growth

3.18 Together with the ONS estimate of actual output, the estimate of the output gap sets the 'starting point' for the projection of potential output.[8] The growth of potential output from this point is then established by splitting up potential growth into several components that are then analysed and projected separately:

- productivity growth (output per hour);

[8] The starting level for each of the potential output components (trend output per hour, average hours, employment rate and population) are similarly derived by combining the component gap with the ONS latest outturns for the actual level of these variables.

- average hours growth;
- employment rate (16+) growth; and
- population (16+) growth.

The overall growth rate of potential output is equal to the sum of the growth rates of the potential output components. This approach is similar to the conventional 'production function' approach used by many other institutions, including the OECD, European Commission, Congressional Budget Office and IMF.

3.19 To project the components of potential output, we use a variety of approaches:

- the projection for **trend productivity growth** is informed by an assessment of the latest evidence, together with a degree of judgement on factors relevant to the outlook for productivity over the projection period (e.g. changes to the rate of capital deepening);
- **average hours** have been steadily declining since the 1970s and are usually projected in line with recent trends;
- the prospects for **the trend employment rate** can be split into the outlook for the 'structural' unemployment rate, or Non-Accelerating Inflation Rate of Unemployment (NAIRU); and the trend labour market activity (or participation) rate. Our NAIRU assumption is informed by an assessment of recent labour market developments (such as changes in the level of long-term unemployment or evidence of labour market mismatch), past trends in the UK NAIRU as well as available external estimates and relevant analysis;
- the **trend activity rate projection** is informed by the 'cohort method', an approach used by a number of international organisations to project labour market activity. The cohort method of projecting future participation rates uses historical lifetime participation profiles of different cohorts to model current cohorts through the projection period. It captures the impact of an ageing workforce on the overall labour market activity rate and the effect of current young cohorts gradually replacing current older cohorts. This is important as each generation or cohort has its own specific average level of participation that is usually different from the corresponding participation level of preceding and future generations; and
- **trend population growth** can be split into the prospects for net migration and the prospects for 'natural' population change (i.e. changes in the 16+ population in the absence of net migration flows). Our assumptions for natural population change are derived from the latest official population

projections produced by the ONS. We make our own judgements surrounding net migration prospects, informed by an analysis of recent data, relevant developments (such as policy changes and changes in the level of economic activity) and available external analysis and projections. The ONS publishes different population projections for different net migration assumptions, from which we can choose.

3.20 In the long run, the economy is forecast to return to a "steady-state". The features of this steady state are that the economy is on a balanced growth path (in line with the Solow growth model) with output growth dependent only on productivity and employment growth. Output is determined in the long run by potential labour productivity and the labour supply. These variables are assumed to be unaffected by the price level or inflation (in technical terms the model exhibits both money neutrality and super-neutrality – for example, the NAIRU is not affected by the inflation rate).

Gross domestic product

3.21 Our forecast for GDP begins with an assessment of the cyclical position of the economy - the size of the output gap. This is combined with the latest ONS estimate for the level of actual GDP to produce an estimate of the economy's potential level of output. It is to this that the trend growth judgements described above are applied. The resulting projection of the potential level of output in the economy provides a medium-term anchor for the real GDP forecast.

3.22 In general, it is a standard forecasting convention to assume that the output gap narrows over the forecast horizon. As set out in the monetary policy section, we expect the Bank of England to set monetary policy in such a way that any spare capacity or excess demand in the economy is gradually eroded and output returns to potential.[9]

3.23 The resulting GDP profile presented in our forecast can then be thought of as the product of two judgements. In the short term, we make a conjunctural assessment of growth momentum in the economy, making a wide-ranging examination of recent survey data and interpreting current economic news. In the medium term, the speed at which we expect the output gap to close will depend on our assessment of comparable episodes and of current influences that might suggest a path different to that implied by historical experience.

[9] Of course the Bank of England will take into account the effect of the Government's fiscal plans as part of its general assessment of the economic outlook and set monetary policy accordingly.

3.24 The approach, as described, is top-down in the sense that GDP is determined directly, rather than constructed bottom-up by the aggregation of forecasts of its expenditure or income components. However, it should be stressed that considerable time is spent moving back and forth between the individual forecasts for the expenditure and income components of GDP and the forecast of the aggregate measure.

Near-term forecast

3.25 While the overall shape of the GDP forecast is determined by our assessment of the size of the output gap and the speed with which it closes, for the current quarter and quarter ahead we take a different approach. This involves making use of high-frequency data and surveys, but also interpreting economic and non-economic news (unexpected events like heavy snowfall and flooding) and applying judgement.

3.26 When considering the GDP forecast for the current quarter, we begin by looking at the *Index of production*, *Index of services* and *Output in the construction industry*. These releases are available from the Office for National Statistics at a monthly frequency and, together, account for the vast majority of the output measure of GDP, which drives the preliminary estimate for the quarter.[10] We also look to consumer and business surveys as leading indicators of headline GDP growth, as they are timelier than official data, and monitor developments in household and firm behaviour, which aids the construction of the quarterly expenditure-side forecast.

3.27 For example, one approach common to most current UK economic forecasters is to weight together the Chartered Institute of Purchasing and Supply, *Purchasing Manager's Index* for each sector of the economy to estimate quarterly GDP growth. Other surveys are also useful, including those from the Confederation of British Industry, the British Chambers of Commerce and the British Retail Consortium.

3.28 Survey data for the quarter ahead tend to have lower information content but we do monitor forward-looking indicators such as business expectations and new orders. We also think about any special one-off events that could have temporarily affected the headline quarterly growth rate and calculate the degree to which we would expect an associated response in subsequent quarters. This

[10] Monthly output in the construction industry, at the time of writing, is a relatively new product and, as such, is provided in non-seasonally adjusted terms. Therefore we use it to inform our assessment of momentum rather than as a direct input to our estimate of quarterly GDP. There is no monthly GDP data released by the ONS.

enables us to make an assessment of the underlying growth momentum in the economy. We sometimes publish a graph of this in our *Economic and fiscal outlooks* to illustrate the short-term influences of special factors.

Medium-term forecast

3.29 The practice of assuming that the output gap narrows over the forecast horizon is consistent with the approach used by other institutions that produce macroeconomic forecasts over the medium to long term.[11] But neither the trend growth framework, nor the macroeconomic model, include a mechanism by which the output gap is closed.

3.30 Our judgement about the speed at which the output gap closes is informed by the path of the output gap during comparable stages of previous economic cycles as well as by an assessment of factors that might suggest a different path to that implied by historical experience. We assume that the Bank of England softens or stimulates aggregate demand such that the output gap gradually closes over the forecast period. This is set out in more detail in the monetary policy section of this paper.

3.31 In judging the speed at which output returns to potential we also consider the plausibility of our medium-term growth projections. In a flexible market economy, a persistently wide output gap that displayed little sign of closing by the end of the forecast period would cast doubt on the validity of our trend growth assumptions. Strong growth rates, without historical precedent, towards the end of the forecast period would also be cause for concern. Accordingly, due consideration is given to ensuring that the output gap closes over a reasonable period of time, while taking into account the implications for the rate of growth over the medium term.

3.32 Generally, our forecasts show the output gap closing during the projection period. However, following a particularly deep recession or large boom it may be reasonable to assume that the output gap will remain open longer than five years. Speed limit effects, for example, point to the possibility that there may be limits to the growth rate the economy can sustain while maintaining inflation at target, even if output is below trend. Under this theory, inflation could remain at or above target when there is spare capacity in the economy, in the presence of temporary supply bottlenecks. Recent IMF evidence also suggests that when output gaps persist for an unusually long period of time, inflation tends to

[11] The long-term scenarios set out by the OECD (2011) assume that output gaps are closed by 2015 for most OECD countries; by 2016 for Ireland, Portugal and Spain; and by 2018 for Greece. Similarly, IMF (2011) assumes that output gaps for major advanced economies are close to zero by 2016.

stabilise at a low rate, reflecting well-anchored inflation expectations and downward nominal rigidities.[12]

Forecasting the expenditure measure of GDP

3.33 There are three different approaches that can be used to measure GDP.[13] The primary focus in most economic forecasts, including our own, is on the expenditure measure (known as GDP(E)). This is in large part because the majority of economic theory is analysed from this angle. However, we also present much more detail on our income (GDP(I)) forecast than is typical of most forecasters as these income flows are important for the public finances projection. In tandem with almost all other institutions, we do not produce an explicit GDP(O) forecast broken down by industrial sectors.[14]

3.34 The three approaches can be summarised as follows:

- the expenditure approach measures GDP(E) by estimating the money spent on total output in the economy. Expenditure is split into household consumption, private investment, government consumption and investment, as well as imports and exports of goods and services;
- the income approach measures GDP(I) by estimating total factor income received by UK residents. The income is split into compensation of employees and the operating surplus of corporations; and
- the output approach measures GDP(O) by estimating the total value of all final goods and services produced in the economy.

3.35 The composition of GDP can be as important to the fiscal forecast as the headline measure of GDP. This is because different expenditure components are significantly different in their impact on tax receipts. Stock building, for example, contributes less tax revenue than private household consumption (after adjusting for its share of GDP). For this reason, the judgement about the composition, and balance, of domestic and external demand is a key decision for the forecast with potentially important implications for the fiscal forecast.

[12] See IMF (2010)

[13] GDP can be measured as the total output or production of goods and services in the economy (GDP(O)), the total expenditure on these finished goods and services (GDP(E)), or the total amount of income generated by them (GDP(I)).

[14] Given the equivalence with the other measures of GDP, an approximate output forecast could, in principle, be inferred from the supply-use tables which the ONS use to balance the three measures of GDP.

3.36 This point was demonstrated by the 'delayed rebalancing' scenario in the November 2010 *Economic and fiscal outlook*. In this scenario, the headline measure of GDP was identical to that of the central projection but the fiscal position was improved (over the forecast horizon, at least). This was because the forecast growth relied more heavily on private consumption, which is a more 'tax-rich' component of GDP than, for example, exports.

3.37 The explanation of influences on forecast variables provided here is set out largely in terms of the structure of our main macroeconomic model. But as discussed in Chapter 2, this should not be taken to imply that the structure of the model, and the economic theory embedded within it, places excessive restrictions on the shape of the forecast. Each of the major component forecasts is a combination of model-informed projections and the exercise of the BRC's collective judgement. It can also be helpful to think about the different elements of our forecast in the same way in which we discussed the overall GDP forecast, in terms of short and medium-term influences.[15]

Consumption

3.38 The forecast for consumption growth in the first few quarters of the forecast is informed by a very wide range of high-frequency survey and economic data. Information on current quarter household consumption is available from the British Retail Consortium and CBI distributive trades surveys, Visa credit card data and even down to the weekly frequency of John Lewis sales figures. There is also some evidence that consumer confidence measures such as the GFK Nationwide and European Commission surveys are useful leading indicators.

3.39 Our approach to forecasting household consumption is within the spirit of the permanent income/life cycle model, with income and wealth being the major determinants. In the short run, the main drivers of consumption are real household disposable income, short-term interest rates, real mortgage payments and unemployment (capturing confidence effects or the precautionary motive to save). The short-run interest rate is intended to capture the cost of borrowing or short-run credit-rationing effects. This is a key area where judgement is applied to the overall consumption forecast after a detailed assessment of credit conditions.

[15] This approach is, in loose terms, similar to the 'core' and 'non-core' structure of the Bank's current forecasting model BEQM, whereby data-driven adjustments are made to the short run dynamic adjustment path for variables for which medium-term equilibrium is delivered by the economic theory embedded in the core model. For more details on BEQM see Bank of England (2005).

3.40 The link between consumption and housing is controversial and has been the subject of much recent discussion.[16] Theoretically it is not clear that an increase in the value of houses should be regarded as increasing the real wealth of the personal sector as a whole.[17] Nevertheless, until recently there appeared to be a strong correlation between consumption and house prices. Our model therefore includes a term for housing equity, which may in fact be a proxy for a number of other effects. Higher house prices may ease credit constraints if individuals can use their housing wealth as collateral. Alternatively, physical wealth could serve as a proxy for future earnings. Again, the relative weight placed on this channel is a key area of discussion in forecast rounds.

3.41 In the longer term, consumption is driven by the overall household balance sheet position and is determined by real labour income[18] and real financial wealth, representing current and (expected) lifetime future resources. Financial wealth is affected by financial markets, through equity and bond prices, which will reflect expectations of future income. Changes in prices will reflect changes in expectations that will cause wealth to be revalued and affect behaviour now. We assume that households choose consumption such that their net worth is rising broadly in line with incomes.[19]

3.42 However, large but temporary shocks to the economy (such as a fiscal consolidation) may be consistent with households reducing their saving for an extended period, until incomes recover. If we were to judge that an event had a permanent effect on incomes, households would be expected to reduce their consumption plans accordingly. Of course, determining the distinction between an 'extended but temporary' effect and a 'permanent' effect is easier said than done.

3.43 Our forecast is for aggregate consumption at the whole economy level, but there will be differences in the behaviour of consumers at the individual level. This is a clear limitation of any 'representative agent' model, in which a shift in aggregate consumption maps to a shift in the preferences of *all* households. An example of this complication is that while at the aggregate level household balance sheets may give one impression of the outlook for consumption, the distribution of

[16] See for example Buiter (2008)

[17] While an increase in house prices represents an increase in current wealth for current homeowners, it also represents a reduction of future net income for (typically young) non-home owners, and so may have no impact on aggregate consumption.

[18] This is not the same as real household disposable income which includes dividends, net interest receipts and rent.

[19] In technical terms, long run homogeneity of degree 1 with respect to real labour income and wealth is imposed.

assets and liabilities between households may also have an important bearing, particularly if some of those households are less able to borrow than others.

Investment

3.44 Investment is the most volatile component of GDP and also subject to large revisions, making it extremely challenging to forecast accurately, even at very short horizons. Our forecast for investment is broken down into its four main components: business investment, residential investment, government investment and the transfer costs of non-produced assets. The final category includes items such as estate agent fees that are recorded as investment in the National Accounts, and is the least important element. The most important is business investment as it has the largest influence on the size of the productive capital stock.

Business investment

3.45 Information on the near-term outlook for investment is available from the CBI *Industrial Trends Survey* via the investment intentions balance. The 'factors limiting investment' series is useful, as are the *Bank of England Agents' Surveys*, which ask whether firms can increase output without increasing investment, and Deloitte's *Chief Financial Officers Survey*.

3.46 Firms are assumed to invest in new capital on the basis of expectations of output and relative factor prices, the relative costs of labour and capital inputs to production. Their investment decisions will also depend on the degree of capacity utilisation. If their plans turn out to have been too optimistic, capacity utilisation falls and firms cut back on their investment plans. In the long run it is assumed that the investment-capital ratio is proportional to the output-capital ratio.

3.47 To estimate relative factor prices we need to calculate the cost of capital (the determination of wages is described in the labour market section). The estimate we use measures real own-product marginal post-tax cost of capital in private sector industry. It is a function of the cost of finance, the corporate tax rate and the value of investment allowances. The cost of finance measure weights together the cost of debt, equity and retained earnings, taking account of the different tax treatment of these sources of finance.

3.48 Underpinning this modelling structure is the assumption that a firm's financial structure is irrelevant to its investment decision, because external funds are a perfect substitute for those generated internally (in line with the Modigliani-Miller theorem). In other words, firms face a cost of borrowing that is independent of the level of borrowing: if firms are willing to pay the cost of capital, financial markets will make the funds available. However this result relies on the

assumption of perfect capital markets and, for example, the same tax treatment of debt and equity financing.

3.49 Once we allow for capital market imperfections, it is clear that financial constraints may prevent firms from undertaking investment. For example, when they are highly geared they find it more difficult to raise finance (largely for moral hazard and adverse selection reasons) and so are prevented from undertaking profitable investment. When considering investment prospects we also consider the prevailing conditions in financial markets and structure of firms' balance sheets. Corporate profitability and retained earnings will influence the ability of credit constrained firms to finance investment. Uncertainty over demand conditions is also commonly cited by firms as important to their investment decisions.

Residential investment

3.50 Residential investment is composed of both investment in new houses and home improvements. It has proved a notoriously difficult area for macroeconomic forecasters, particularly in home improvements where data issues are especially challenging. It is an inherently volatile activity, as relatively small changes in the desired housing stock require large changes in housing investment. It is also the component of aggregate demand that is most dependent on credit.

3.51 The OBR's model framework for thinking about residential investment can be thought of as a structural supply relation. In this approach, residential investment is a function of real house prices, acting as a proxy for the profitability of house building, real interest rates and nominal short interest rates (which proxy the role of cash-flow effects).

3.52 In the (very) long run there appears to be a stable (co-integrating) relationship between investment in housing, real interest rates and real house prices. However, actual residential investment can depart from this predicted long-run equilibrium level for a number of years, and move back towards it only very slowly, which limits its usefulness over shorter horizons.

3.53 The household investment forecast also depends heavily on the projection for turnover in the housing market, which reflects the demand for housing. In the short term, we use a number of leading indicators to forecast property transactions. Dependent on which data is available, we use mortgage approvals from the Bank of England, the Royal Institution of Charted Surveyors or the British Bankers' Association, which lead the HMRC measure of completed transactions.

3.54 The medium-term anchor for the transactions forecast relates housing turnover to the average duration spent in a house and CLG household formation projections. To this end, we take a long-run average of implied duration (dividing the number

of households by the number of transactions). How we get from the short-term outlook to the medium-term anchor is determined by judgement, based on an assessment of historical data and the availability of mortgage finance. The transactions forecast, coupled with the house price projection, are also one of the most important influences on the acquisition of household deposits as first time buyers' borrowing partly translates into last-time sellers' deposits.

Government

3.55 The forecast for government consumption and investment is conditioned on the Government's fiscal plans set out in the Budget. In broad terms, prospects for government consumption can be thought of as roughly following the Government's plans for central government expenditure on public services and administration - currently known as 'Resource Departmental Expenditure Limits' (RDELs) in the government's spending framework. These plans are typically set in nominal terms. Therefore, to produce a forecast for real government consumption, we also need to forecast a path for the government consumption deflator.

3.56 The deflator forecast is generally split into two parts: a weighted average of government wage and procurement costs (with the Total Final Expenditure deflator used as a proxy for the cost of procurement) and real government consumption in departments whose output is measured using direct activity indicators. Following the implementation of Atkinson review proposals, a larger share of government output is now measured directly, with the rest calculated on the assumption that input growth equals output growth (equivalent to assuming zero productivity growth).

3.57 A more disaggregated split of overall RDEL spending into wages and salaries and procurement, among other things, is also an important input into our forecasts of other variables, such as household income. These splits are taken from the Treasury's' COINS database of departmental spending, where available, with later years of the forecast modelled by the OBR (see *Briefing paper No.1* for more detail).

3.58 In a similar fashion to government consumption, nominal government investment is an exogenous input to the forecast based on published government plans. Real government investment is then determined by our chosen forecast path for the deflator. Typically this forecast will be consistent with the path for whole economy investment prices, as the two series are historically reasonably well-correlated.

Exports

3.59 The forecast for exports is published at an aggregated level but when constructing the forecast it is helpful to consider paths for goods, services and oil

separately. We would expect the three to evolve quite differently, given different underlying trends and cyclical responsiveness to global activity and prices.

3.60 Exports of non-oil goods depend on growth in UK export markets and relative export prices. UK export markets are determined as other countries' imports of goods and services, weighted according to their importance in the UK's total exports. Oil exports are calibrated as an exogenous proportion of output. Exports of services depend on a measure of world activity (world trade in non-oil goods) and a measure of price competitiveness.

3.61 In aggregate, the UK's share of global export markets has been on a more-or less continuous downward trend for the last 20-30 years, reflecting the emergence of fast-growing developing economies. We typically assume that this trend continues out to the end forecast horizon, although there may be short-run gains (or larger losses) of market share from movements in the (real) exchange rate.[20]

Imports

3.62 The path for imports is informed by the prospects for domestic demand and the terms of trade. The composition of domestic demand growth is important as different components of demand have different import contents. These import contents are derived from the latest set of analytical input-output tables. For example, investment has a high import content so a relatively strong forecast for this component implies a stronger forecast for imports.

3.63 Movements in the terms of trade are also important. For example, in response to a decline in the purchasing power of sterling we should expect firms and consumers to switch to more cheaply produced domestic goods. As is the case with exporters, it is likely to take some time for firms to adjust to the change in relative prices with less readily substitutable goods and services (the estimated adjustment in our model is very sluggish).

3.64 Oil imports are obtained as the residual between demand (domestic oil demand and exports) and domestic supply (North Sea production). Total domestic demand for oil depends on the level of UK output and the relative price of oil.

3.65 There has been a sustained, upward trend in the share of imports in domestic income, or import penetration, in the UK (and most OECD countries). This is a

[20] In technical terms, our model easily satisfies the Marshall-Lerner condition (the sum of import and export volume price elasticities exceed unity) for the balance of payments to improve in response to a real depreciation of the exchange rate.

reflection of the rise in the ratio of world trade to world GDP and is captured in our forecast.

Stock building

3.66 The rate of change of the level of stocks will add or subtract to the growth rate of the economy. However, stock building is not typically an important component of domestic demand and it is a generally accepted forecasting convention to assume that stock building has no material effect on the economy after the first couple of quarters of the forecast.

3.67 An exception is during and after recessions when large movements in stock building are normally observed: to the extent that the recession is not predicted there will be a (potentially sharp) drop in expected demand and, as a consequence, an *involuntary* increase in stock levels. Over time, firms will then adjust their holdings of stocks to their desired level. Survey measures of stock adequacy levels such as those available from the CBI give some guide to the short term path. In the medium term, the forecast is anchored on a stable stock-to-output ratio, which has been broadly flat since the mid 1990s.

Forecasting the income measure of GDP

3.68 In analysis of economic forecasts it is usually the expenditure measure of GDP that receives the most attention and emphasis. However, some of the most important drivers of the fiscal projection, such as total wages and salaries and corporate profits, are measures of income.

3.69 Our approach to forecasting the income measure of GDP is very different to that taken for the expenditure measure. Taken together, the expenditure-led forecast for real GDP and the inflation projection define nominal GDP over the forecast period. The income forecast is then concerned with splitting the corresponding income flows between labour and capital.

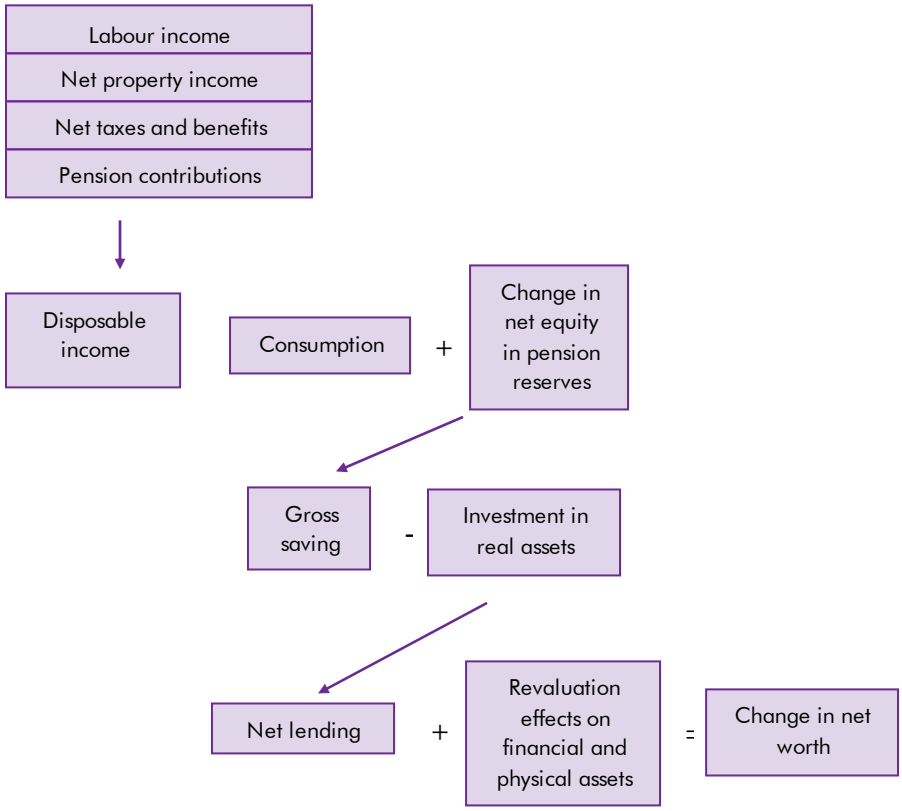
3.70 This area of the forecast also serves as an essential sense check of the internal consistency and coherence of the forecast as a whole. The rest of this section sets out how we approach it, our assumptions and the key judgements we take at each forecast round.

3.71 The income side of the National Accounts is broken down into five sectors. Based on total resources, the largest is the household sector, followed by the public, private non-financial, private financial and external sectors. In our model, the way in which each sector is treated varies significantly. For example, the household sector is enumerated in a relatively detailed way but corporate sector variables are forecast at a high level of aggregation.

Household sector

3.72 Household income consists of labour income, property income, social benefits and transfers. Set against these are pension contributions, direct taxation, and debt servicing costs, leaving household disposable income. What households do with this income is driven by the expenditure forecasts for household consumption and investment, giving a projection of the saving ratio and then household net lending respectively, see Figure 3.1.

Figure 3.1: Deriving changes in household net worth



3.73 The labour income forecast is conducted off-model. As described in the labour market section, the trend growth framework anchors the forecast for employment and this, combined with our judgements on wage growth and average hours, gives total wages and salaries.

3.74 Property income received by households comes from a number of sources. The largest source tends to be interest and dividends earned on household pension assets, which are attributed to household income in the National Accounts framework. However, while we assess this area of the forecast in light of new data, we tend to look through changes in this type of income when we consider

the household consumption forecast – at least in the short term. It is likely that households have limited information about the value of their pensions in real time and will not revise their short-term consumption plans in response. Property income attributed to households is modelled as a function of the rate of return on domestic and international bonds, equities and other assets.[21]

3.75 Another source of property income is interest on savings, which is forecast as a function of household deposits and deposit rates. A generally smaller contributor to household income is dividends received, currently forecast as a function of the stock of equities held by households and corporate profitability.

3.76 As well as owning assets in the form of equities and deposits, which receive dividend payments and interest payments respectively, households also hold a stock of liabilities, comprising secured and unsecured credit. To service these liabilities households make interest payments and we model these as a function of the stock of debt and lending rates.

3.77 Social benefits and transfers are fed into the income forecast directly from the forecast for the public finances. This is also true of the direct taxation element of disposable income. Employee contributions to pension funds are simply held constant as a share of total wages and salaries before adjustments are made to take into account policy measures in this area.

3.78 When we consider the saving ratio implied by our forecast, we assess both what might be termed the 'active' part of saving and the 'inactive' part that occurs without households' direct intervention. While we do not target an equilibrium saving ratio in our forecast, we do see it as a useful diagnostic tool for the coherence of other key judgements. Should we decide that the saving ratio profile is inconsistent with our view of household behaviour, this would give us cause to revisit our expenditure forecast.

3.79 Subtracting household investment in fixed assets (mainly housing) from gross saving, and adjusting for changes in pension reserve equity, gives the household financial balance (net lending). This represents the amount households need to borrow or are able to lend once all uses are subtracted from their total resources. Again, this serves as a useful diagnostic tool for both the consumption and household investment forecasts and distils a number of key judgements into one tractable projection.

3.80 If households were expected to spend and invest more than they earn, the difference would be made up by drawing down on financial assets or borrowing.

[21] These rates of return are exogenous assumptions outlined at the beginning of this chapter.

Net acquisition of financial assets comprises changes in deposits, the net acquisition of equities, the net accumulation of pension assets and net purchases of other assets.

3.81 Consistent with liquidity preference theory, household accumulation of deposits is modelled as a function of nominal consumption and its opportunity cost (the deposit rate). Another important determinant is turnover in the housing market, based on the notion that some proportion of additional first-time buyer mortgage borrowing will find its way into the deposit account of a last-time seller. It is also the case that higher housing market turnover creates a higher stock of deposits at any one time, so the deposits forecast is best thought of as reflecting total transactions demand for cash, not just GDP transactions. Equities are seen as a discretionary asset, moving in line with net lending, while net acquisition of pension assets reflects our forecasts for employee and employer contributions to pension funds.

3.82 Net acquisition of financial liabilities is given by net lending from the capital account less the value of net financial assets purchases. If households buy more financial assets than they have resources available, the shortfall will be made up by borrowing. This brings the financial account into balance. While there is no single model equation that governs the accumulation of liabilities we think carefully about the overall demand for credit from the household sector and the willingness of banks to lend as part of our general assessment of credit conditions.

3.83 Consistent with the permanent income hypothesis, if households are hit by a temporary shock to their incomes we would expect them to smooth their consumption, drawing on financial assets or borrowing until their incomes recover. If there is a permanent change to the level of their incomes we would expect households to revise their consumption and asset accumulation plans accordingly.

3.84 Taking into account changes in the value of financial assets and physical wealth (mostly housing) gives the household net worth forecast. This gives a complete picture of the household balance sheet, which informs the medium-term consumption forecast. Asset price projections are generally given by conditioning assumptions and we do not apply judgement to this area of the forecast.

Government sector

3.85 The OBR macroeconomic model represents the public sector in a high level of detail but most variables are populated by forecasts made off-model as part of the wider public finances forecast. For more information on how this is put together see *Briefing paper No. 1: Forecasting the public finances*. While the taxation, spending and transfers forecasts affect the household disposable

income projection, the public finances projection also affects the corporate sector income forecast through the general government operating surplus forecast, because the corporate sector operating surplus is estimated by residual.

External sector

3.86 The extent to which the domestic sector consumes less or more than it produces is given by the net trade position. How much more or less the domestic sector consumes relative to what it earns is given by the current account balance. This includes the trade position but also takes into account transfers[22] and the income earned from foreign asset holdings less the payments made on foreign-owned domestic assets. This is known as whole-economy net lending or the external financial balance - the corresponding net lending term derived from the financial account.[23]

3.87 The trade component of the current account balance projection consists of the import and export forecasts set out in the expenditure section of this paper. Here we focus on net investment income, which is modelled in a similar way to household sector investment income. UK asset holdings are split into holdings of foreign direct investment, foreign equities, pension claims, bonds and 'other' investments – such as banking loans. Our approach to estimating the income flow is to construct a weighted average rate of return and apply it to the stock of assets.

3.88 The rates of return we use are given by the change in world equity prices (assumed to grow in line with nominal world GDP) and long and short world interest rates (expectations for which are derived from financial market instruments). The Sterling ERI forecast (made on an uncovered interest parity basis) is also used to adjust returns on the sterling value of foreign-currency denominated assets – and so affects the flow of sterling income. The flow of payments out of the UK on foreign-held assets is constructed in a very similar way, estimating an average rate of return on the typical foreign portfolio.

3.89 The external sector balance sheet sets foreign claims on UK assets against UK claims on foreign assets giving the international investment position. We use a number of behavioural equations to determine the evolution of these asset portfolios, disaggregated into the asset classes described above. For example, if household purchases of equities were forecast to increase, this would be partly reflected in the external balance sheet by an increase in UK holdings of foreign

[22] Such as those to and from the European Union.

[23] In theory the current account balance and the financial balance should be equal but in practice measurement error requires a statistical discrepancy to reconcile the accounts.

equities relative to other assets. This allows for feedback from changes in the composition of the stock of assets to the income flows it generates.

Corporate sector

3.90 The corporate sector is not modelled in the same level of detail as the household or external sectors and is split into two subsectors: financial and private non-financial companies. For financial companies we hold the National Accounts measure of gross trading profits constant at its most recent value across the forecast period. This may seem counterintuitive but financial sector trading profits in the National Accounts do not map across well to the profits reported in financial company accounts – by this measure, the financial sector would have made a loss every year since 1959.[24]

3.91 There is another measure in the national accounts that corresponds to financial company output in the form of financial intermediation services indirectly measured (FISIM).[25] In the National Accounts this is the difference between Bank Rate and lending rates to the wider economy and represents the value of financial services consumed by households and firms. In our model, the FISIM forecast is projected from the interest payment and receipt flows associated with household and private non-financial corporations' savings and debt.[26]

3.92 Our model does not have a detailed representation of the financial sector balance sheet but, as we set out in the credit conditions and lending section, we make a thorough assessment of its size and composition and implications for the shape of the forecast more generally at each forecast round.

3.93 The other, larger subsector, private non-financial companies (PNFCs), is modelled at a high level of aggregation and acts as the residual that balances the income account in our model. To arrive at PNFC profitability we begin with our forecast of gross value added. From this we subtract costs of production such as consumption of capital, compensation of employees and taxes less subsidies. This gives whole-economy operating surplus. From here we subtract our forecasts for the operating surplus attributed to households,[27] government, and public corporations, the rent paid by PNFCs, payments for financial services and financial sector profits.

[24] This is principally because property income is deducted to derive trading profits in the National Accounts.

[25] See ONS (2010) for more information.

[26] Our approach to forecasting tax receipts from financial firms is set out in *Briefing paper No. 1: Forecasting the public finances* and does not depend on the financial sector variables in our model.

[27] Mainly the imputed value of owner-occupied housing services.

3.94 This gives us a measure of PNFC profitability from which we subtract our projection of North Sea oil profits to give the non-oil PNFC profits forecast – an important fiscal determinant. Because of its importance to the fiscal projections, the non-oil PNFC profit forecast receives a great deal of attention at each forecast round and acts as another diagnostic for the coherence of the income forecast. We closely scrutinise all determinants and compare the profits projection to a benchmark equation, considering both current trends and qualitative evidence. Should we decide that the profitability profile implied by the rest of our forecast is inconsistent with our other judgements, this would give us cause to revisit other areas of the forecast.

3.95 A related diagnostic test is the labour share of domestic income, which is of importance to the public sector finances forecast because labour income is more tax-rich than corporate profits. Again, if we were dissatisfied by the labour share projection we would reconsider our forecast for compensation of employees and the profits forecast would reflect any change.

3.96 The corporate sector financial balance sheet is not represented with the same sophistication as that of households. Less use is made of the net lending constraint; instead, total acquisition of liabilities is driven by a simple equation that depends on the business investment forecast. We determine the split between different liabilities (principally bank lending, bond issuance and equity) judgementally.

Inflation and nominal GDP

Inflation forecast

3.97 The inflation target is the anchor for the inflation forecast and that, in turn, provides the nominal anchor for the forecast. We generally assume that the Bank of England will meet the inflation target by the end of the forecast period so that CPI inflation remains at 2 per cent. Normally we would expect this to occur no later than over a two-to-three year horizon, over which the effects of monetary policy are normally thought to be felt. [28] There may be circumstances in which we depart from this view, for example, if the normal monetary transmission mechanism is thought to be impaired.

[28] For more details on the monetary transmission mechanism see: http://www.bankofengland.co.uk/publications/other/monetary/montrans.pdf

3.98 The prices forecast encompasses consumer price indices (such as CPI, RPI, RPIX and Rossi),[29] the National Accounts deflators (e.g. consumers' expenditure deflator) and other price indices such as house prices. Together with the forecast for real expenditure components, these variables determine the nominal side of the forecast, which contains many of the determinants used to construct the public finances projection.

3.99 Although there are differences in the calculation and coverage of each of the price indices forecast, these variables are interrelated: some by technical relationships in the main macroeconomic model (see the diagrammatical representation of the macroeconomic model in Annex A) while others are more generally informed by the judgement on the inflation outlook over the forecast period, such that together they tell a coherent story. This judgement begins with forming a view on the CPI, the inflation measured targeted by the Bank of England.

3.100 The short-term forecast for consumer prices is informed by the outlook for each of the CPI components. The effects of anticipated energy price changes or any policy changes to taxes and duties are incorporated into the forecast at this stage. An active dialogue with other forecasters, such as the Bank of England, is also maintained and used to inform our short-term view. We also find that the short-term forecast is useful for identifying base effects (e.g. from food, petrol and utilities) whose influence will still be felt in the subsequent year.[30]

3.101 Further out, the main drivers of the consumer prices forecast are the degree of spare capacity or excess demand,[31] import prices, unit wage costs, developments in retail margins and the effect of monetary policy in anchoring inflation expectations to target. In the medium term, we assume that the Bank of England will meet the inflation target so that CPI inflation remains at 2 per cent thereafter.

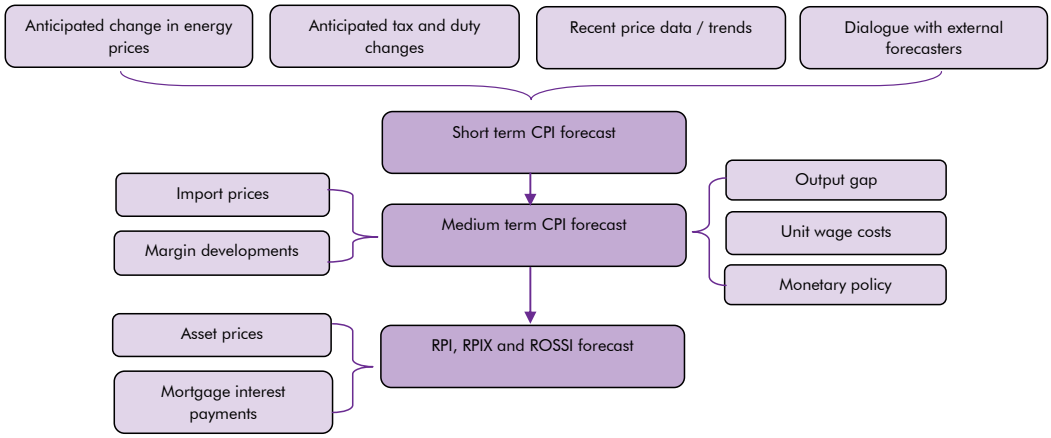
3.102 The profile for RPI inflation is built up in a similar way by assessing the outlook for the components, and is consistent with the profile for CPI taking into account differences in coverage and calculation. We forecast the additional components included in the RPI that are not covered by the CPI, for example mortgage interest payment (MIPs) (see section on credit conditions) and housing depreciation (determined using our forecast for house prices).

[29] Rossi is defined as the RPI all items index excluding mortgage interest payments, housing depreciation, rent and council tax.
[30] The annual rate of inflation is affected by recent price changes and price changes in the base period a year ago.
[31] HM Treasury (2010) investigated this relationship econometrically using a Phillip's curve model. However, we do not assume that there is a mechanical relationship between the output gap and inflation in the forecast; rather it is one of a number of factors that are incorporated judgementally.

3.103 Excluding the MIPs component from RPI inflation gives a profile for RPIX. Rossi is the RPI excluding MIPs, housing depreciation, rents and council tax.

3.104 We also take into account the differences in calculation between the RPI and CPI measures of inflation, due to the use of different weights and the 'formula effect'. The formula effect occurs as a result of the use of the geometric mean (GM) to aggregate prices at the elementary item level in the CPI, whereas the RPI uses an arithmetic mean (AM). A judgement is typically taken on the contribution to the medium-term difference between the RPI and CPI from the formula effect, based on recent trends.

Figure 3.2: Inflation forecast – flow chart



GDP deflator

3.105 The broadest measure of domestic price movements is the GDP deflator, which reflects the prices of domestic value added in its entirety. The GDP deflator reflects the prices of all domestically produced goods and services in the economy including the prices of consumption goods and services, investment goods, government services and exports, minus the price of UK imports. In our forecast, the GDP expenditure price deflators, when combined with the expenditure components, define the expenditure side of the economy in nominal terms.

3.106 The GDP deflator is calculated using the component forecasts for the GDP deflator identity for the first few years of the forecast and in the medium term the growth rate for the GDP deflator is set to be consistent with our medium-term inflation assumptions:

- the consumers' expenditure deflator moves broadly in line with the consumer price indices forecasts;

- the total export and import price deflators are built up from a number of sectoral deflators, including services, goods and oil prices. The forecast is influenced by our forecasts of the exchange rate, Brent crude prices and world goods prices (for more details see the diagrammatical representation of the macroeconomic model in Annex A);

- the Government consumption deflator forecast is generally split into two parts: a weighted average of government wage and procurement costs (with the Total Final Expenditure deflator used as a proxy for the cost of procurement) and real government consumption in departments whose output is measured using direct activity indicators; and

- the investment deflator forecast is informed by trends in its components (e.g. dwellings), as well as the general outlook on inflation and import prices.

Labour market

3.107 Our labour market forecasts include forecasts for the main Labour Force Survey (LFS) aggregates and the claimant count measure of unemployment, a key determinant of spending on social security benefits. The forecast for total employment is decomposed into general government employment and market sector employment. These are combined with forecasts for nominal earnings growth to generate a forecast for the growth of total wages and salaries, which is used to forecast a number of public sector receipts, such as those from income tax and national insurance contributions.

Labour Force Survey variables

3.108 Our forecast of the labour market includes projections of a number of headline labour market indicators derived from LFS, defined on an age 16+ basis. These include employment, participation, unemployment, household population, average weekly hours worked and total weekly hours worked.

3.109 Over the near term, our forecast for GDP growth, together with an assessment of recent labour market data and labour market leading indicators, help to inform the path of the employment rate, participation rate, unemployment rate, household population and average weekly hours worked. Forecasts for the level of participation, employment and unemployment are then derived by combining the forecast of the household population with the forecasts of the participation rate, employment rate and unemployment rate.

3.110 Beyond the short term, it is assumed that these variables gradually return to their underlying trend levels, with judgements about how the output cycle interacts with the labour market determining the speed at which each particular variable reverts

to trend. Important aspects of this will include judgements about firms' expectations, possible lags between the labour market and output and the speed at which sectoral change can be accommodated. A further consideration is the plausibility of the implied cyclical path for actual labour productivity: if the forecasts for output, employment and average hours worked imply an implausible path for output per worker or output per hour then this would lead us to revisit our output and labour market forecasts.

Workforce jobs

3.111 In addition to the LFS measure of employment, the labour market forecast also includes projections of workforce jobs, a measure of the total number of jobs in the economy, rather than the number of people in employment. The number of workforce jobs is typically assumed to grow broadly in line with LFS employment, although we may depart from this convention over the short term if judged appropriate. For example, if the difference between the latest workforce jobs data and LFS employment is particularly large, [32] then it might be appropriate to assume different growth rates if we expect the gap between the two measures to move back towards a particular level.

Claimant count

3.112 As well as the LFS measure of unemployment, we also forecast the level of the claimant count. The claimant count measures the total number of people claiming Jobseeker's Allowance (JSA) and is therefore one of the determinants of our forecast for social security spending.

3.113 Our forecast of the claimant count is closely linked to our projection of LFS unemployment. In general, we assume that the claimant count moves broadly in line with LFS unemployment, although we might expect the paths to diverge over the near term if there are different signals from the latest data. Government policies that are likely to move people from claiming one benefit to claiming JSA may also have a significant bearing on the claimant count. To ensure that projected expenditure on JSA is consistent with our forecasts for other elements of social security spending, we account for the impact of policies that may lead to a transfer of individuals to JSA from other benefits using the latest available evidence on claimant count inflows.

3.114 Over the longer run we assume that the claimant count gradually returns to a level consistent with its historical relationship with LFS unemployment.

[32] The Office for National Statistics publishes a regular comparison of LFS and workforce jobs, available on its website: www.ons.gov.uk.

Employment decomposition

3.115 Our forecast of total employment can also be decomposed into general government employment and market sector employment. [33] Our forecast for general government employment is based on a top-down approach, combining estimates of paybill growth and the growth of paybill per head to derive a projection of general government employment growth. Projections for paybill growth are based on forecast growth in the sum of RDEL, Local Authority Self-Financing Expenditure (LASFE) and BBC current expenditure, while paybill per head growth is determined by assumptions about changes in the basic pay settlement, pay drift, employer pensions contributions and other factors, such as national insurance contributions. More details of our approach to projecting general government employment are set out in our November 2010 *Economic and fiscal outlook*.

3.116 The sum of market sector employment and general government employment approximately constitutes total employment. Once we have obtained a forecast of general government employment, our forecast of market sector employment is jointly-determined with our forecast of total employment. Over the medium term, the level of market sector employment is assumed to return gradually to a level consistent with the projected trend level of total employment and our projection of general government employment.

Earnings

3.117 A key determinant of our forecasts of a number of public sector receipts, such as income tax and national insurance contributions, is our forecast for the growth of total wages and salaries. In addition to forecasts of employment, this requires a forecast for average earnings growth.

3.118 Consistent with our forecast of employment, we forecast average earnings growth on both a market sector and general government basis. Our forecasts of market sector and general government average earnings growth are then combined with our employment forecasts for each sector to generate a forecast of the annual growth of total wages and salaries. [34]

[33] The market sector is defined as the private sector plus public corporations while the general government sector is defined as the public sector less public corporations.

[34] For the purposes of the fiscal forecast we make a separate assumption about the path of financial sector bonuses. Bonuses are generally paid to high-earning individuals and therefore tend to be taxed at a higher rate than non-bonus income. See *Briefing paper No.1: Forecasting the public finances*.

3.119 Average earnings growth in the general government sector is set to be consistent with the assumptions underlying our estimate of paybill per head growth, which we use to forecast general government employment. In particular, general government average earnings growth is determined by our assumptions about the growth of the basic pay settlement and pay drift. More details are set out in our November 2010 *Economic and fiscal outlook*.

3.120 In the macroeconomic model, nominal average earnings in the market sector are determined according to a standard Layard-Nickell[35] model in which wages (but not employment) are set in a bargaining framework.[36] This equation helps to inform our short run forecast of market sector average earnings growth, along with the degree of labour market slack (as proxied by the unemployment and participation rate gaps) as well as the behaviour of inflation and inflation expectations.

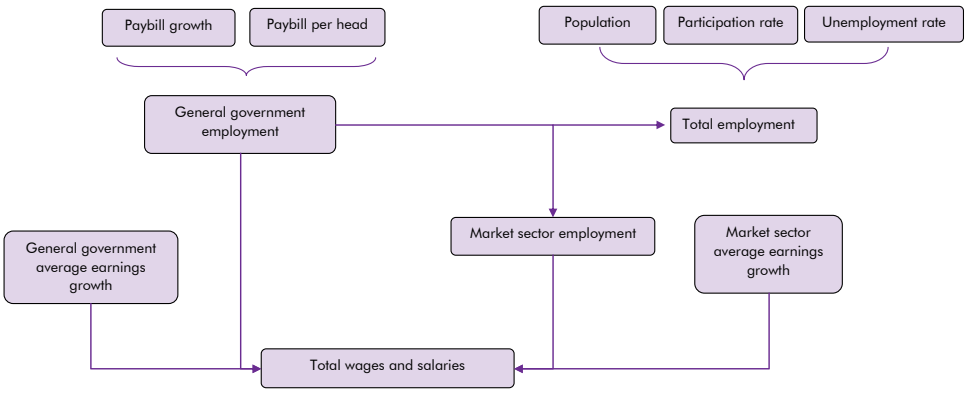
3.121 An important consideration here is the adjudged degree of real wage resistance to changes in inflation. If real wages are expected to be relatively flexible following a shock to the price level or inflation then we would expect limited pass through to nominal wages. Relevant factors to consider when assessing the degree of real wage flexibility include movements in longer-term inflation expectations and the recent behaviour of nominal wages, as well as the nature of the shock to prices or inflation. For example, the nominal wage response may differ depending on whether movements in inflation correspond to changes in domestically generated inflation or to changes in import price inflation.

3.122 Over the longer run, market sector nominal average earnings are assumed to grow in line with nominal GDP per worker, equal to the product of trend output per worker growth and the long-run annual growth rate of the GDP deflator. Accordingly, real earnings are assumed to grow in line with output per worker in the long run.

3.123 Market sector and general government average earnings growth, together with the forecast of market sector and general government employment, determine the forecast for total wages and salaries. Figure 3.3 provides an illustration of how we construct the wages and salaries forecast.

[35] Layard, Nickell & Jackman (2005)
[36] Specifically, average earnings growth is determined as a function of the GVA deflator, LFS unemployment rate, private sector productivity, real productivity wage, union density, the employee retention ratio (take home pay), employers tax rate and the wedge between the price of consumption and the price of output. See macroeconomic model documentation for more details.

Figure 3.3: Wages and salaries flow diagram



World forecast

3.124 It would not be practical for us to produce a full scale bottom-up forecast of the world economy and therefore we review in detail and make use of forecasts produced by the IMF and the OECD.

3.125 The models we do use consist of simple statistical models for the short term, while for the medium term we look at trend output growth and the historical trade to GDP ratio and make use of trade elasticities from the academic literature. We only produce individual output and trade forecasts for the larger economies and for the rest of the world we produce regional output and trade forecasts, which rely heavily on IMF forecasts. The important variables for the UK forecast are growth in UK export markets and world trade. In addition to producing forecasts for world output and trade, an important part of the process is to identify global risks that could affect the UK economy.

Credit conditions

3.126 In our model, credit conditions enter primarily through variables that capture the cost of credit, such as interest rates and lending spreads. The availability of credit and the implications arising from it feed into the forecast implicitly through our assumptions relating to household saving behaviour and our projections of investment, consumption and the overall profile of GDP.

3.127 Our general approach to assessing the cost of credit has two features:

- first, we consider the likely funding costs faced by the banking sector. These are generally determined on a macro scale and reflect global investment and saving behaviour, perceptions of counterparty risk and developments in

monetary policy. Our assessment of the non-monetary policy effects on bank funding costs is captured by a funding spread over policy rates; and

- second, we consider domestic factors that influence the price of lending, such as competitiveness within the banking sector, operating costs and expected bad loan provisions. We apply this judgement to the forecast by applying a mark-up to lending rates and a mark-down to deposit rates. A key diagnostic of the forecast is a proxy of the net interest margin, which captures the difference between the interest banks pay out on the stock of deposits and the interest they receive on the stock of loans.

3.128 Mortgage rates are modelled by disaggregating the stock of mortgages into those earning a fixed rate of interest and those on a variable rate. While the variable rate forecast is independent of the stock of mortgages, the fixed rate is not. The duration of fixed rate mortgages means that the effective rate paid on the outstanding stock is relatively insensitive to changes in interest rates as a small proportion of that stock matures and comes up for refinancing at any given time. The fixed rate to be applied to the refinanced mortgages is derived from the 2-year and 5-year swap curve and a spread reflecting funding costs. Deposit interest rates are forecast in a similar way with the stock of deposits split into those which are instant access (sight deposits) and those which are tied up (time deposits).

3.129 While the price of credit is important, it tells us little about the willingness of banks to lend or the appetite for credit. At each forecast round, we consider recent developments in financial markets that might affect the flow of lending as well as longer-term trends in, for example, bank funding costs or the size and structure of financial sector balance sheets. We also assess the effect of policy changes related to the regulatory environment.

Scenario analysis

3.130 In assessing the outlook for the public finances it is useful to think about ways in which the economy might diverge from our central forecast and what the fiscal consequences might be. To this end, we present alternative economic scenarios that reflect the views of credible outside commentators and explore the sensitivity of the fiscal projection to key forecast judgements. Our scenarios are not intended to capture all the ways in which the economy might deviate from the central forecast and we do not attempt to attach particular probabilities to their occurrence.

3.131 Our central fiscal projection is produced using a wide range of economic determinants from our large-scale macroeconomic model. The approach we take in producing scenarios is simpler and depends on 'ready-reckoning' the effect of

changes in a small selection of determinants on the central forecast. The forecasts are only broad-brush illustrations, produced without using the OBR model. They are based on stylised assumptions and heavily dependent on judgement. One implication is that the bands of error surrounding the central forecast fan chart are not applicable and the results should naturally be approached with a higher degree of caution.

3.132 As we set out in the monetary policy section, there are no model variables which drive the closing of the output gap or capture the formulation of monetary policy. Therefore, to produce stylised scenarios it is useful to specify some simple rules for the way monetary policy is set and for how output and employment respond. To this end, we use three very simple rules: the Taylor rule, a simple aggregate demand relation and Okun's law.

3.133 While we often use these relationships, we may wish to present a scenario in which, for example, the unemployment sensitivity to the output gap is higher or lower than implied by our central forecast. Therefore, to maintain some degree of pragmatism in our approach we may deviate from these simple relationships in our presentation of scenarios.

3.134 In its simplest form, the Taylor rule relates the interest rate to a natural nominal interest rate, the current deviation of the rate of Consumer Prices Index (CPI) inflation from target and the output gap.[37] Here we use the original coefficients from Taylor's 1993 study and decompose the nominal rate into inflation and the real natural rate:

$$i_t = i_r^* + \pi_t + 0.5(\pi_t - \pi^*) + 0.5(y_t - y_t^*)$$

3.135 Where i_t is the policy rate at time t, i_r^* is the real natural interest rate, π_t is the rate of CPI inflation, π^* is the inflation target, y_t is the level of output and is the y_t^* estimated potential level of output. The difference between the level of output and potential output is known as the output gap.

3.136 We take differences of this rule relative to the central forecast to arrive at marginal responses to deviations from the central forecast. It is assumed that the inflation target and the real natural interest rate are the same in both the scenario and the central forecast - superscript *s* denotes a variable relates to the scenario.

$$i_t^s - i_t = 1.5(\pi_t^s - \pi_t) + 0.5[(y_t^s - y_t^{s*}) - (y_t - y_t^*)]$$

[37] Taylor. (1993)

3.137 This expression indicates that if inflation is one percentage point higher under an alternative scenario, the Bank of England will set interest rates 1.5 percentage points higher than in the central forecast (a coefficient above unity ensures that the Bank of England returns inflation to target). If the output gap is 1 percentage point wider than in the central forecast, the Bank of England will set interest rates 0.5 percentage points lower under an alternative scenario.

3.138 Output responses to monetary policy are assumed consistent with a very simple aggregate demand equation:

$$y_t = y_{t-1} - \beta_i (i_t - \pi_t - i_r^*)$$

3.139 The variables have the same interpretation as above and the β coefficient represents the sensitivity of output to deviations of the real interest rate from the real natural rate.

3.140 Again, taking differences relative to the central forecast:

$$y_t^s - y_t = (y_{t-1}^s - y_{t-1}) + \beta_i[(i_t - \pi_t) - (i_t^s - \pi_t^s)]$$

3.141 This expression indicates that the difference in output between the scenario and the central forecast is a function of the real interest rate differential in the current period and the output differential in the preceding period. The beta coefficient gives the sensitivity of output to real interest rates. We assume a one percentage point increase in interest rates takes around 6 months to have its maximum impact on output of around -0.3 percentage points.

3.142 The output gap is assumed to have an effect on unemployment consistent with Okun's law[38]. Unemployment in the scenario rises by around half a per cent for a one percentage point wider output gap relative to the central forecast.

Conclusion

3.143 One key advantage of 'contracting out' the production of official fiscal forecasts to an independent body like the OBR is that governments can no longer dismiss scepticism regarding official fiscal forecasts by pointing out that they have access to privileged information on revenues and spending that outsiders lack. The OBR has access to all relevant information on the public finances from within Whitehall and we are endeavouring to present the conclusions that we draw from it as transparently as we can.

[38] See Baily and Okun (1965)

3.144 On the face of it, the case for contracting out macroeconomic forecasting is less powerful. It is far from clear that official bodies have any significant informational advantage over anybody else in producing macroeconomic forecasts, although they may have more resources to devote to it. One might ask why the OBR should produce macroeconomic forecasts at all and why we should not use those of the Bank of England or of the other non-government bodies that produce regular forecasts for the UK economy.

3.145 As we have attempted to show in this document, an important answer to that question is that we need a macroeconomic forecast that is explicitly tailored to the task of producing a highly disaggregated fiscal forecast that will allow us to assess the Government's progress against the fiscal targets it has set itself. For this we need a macroeconomic forecast that runs over a relatively long time horizon, that generates a large number of determinants from both the expenditure and income sides of the economy, and that is amenable to sensitivity and scenario analysis. No such external forecast is available and therefore producing one is a key part of the OBR's role.

3.146 The purpose of this document is to explain how we go about the task of macroeconomic forecasting, so that outside users can understand them better and can have confidence in the professional judgement being brought to bear. Needless to say, people are bound to disagree with some of the assumptions that we make and the conclusions that we reach – that would be true of any forecaster. Having read this paper, users may also have ideas for how we could improve the methodology we use and the data that we draw upon. We would be delighted to hear any suggestions.

A Main macroeconomic model

Diagrammatic representation of the macroeconomic model

A.1 This annex maps out the structure of our macroeconomic model in a series of flow charts, which detail the main determinants of key model variables and their interactions. The variables in the model are organised into groups, and that grouping approach is replicated here. More details on the model properties and the complete model code are available in HM Treasury (2008). However, there have inevitably been a number of updates to the model since the documentation was last published.

A.2 A distinctive feature of our model is the very detailed treatment of the public sector, which far exceeds that of any comparable UK model (and accounts for just under half of the total model variables). This reflects the development of the model as a tool designed specifically to aid the production of forecasts for the public finances. However, these parts of the model (Groups 9, 10 & 20) are omitted from the representation here as they consist largely of technical relationships and accounting identities, rather than containing any 'economic' content. As set out in *Briefing paper No. 1: Forecasting the public finances*, forecasts for these variables are produced by separate models in HMRC, DWP and the DMO.

Figure A.1: Group 1 Consumption

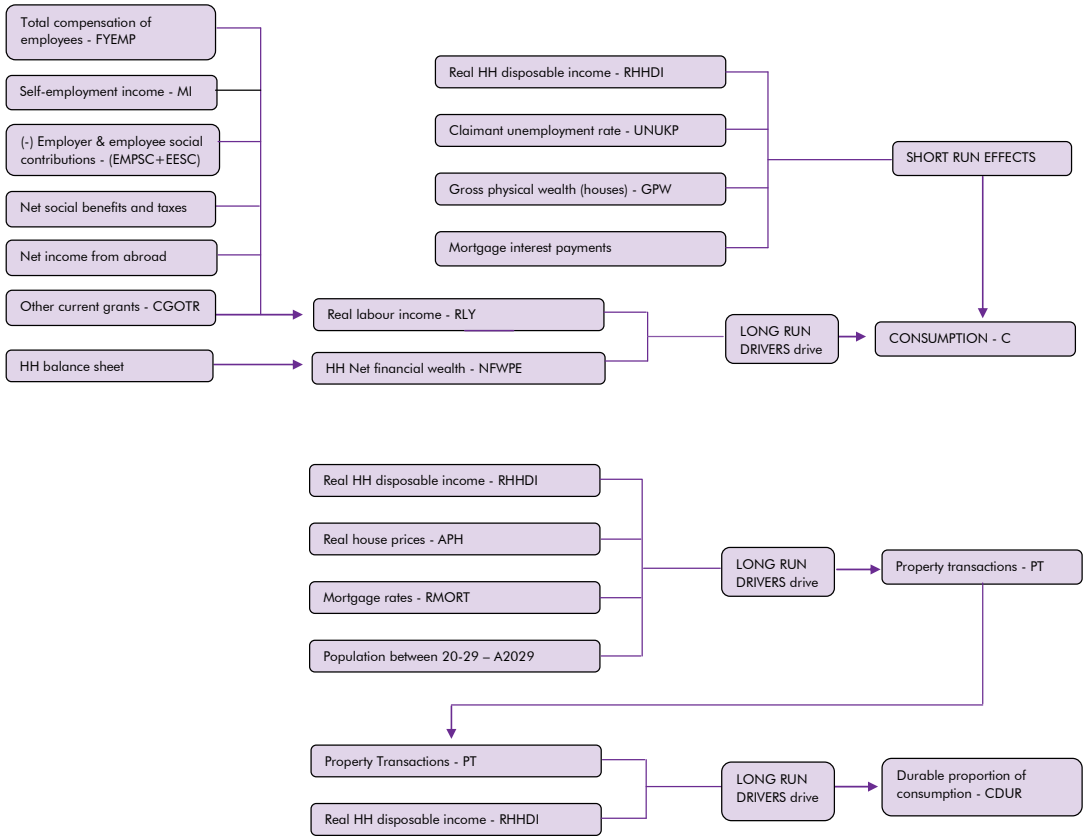


Figure A.2: Group 2 Inventories

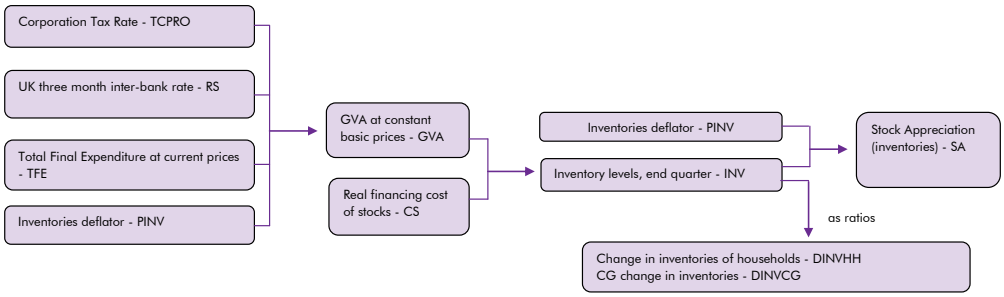


Figure A.3: Group 3 Investment

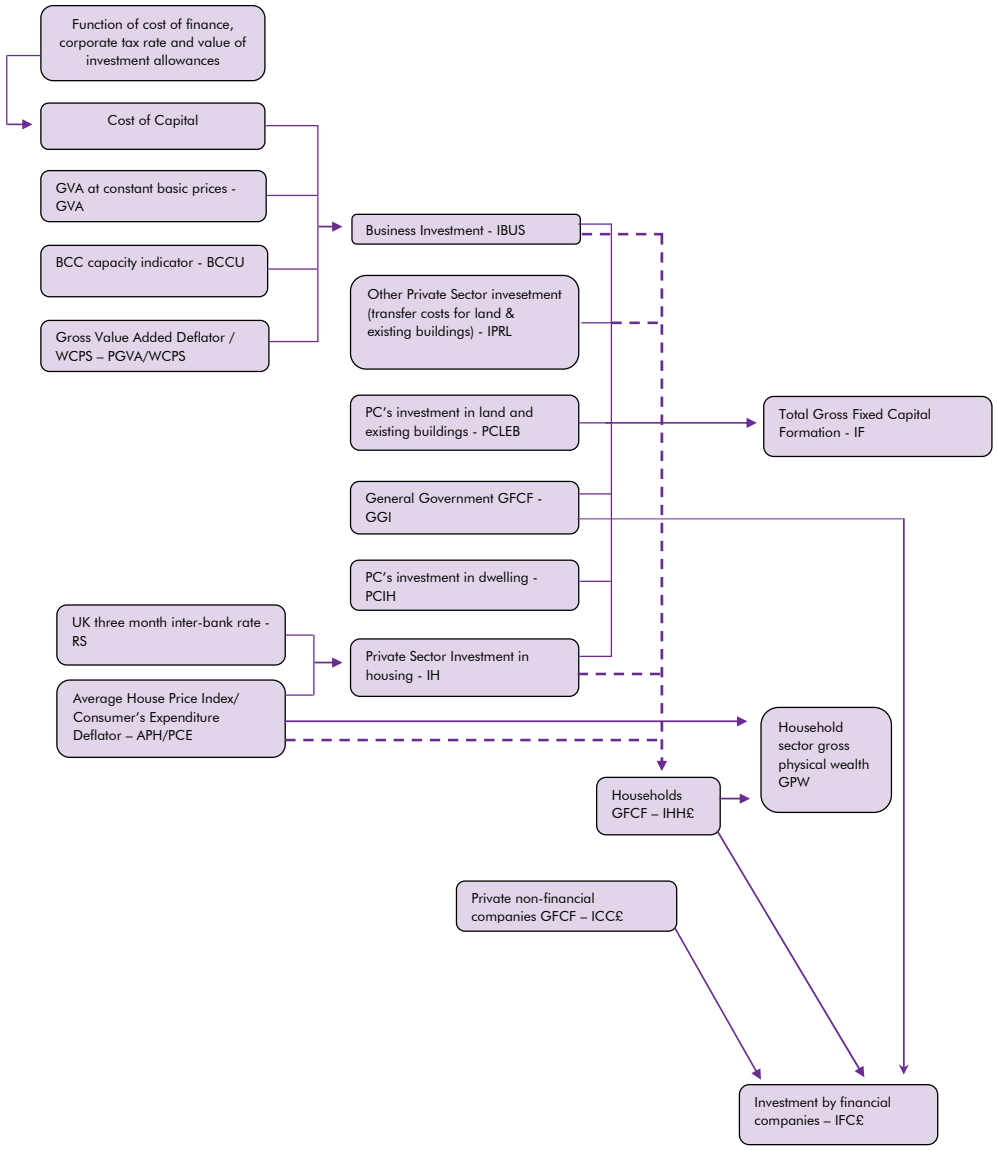


Figure A.4: Group 4 The labour market

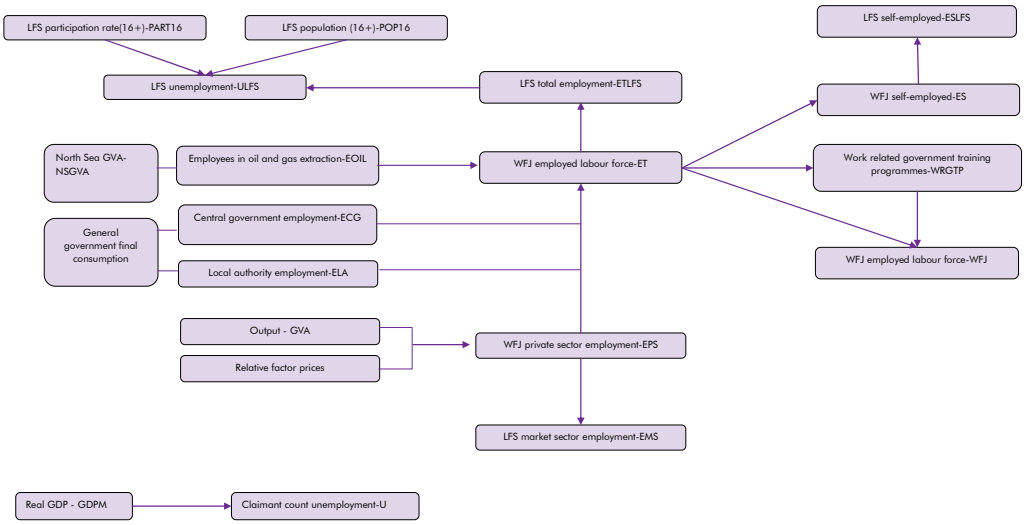


Figure A.5: Group 5 Exports of goods and services

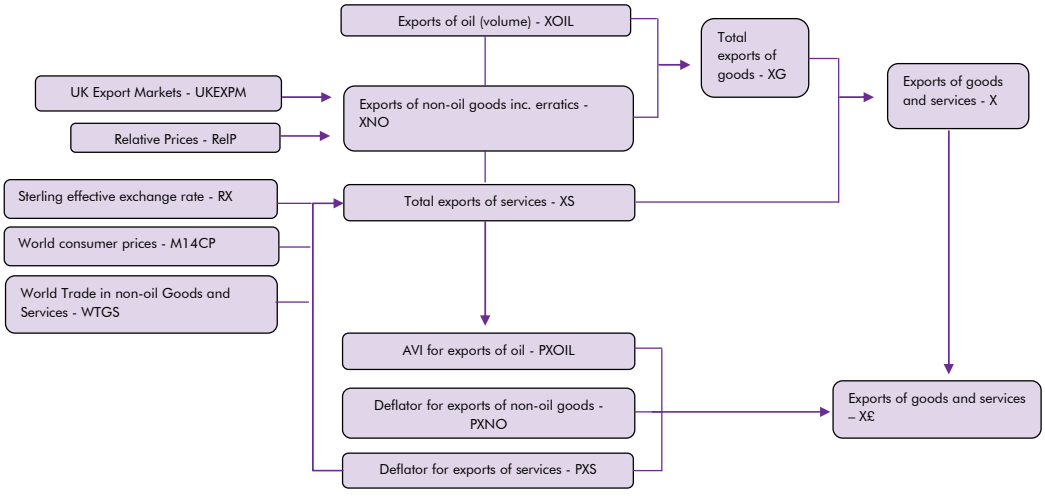


Figure A.6: Group 6 Imports of goods and services

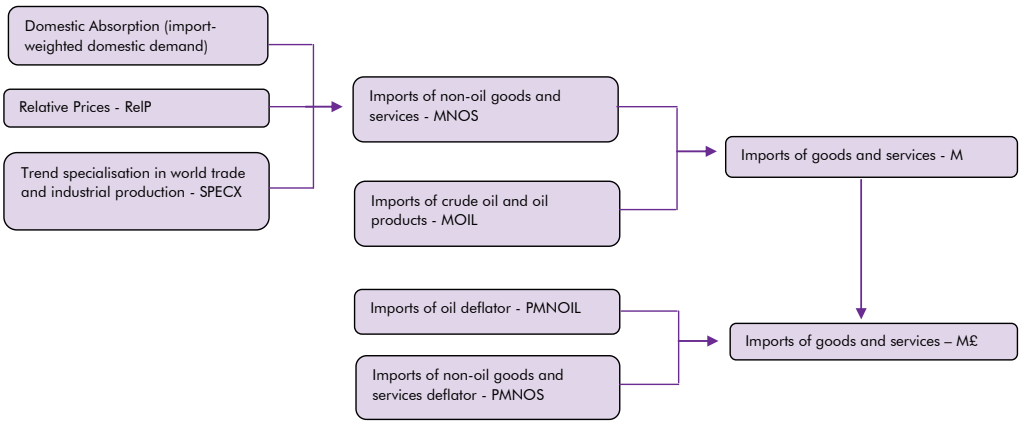


Figure A.7: Group 7 CPI and RPI

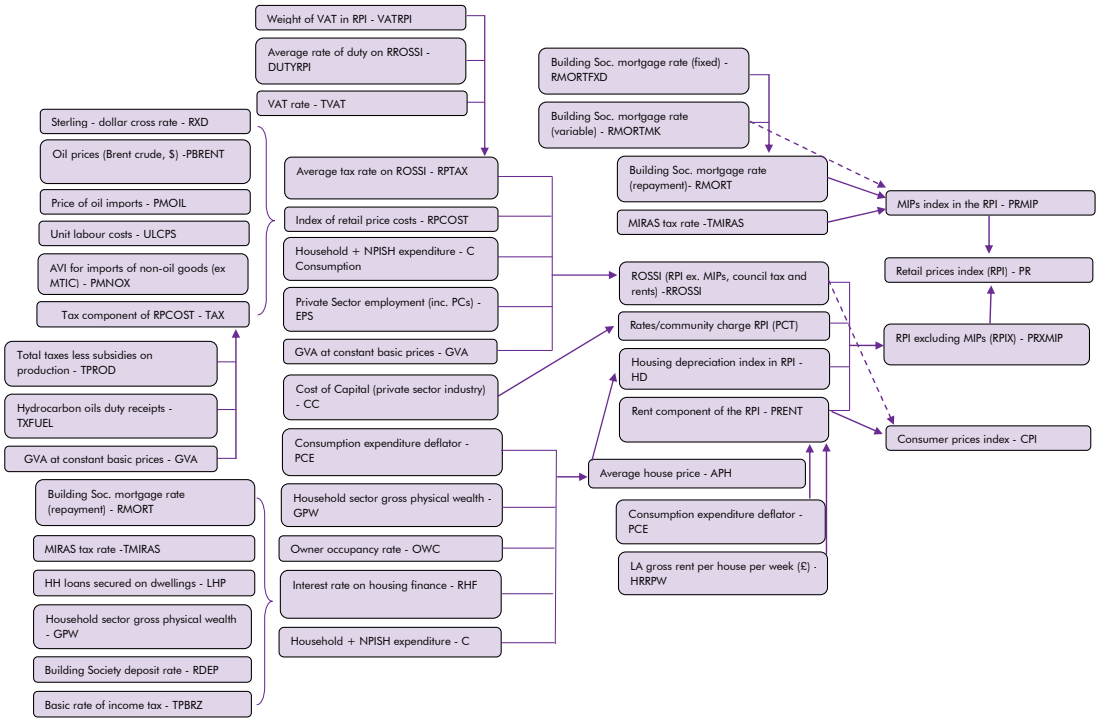


Figure A.8: GDP(E) deflators

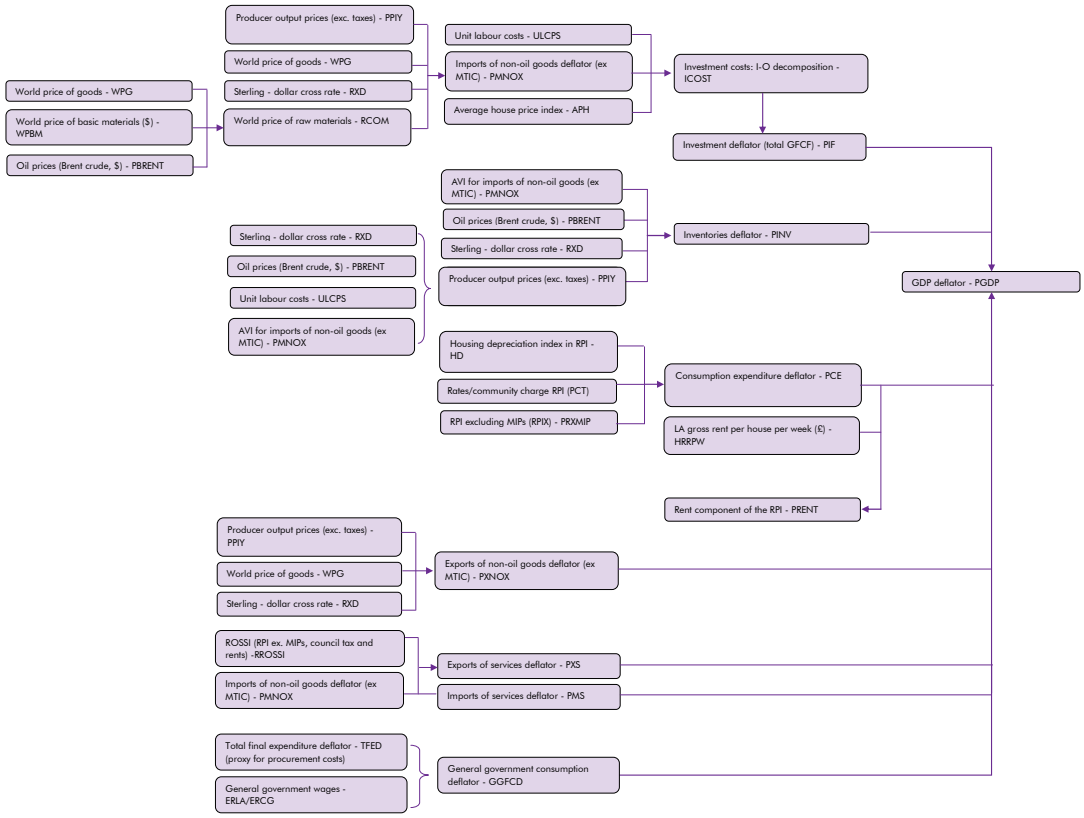
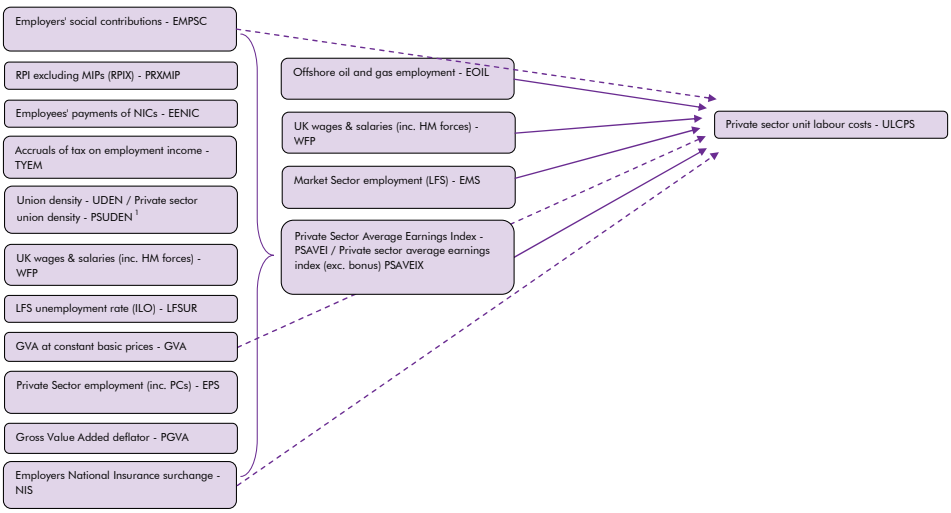


Figure A.9: Earnings



[1] Private sector union density (PSUDEN) is used to calculate Private Sector Average Earnings Index excluding bonuses (PSAVEIX) whereas union density (UDEN) is used for Private Sector Average Earnings Index (PSAVEI).

Figure A.10: Group 8 The North Sea

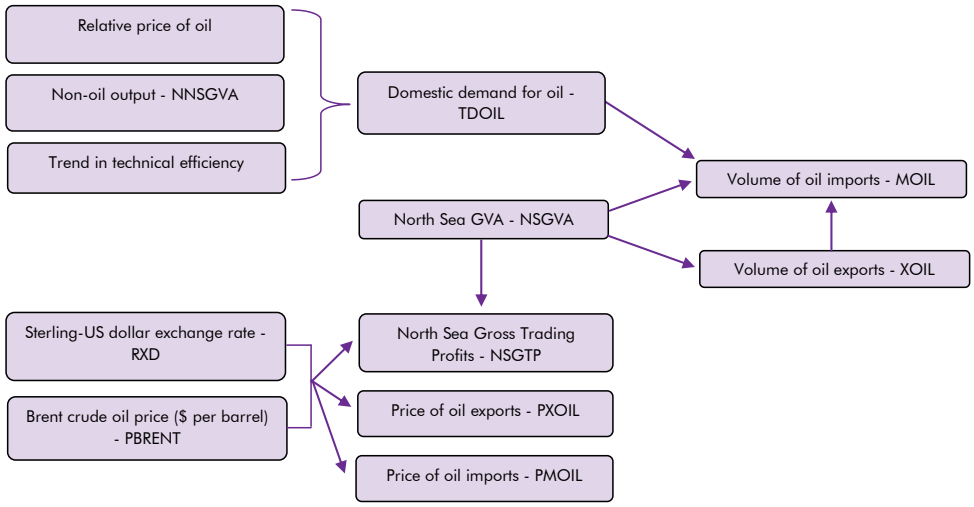


Figure A.11: Group 11 Balance of payments

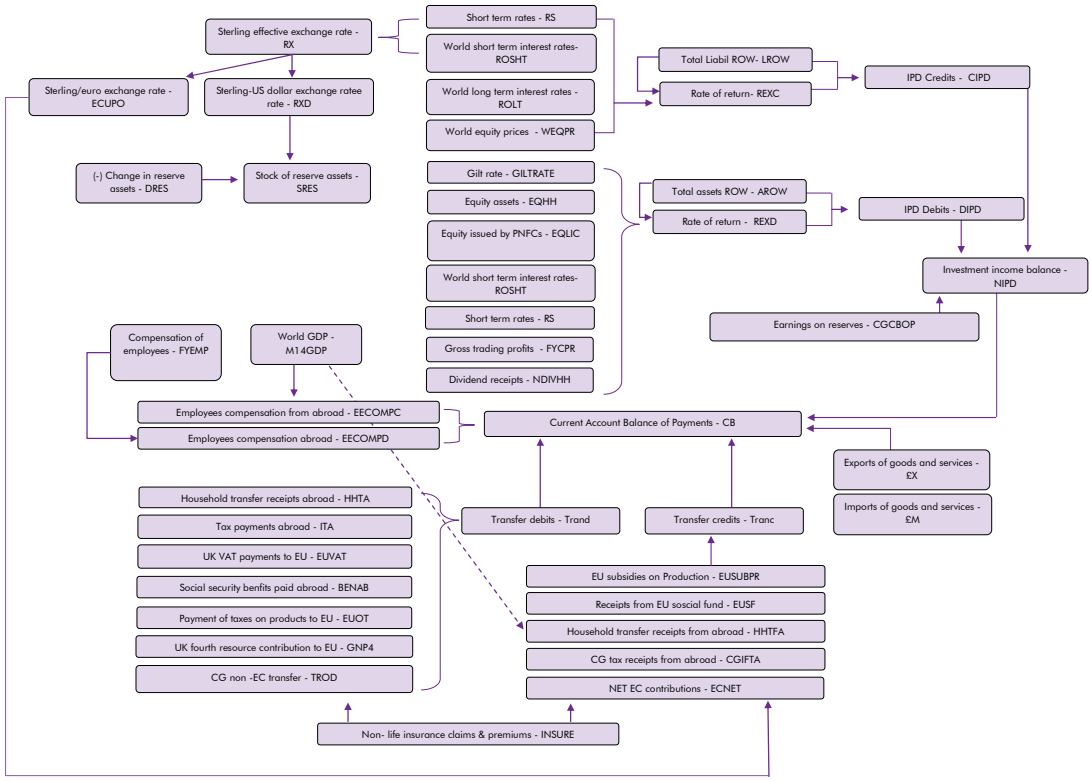


Figure A.12: Group 14 Domestic financial sector

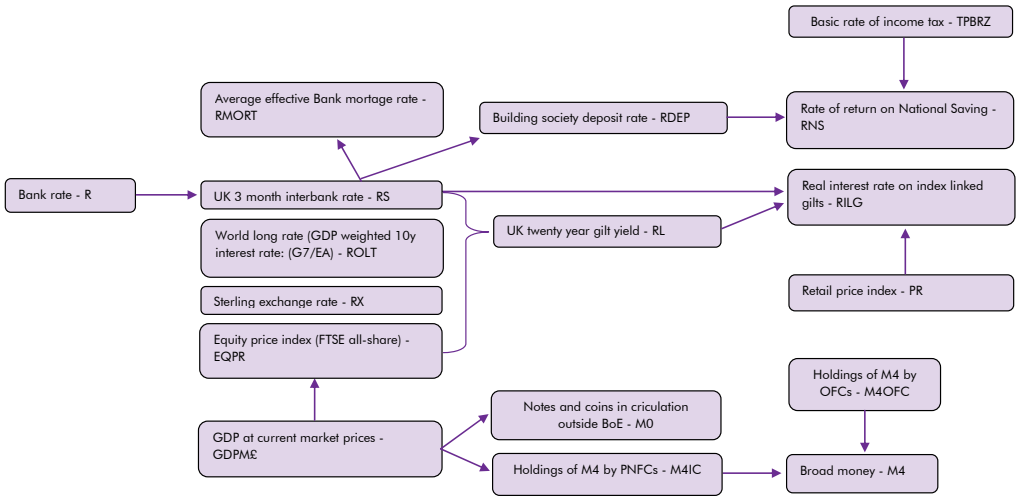


Figure A.13: Group 15 Income account

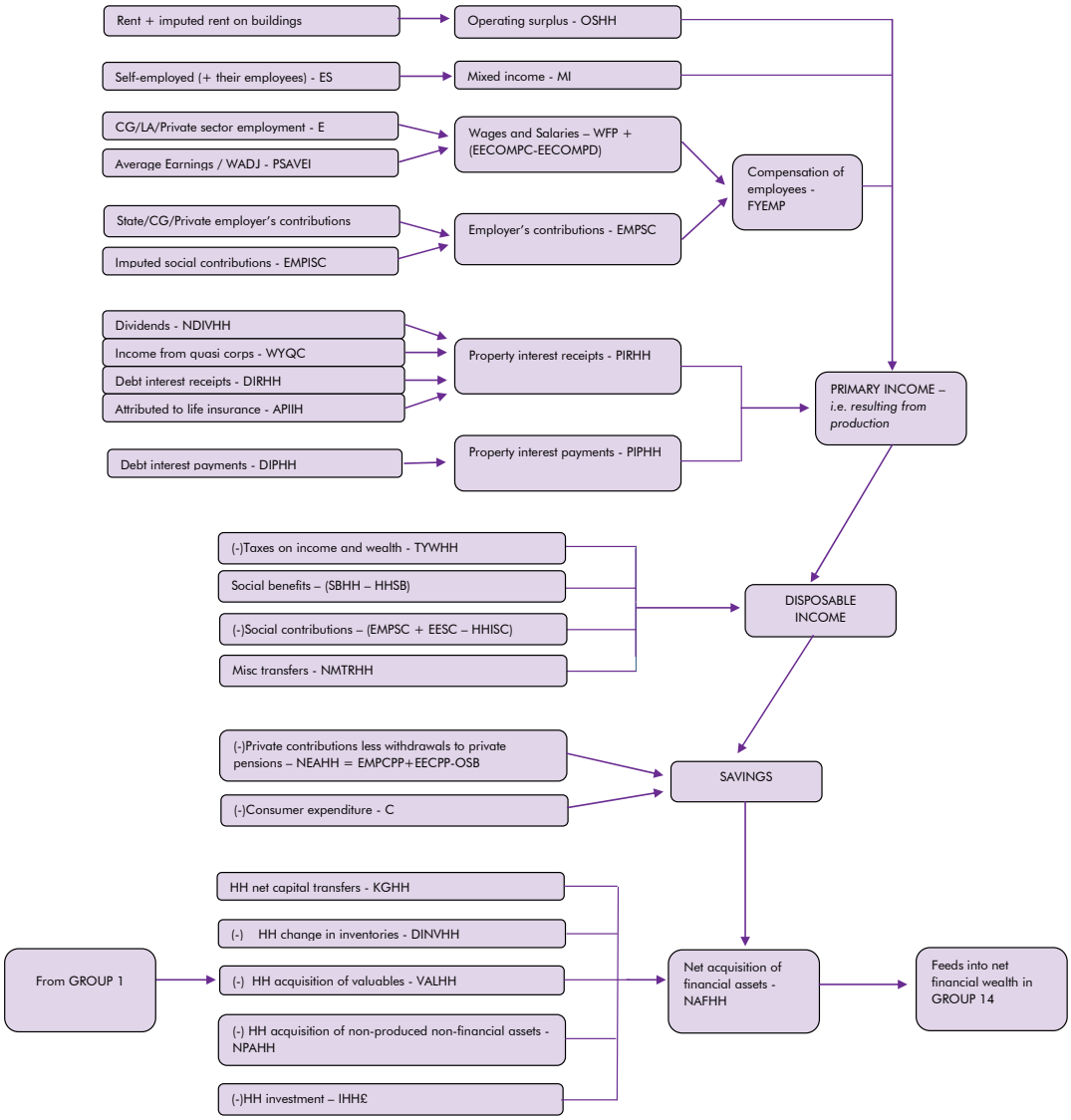


Figure A.14: Group 16 Gross domestic product identities

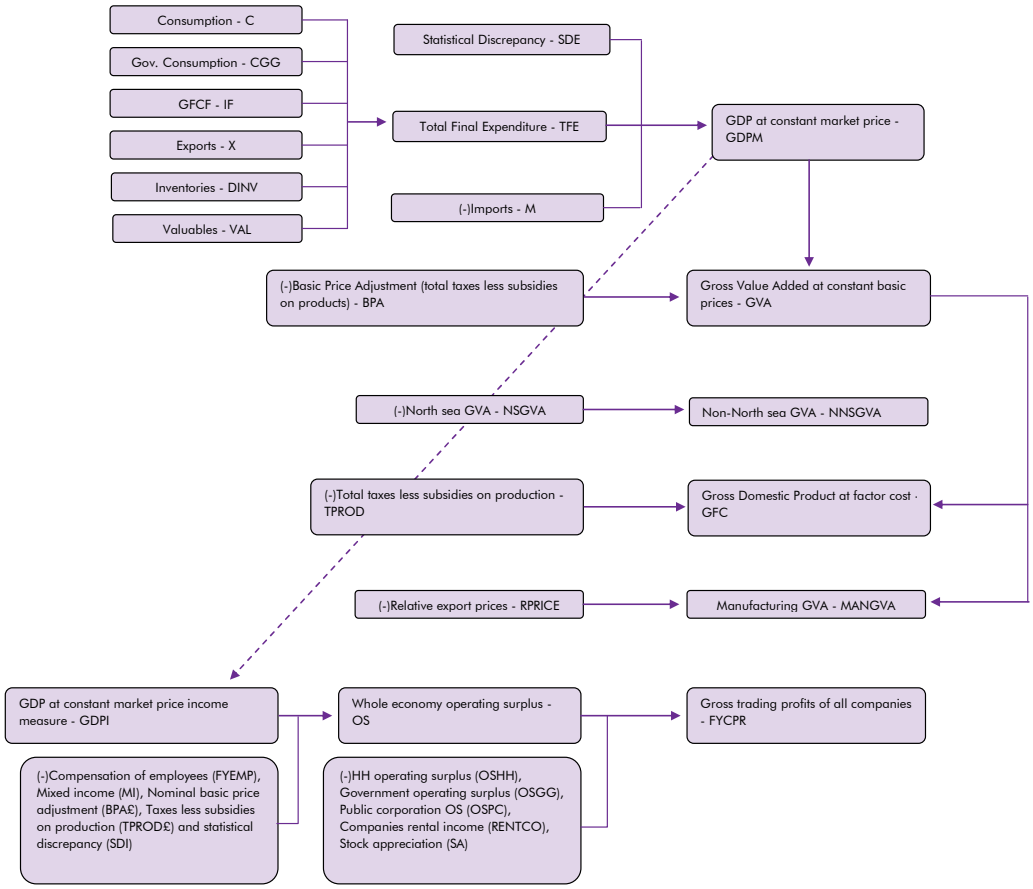


Figure A.15: Group 18 External balance sheet

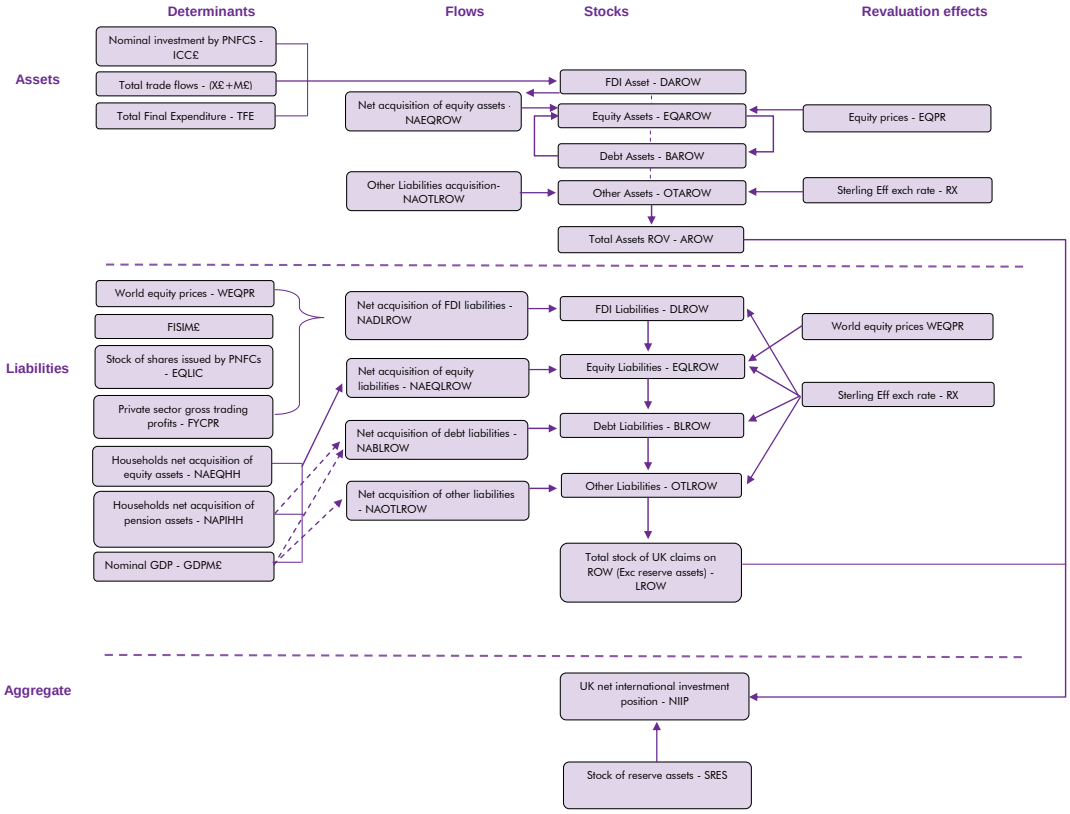


Figure A.16: Group 18 Household balance sheet

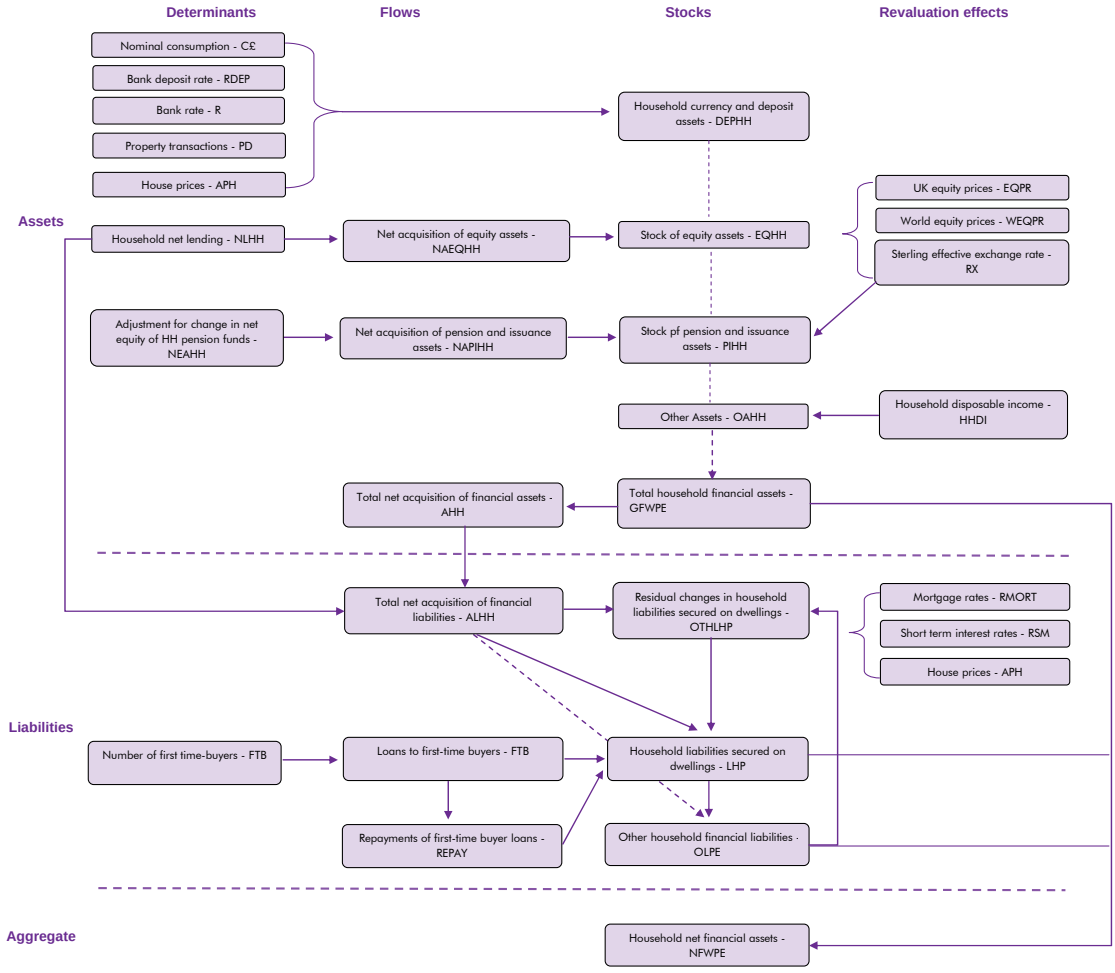
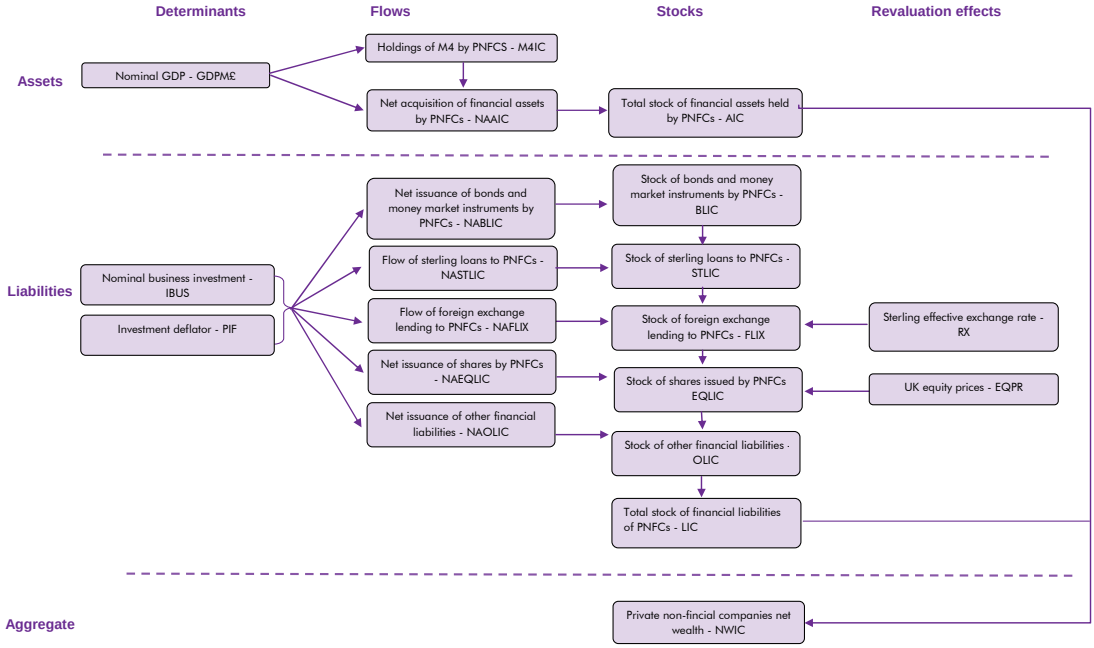


Figure A.17: Group 18 Corporate balance sheet



B References

Baily and Okun (1965), 'The Battle Against Unemployment and Inflation: Problems of the Modern Economy'. New York

Bank of England (1999), 'Economic models at the Bank of England', Bank of England

Bank of England (2005), 'The Bank of England Quarterly Model' Available from: www.bankofengland.co.uk/publications/other/beqm/beqmfull.pdf

Buiter (2008), 'Housing wealth isn't wealth', *NBER working paper,* No. 14204.

Clements and Hendry (2002), 'Modelling methodology and forecast failure' *The Econometrics Journal*, Vol. 5, pp. 319-344

Fair (2010), 'Analyzing Macroeconomic Forecastability' *Cowles Foundation Discussion Paper,* No. 1706

Groen, Kapetanios and Price (2009), 'Multivariate methods for monitoring structural change' *Bank of England Working Paper* No. 369

HM Treasury (2008), 'Macroeconomic Model Documentation, March 2008 Public Model' Available from: www.parliament.uk/deposits/depositedpapers/2009/DEP2009-2901.pdf

HM Treasury (2010), 'Inflation and the output gap in the UK' *Treasury Economic Working Paper* No. 6

IMF (2010), 'Still Minding the Gap - Inflation Dynamics during Episodes of Persistent Large Output Gaps' *IMF working paper* No. 189

IMF (2011) *World Economic Outlook – April 2011. Available from: www.imf.org*

Layard, Nickell and Jackman (2005), 'Unemployment: Macroeconomic Performance and the Labour Market', Oxford University Press.

Meese and Rogoff (1983), 'Empirical exchange rate models of the seventies. Do they fit out of sample?' *Journal of International Economics*, 14, pp. 3-24

Melliss and Whittaker (1998), 'The Treasury forecasting record: Some new results' *National Institute Economic Review* Vol. 164, No. 1, pp 65-79

Nelson and Nikolov (2003), "UK inflation in the 1970s and 1980s: the role of output gap mismeasurement," Journal of Economics and Business, Elsevier, Vol. 55(4), pp 353-370

OECD (2011), *Economic Outlook* No.89 available from: www.oecd.org

ONS (2010), 'The recording of financial intermediation services within sector accounts' *Economic and Labour Market Review*, Vol. 4, No. 6

OBR (2010), 'Assessment of the Effect of Oil Price Fluctuations on the Public Finances' Available from: www.budgetresponsibility.independent.gov.uk

OBR (2011a), 'Forecasting the public finances'. *OBR Briefing paper* No. 1, Available from: www.budgetresponsibility.independent.gov.uk

OBR (2011b), 'Estimating the output gap. *OBR Briefing paper* No. 2, Available from: www.budgetresponsibility.independent.gov.uk

Pagan (2003), 'Report on modelling and forecasting at the Bank of England.' Available from: www.bankofengland.co.uk/publications/news/2003/paganreport.pdf

Smith (1998), 'Emergent policy-making with macroeconometric models' *Economic Modelling*, Vol. 15, No. 3, pp 429-442

Taylor (1993), 'Discretion versus policy rules in practice' *Carnegie-Rochester conference series on public policy*, 39, pp195-214

Wallis and Whitley (1991), 'Sources of error in forecasts and expectations: UK economic models, 1984-1988' *Journal of Forecasting*, Vol. 10, pp231-53

ISBN 978-1-84532-861-0