Not the OBR

A Macroeconomic Policy Model of the UK Economy:

with insights from Godley & Lavoie

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Introduction

The CBR model of the UK economy has been developed since 2013 as part of a programme of work resulting from a deep dissatisfaction with current macro-economic policy in the UK and with the quality of economic advice and policy that supports it. We believe that the causes of ongoing economic crisis since 2007 have been inadequately analysed, leading to confusion on designing adequate policies for reform. The economics profession as a whole has failed in its key task of providing clear signposts for policies on how to avoid a prolonged period of slow growth. Specifically, we disagree with the expectation that austerity policies will have little or no adverse impact on economic growth.

The economic crisis, beginning in 2008, was largely unforeseen by either official or commercial forecasters. Similarly there was a general failure to foresee the weakness of the post-crisis recovery or the combined trends of strong employment growth and a lack of productivity growth. Our response thus far has been two-fold. Firstly we published a detailed report[1] examining macro-economic trends in the decades of liberal economic policies since 1980, contrasted with the 'corporatist' decades prior to 1980. This shows that far from improving economic performance liberal economic policies were associated with slower growth in GDP and productivity.

Secondly, we have developed Keynesian forecasting models for UK macro-economic trends and trade without the arbitrary supply-side growth assumptions built into the model of the OBR (and similar forecasting models of the OECD and IMF). These models are used to develop baseline forecasts and alternative policy simulations. The results are currently published in forecast reports on the CBR website[2] and in future will be published on a new website (www.camridgeeconomics.com) which aims to promote economic policy ideas in the spirit of Cambridge Keynesians including J M Keynes, Nicholas Kaldor and our mentor, the late Wynne Godley. The website has no connection with the economics faculty at Cambridge which is dominated by mainstream economic ideas and in our view contributes little to practical macro-economic policy debates in the UK.

The CBR model has been developed as a guide to macro-economic policy-making at a very difficult time in the evolution of the economy. After more than 60 post-war years in which the real GDP per head seldom deviated much from a growth path of 2.5% per annum it suddenly slumped after 2007. GDP in 2007 was only 4% below the long-term trend, but by 2015 per capita GDP had unprecedentedly fallen to 16% below this trend (chart 1), and by 2015 involved a huge cumulative loss of 100% of GDP[3]. Even though employment has held up better than anyone expected, unemployment nevertheless rose by close to a million between 2007 and 2011 before falling back by half a million. The cost of a relatively benign jobs performance has been to reduce labour productivity which in 2014 is now also 16% below its previous trend. The gap in GDP per hour between the UK and the USA has widened by 8% from its pre-crisis level. If productivity returns at

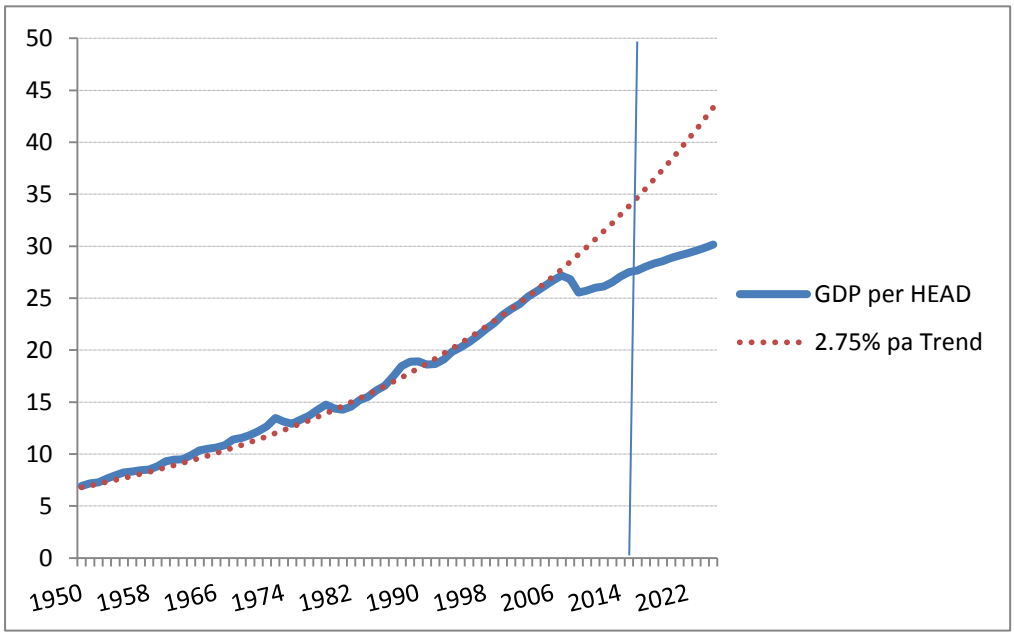
[1] www.cbr.cam.ac.uk/publications/special-reports/

[2] www.cbr.cam.ac.uk/publications/special-reports/

[3] Per capita GDP in 2015 was even further below the pre-1973 trend (of 2.85% per annum) at 35% of GDP.

some point to its former relationship with the USA we can expect future pressure on employment unless the economy begins to grow rapidly (and more rapidly than the USA).

Chart 1 Real GDP per Head



The wrong road taken by the economics profession over the last thirty years involved overturning or distorting many of the important insights developed by Keynes in response to the major economic depression of the 1930s. It also involved the marginalisation of important post-Keynesian figures including Hyman Minsky and Wynne Godley. Our belief is that there is enough in the work of these three authors to provide a good understanding of the present crisis. In particular we are guided by the work of our late mentor and former colleague Wynne Godley, and especially by the ideas in his magnum opus 'Monetary Economics' published in 2007 with Marc Lavoie. Wynne Godley's approach was strongly Keynesian, based on the principles that economic analysis should be realistic and useful to policy makers. He had no time for unrealistic ideas based on fully rational, profit-maximising agents with perfect foresight operating in clearing markets as a method of inquiring into how the economic world actually functions. We share these views and like him view the alternative as sticking closely to what we know about the main decision takers in a modern economy; i.e. households, companies, banks, trades unions and governments and above all to empirical evidence on how these institutions behave and interact.

We begin this article by outlining the nature of the status quo in forecasting models in the UK. Since the OBR model provides the main underpinning for government macro-economic policy, we describe its approach in detail, both to demonstrate what we feel are its weaknesses and biases, and to form a contrast with our own approach[4]. Importantly, OBR forecasts are consistent with the Government's aim of balancing its budget by 2019/20. These forecasts are widely reproduced in the media, and despite a patchy forecasting record in the past are often treated as accurate, especially in relation to fiscal outcomes. The notional independence of the OBR has allowed it to develop an undeserved authority for its views on macro-economic policy. Because the OBR forecasts have

[4] We say nothing here about DSGE models, such as that of the Bank of England and other central banks. The BoE model has a poor forecasting record and like others failed to anticipate the banking crisis.

employment always tending towards full-employment they show little labour market downside accompanying a drive towards fiscal balance. It is this more than anything that has persuaded us to develop an alternative forecasting system.

The OBR Model of the UK Economy

OBR forecasts are usually produced twice a year to coincide with the Government's Spring Budget and Autumn Expenditure Statement. The purpose is to provide projections for fiscal policy, and the OBR's very detailed projections for tax revenues and public spending provide a most useful and transparent guide to fiscal policy. Having said this, tax revenues and some aspects of expenditure (e.g. unemployment benefits and debt interest payments) depend on the OBR's forecasts for the wider economy. It is here that we have doubts about the meaningfulness of the OBR approach.

Much of the detail of the OBR model is recognisable to pragmatic Keynesians. There are sensible equations for the components of expenditure and their prices, and for household and company income. However, any similarity to a Keynesian system stops here. This is because the OBR envelope this demand system within a simplistic supply-side projection in which arbitrary assumptions about productivity play a major role. The OBR model forecasts begin by projecting a trend path for potential output and then assume that monetary policy will guide the economy from whatever off-trend position it is judged to hold in the initial year toward that path[5]. Any off-path point due to shocks leads to a return to trend, usually within 3 to 4 years. The OBR's approach is based on a neo-classical view that the economy will tend to make full use of available resources subject to monetary policy signals.

The OBR's statement that monetary policy will guide output onto the long-term path for capacity is a fiction in the sense that there appears to be nothing in the model to ensure convergence. In reality, monetary policy is required to guide inflation towards its 2% per annum target, and this is assumed by the OBR to be consistent with an equilibrium unemployment rate. In practice, the supply and demand sides are brought together in the model essentially by massaging demand so that it converges on the supply projections over a period of around three years. How this achieved is unclear. It is a complex exercise based on trial and error. In the OBR's 45 page description of the model[6], the word 'judgement' appears 54 times. It looks as though business investment assumes the main burden of adjustment. OBR forecasts usually involve sustained periods of unusually rapid growth in business investment to make demand converge onto the trend for supply capacity.

This approach can appear reasonable in times of normal economic growth but will fail in the face of a major shock as in 2008. The approach becomes particularly misleading in what Keynes called a 'liquidity trap', when monetary policy becomes ineffective in the face of a deficiency of demand. It is worth noting that in order to make this approach consistent with business surveys on capacity

[5] Office for Budget Responsibility Briefing Paper no.3. Forecasting The Economy. October 2011. For example on p2 'supply potential' is described as 'a medium-term anchor for the forecast'.
[6] OBR Briefing Paper no. 3 Forecasting the Economy. October 2011

utilisation the OBR have had to assume huge 'write-offs' in capacity at the time of the banking crisis in 2008/9, but have been unable to explain convincingly how these write-offs occurred[7].

The OBR's approach is described in detail in paragraphs 3.9 to 3.32 of their Briefing Paper No. 3 Forecasting the Economy. The approach can be summarised as follows:

1. A measure of output gap, the difference between the actual level of output and the supply level of output (potential level, consistent with stable inflation), is produced from various cyclical indicators.

2. The output gap is decomposed into four gaps: output per hour; average hours; employment rate; population. It is assumed that each component of the output gap converges to zero over time.

3. From the initial actual level of output, the calculated output gap determines the initial level of potential output for each of the components over the forecast period.

4. Actual capacity is calculated from a growth trend for each of the components below, starting from the initial values as outlined above.
    a. Growth of output per hour;
    b. Average hours growth;
    c. Employment rate growth;
    d. Population growth

5. The critically important projection for output per hour is dealt with in the OBR Briefing paper with a single sentence: on page 17: i.e. '*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*'.

6. The projection for trend growth in labour supply comes partly from ONS population projections by age and gender, and partly from an assumption about equilibrium unemployment rates i.e. a NAIRU. '*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'*.

7. Paragraph 3.20 states that: "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

[7] See Martin W and Rowthorn R (2012) Is the UK Economy Supply Constrained II?. A Renewed Critique of Productivity Pessimism. Special Report. Centre For Business Research. University of Cambridge. Write-offs equivalent to around 4% of GDP were assumed to have occurred during downturn associated with the banking crisis in 2008/9.

money neutrality and super-neutrality – for example, the NAIRU is not affected by the inflation rate)." We take this to mean that either a mechanism of the model, or a judgement to control the path of the model, ensures that the actual level of output converges to the potential output extrapolated by means of indicators of the components in 3 above.

8. Paragraph 3.21 says that: **"The resulting projection of the potential level of output in the economy provides a medium-term anchor for the real GDP forecast."** It then says in paragraph 3.22 that: …**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.**" It is clear that OBR is assuming that monetary policy will be conducted not only to achieve a target inflation rate, but that in doing so, it will also eliminate excess demand in the sense that the output gap will at the same time be closed. This seems to rely on a NAIRU such that at stable inflation, the output gap is always zero.

9. Paragraph 3.23 indicates that judgement is used to decide on the path of potential output, and that judgement is also applied to deciding in the medium-term the speed with which actual output converges to this potential level of output, based on comparable historical episodes.

10. Paragraph 3.29 is revealing: "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. But neither the trend growth framework, nor the macroeconomic model, includes a mechanism by which the output gap is closed." This suggests that there is no mechanism within the model that will drive actual output to the potential level of output. The belief that this is what must happen in the medium term requires the OBR to impose this condition on the model to obtain their preferred forecast.

11. Paragraph 3.30 indicates that judgement is used to decide the speed with which actual output converges to potential output based on previous economic cycles and other historical evidence. Again, the Bank of England is assumed to manage aggregate demand so that reaching the target of stable inflation also implies elimination of the output gap.

12. Paragraph 3.31 says: "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. "We interpret this to mean that if the model projections show that over the forecast period, the output gap is not converging, this implies that either the path of potential output is implausible or that actual output is not plausible. One or both have to be adjusted until convergence obtains.

13. Finally, paragraph 3.32 makes an interesting point: 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 stabilise at a low rate, reflecting well-anchored inflation expectations and downward nominal rigidities." We interpret this to say that the normal assumption imposed on the model is that convergence takes place within the projection period (4 or 5 years?). The OBR recognise the possibility that the gap might not close in this period, even when target inflation is being maintained. It is not obvious that this possibility ever been used in their forecasts since 2010.

The OBR's approach to forecasting has always been somewhat arbitrary, but in its latest (March 2016) Economic and Fiscal Outlook the arbitrariness became more than usually transparent. To recap, the OBR's forecast for GDP (and hence government revenues, and much else) is obtained as a convergence to full utilisation of productive capacity. The latter, in turn, is a simple projection of labour productivity multiplied by labour supply including working-age population as currently projected by the ONS, plus an assumed equilibrium unemployment rate or NAIRU. The OBR's assumption for the key productivity growth projection looks as though it is mainly based on a view that pre-crisis growth rates will resume soon. Last November they saw an uptick in the flat path that productivity has pursued since 2008 and assumed that productivity would in future follow its pre-2007 trend growth rate of 2.2% p.a. With a small increase in labour supply, this gave them their optimistic GDP forecast of 2.4% per annum (essentially forever).

What the OBR did in the March 2016 EFO was to say the uptick had down-ticked again and that they were no longer confident that productivity would grow in future at 2.2% p.a. In fact productivity has continued its flat trend since 2008. They now assume that productivity will grow at 2.0% per annum every year. Why pick this number? Productivity growth over the last three years has been 0.5% per annum, so this assumption is essentially arbitrary, and makes a nonsense of the whole game of assessing whether the UK economy is on track to balance the Budget by 2019/20. The OBR's current projections for the deficit are conditional on their arbitrary productivity assumption. Different assumptions would give variant projections for the deficit. A reasonable approach might be to present a range of scenarios, but this would merely emphasise how much uncertainty there is over something like the deficit. Not only is the deficit a residual between the large numbers for spending and revenues, but it also depends on the highly uncertain future growth of GDP.

We assume that the OBR are currently trying to maintain some credibility by abandoning last November's unrealistic optimism. They have stayed with the OECD/IMF pack by downgrading their GDP forecast. Right at the start of the current EFO the OBR say that the new pessimism is based on the fall in global stock markets and commodity prices since their last (November) forecast). This may have seemed the case when they were doing their work in January and February, but by publication date in March the UK and US stock markets had recovered most of their January losses and the oil price was recovering quite strongly. What happened, we feel, was a general loss of confidence

across developed economy official forecasters that the post-crisis malaise has not yet come to an end. Their models are little help so they are falling back on gut instinct.

An irony is that our CBR model[8] predicts a temporary recovery in productivity growth in 2017-20 to around 2% pa. However the means of reaching this conclusion is very different from the OBR. The OBR's productivity assumption more or less fixes both GDP and employment in the medium term. A benign productivity growth assumption means that both GDP and employment will grow reasonably well in future. Our CBR model works quite differently. We forecast real GDP with a set of demand equations, and simultaneously forecast employment with separate employment equations. Productivity is then calculated as GDP divided by employment. There are no productivity assumptions. Unlike the OBR forecast in which both productivity and employment rise together, in the CBR forecast productivity recovers because employment growth stalls from 2017. This reflects the evidence that flat productivity growth since 2008 is due to the creation of large numbers of low-productivity jobs in an era of rock-bottom interest rates. Once interest rates start to rise, we believe that job creation will cease and productivity will recover, at least for a few years. This leaves questions about how exactly the modern labour market is working, but our forecasts are at least based on equations fitted on the data, and not on arbitrary assumptions.

In our view, the Government should drop its target for the fiscal deficit and repeal the associated legislation. It should recognise the Keynesian argument that the Government has little control over the deficit. While Government can influence spending up to point (junior doctors and others permitting), it has only indirect influence over the private sector and hence over tax revenues. If the private sector wishes to save, then, by the laws of arithmetic, the public sector is likely to have a deficit. In any case the UK Government deficit will soon drop below a manageable 3% of GDP at which point the debt will begin to fall as a share of GDP. If the deficit were to stay close to say 2% of GDP the debt to GDP ratio would fall slowly, but it would fall and few would be alarmed. We have recently come through the worst financial crash for a century, and will need to live with the consequences for a long time. Policy could be more patient with a focus on more important issues, but the OBR forecasts encourage the Government and commentators to assume that fiscal balance can be achieved with little economic pain.

The CBR Macro-Economic model (UKMOD)[9]

UKMOD is a structural econometric model. It describes how sets of exogenous variables, such as world trade, US interest rates and the world oil price, together with UK fiscal and monetary policy instruments, determine a wide range of endogenous variables including GDP, employment, wages, prices and government deficits and debt. The model is Keynesian in that it is largely concerned with determining demand. The structure of the model is conventional within the Keynesian tradition with aggregate demand determined as the sum of household consumption, investment, government consumption, exports and imports. Supply side variables such as capital stock and labour supply are

[8] (www.cbr.cam.ac.uk/publications/special-reports/)
[9] The model is fully described in working paper 472 at www.cbr.cam.ac.uk/publications/working-papers/2015/

determined endogenously[10]. The model is thus substantially different from the OBR model, in that there are no exogenous assumptions about the path of productive capacity, or about convergence from an initial position to a position of full-capacity operation of the economy.

The UKMOD model recognises the Godley-Lavoie post-Keynesian principle of stock-flow consistency in that ratios of wealth to income tend to return to a stable level in the long-term. This is implicit in the inclusion of wealth terms in the consumption function rather than having any explicit target for the income to wealth ratio. We have abstracted from Keynes and Godley-Lavoie complete treatment of the financial sector and asset allocation with a short-cu. This treats short-term interest rates as an exogenous policy variable and treats credit for house-holds as semi-exogenous. Long-term interest rates are endogenous and reflect (exogenous) short-term rates among other influences. Wage and price setting is post-Keynesian. Consumer prices are determined by a mark-up on wage and import costs offset by labour productivity. Wages in the private sector are determined by the growth of productivity in the private sector, mediated by labour market tightness as measured by the employment rate. We find no evidence for a vertical long-run Phillips curve and none for the notion that inflation will accelerate at low levels of unemployment as suggested by much contemporary theory[11].

The model is based on relationships and interrelationships, econometrically estimated on past annual data. Although we accept in principle the Lucas critique that past relationships can change if new policies are introduced, we take the view that this will only apply in unusual or extreme circumstances and is not a sufficiently general fear to vitiate econometric macro-economic modelling.

Most existing models focus on generating short-term forecasts and use a range of contemporary monthly or quarterly indicators and judgements as a guide to where the economy is and to its imminent movements. Since our focus is on policy simulation using annual data we make no use of such indicators or judgements. This allows our equations to work unaltered in generating policy scenarios, but could mean that very short-term 'baseline' forecasts over a single year may be less accurate than quarterly forecast models with fixes.

The model consists of:

- 250 variables with data from 1950 to 2014
- 80 econometric equations
- 145 identities

[10] Business investment is determined by equations in which the main arguments are current company profitability, expected demand, tax rates and the cost of capital.

[11] Since 1980 the inverse of a vertical Phillips curve can be observed, i.e. as unemployment fell (over the 1980s or from 1993-2007) wage inflation did not rise. However, when unemployment rose (e.g. 1980-85, 1990-93 and 2007-9), wage inflation fell rapidly by a similar amount in each period. This can be interpreted as saying that recessions (1980-2, 1990-3, 2007-9) reduce inflation expectations, but periods in which unemployment falls do not alter inflation expectations nor do they lead to any bidding up of wages, but instead appear to exhibit a norm for wage increases. There is some evidence that since 2010 a wage norm of 2%pa has emerged as Blanchflower and Machin suggest (Feb 2016, Slower UK Wage Growth. CEP Real Wages Update. This norm appears stable in the wide unemployment rate range of 4-11%. We expect this norm to be raised over the next few years due to the large rise in the minimum wage.

The model is based on the post-Keynesian approach of Wynne Godley described in Monetary Economics by Godley and Lavoie 2007[12]:

- 4 sector approach: households, companies, government and foreign sectors. Godley/Lavoie also has a separate monetary/banking sector which is not yet developed in this model
- Stock-flow consistent with tendency for ratios of assets to incomes to stabilise but with short to medium-term divergence from the stock-flow norms due to asset value fluctuations.
- Consumer spending depends on household borrowing as well as income, assets and liabilities
- Conventional investment and trade equations
- Mark-up pricing (i.e. consumer prices rise with wage and other costs of production)
- Wages determined as attempts to gain a traditional share of value-added but constrained by changes in the employment rate, minimum wage and migration flows.

The forecasts generated by the model are conditional on a number of exogenous variables chiefly reflecting government fiscal policy and economic conditions outside the UK. Key exogenous variables are:

- World trade (weighted by UK markets)
- Government fiscal policy plans (tax rates and *nominal* spending plans).
- Short-term interest rate (used as a policy variable to target consumer price inflation)
- Interest rates in the USA
- Global price of oil and other raw materials

In its present form the model does not have a banking sector, although lending to households *is* modelled. Household borrowing is semi-exogenous, determined by an equation reflecting pre-crisis experience in the demand for housing loans but with a partial adjustment mechanism to move from the current situation in which bank lending is constrained by impaired balance sheets to a relatively unconstrained position.

The principles used in deriving the econometric equations are as follows:

- Econometric equations are almost all of the Error Correction Method (ECM) type with long-term and short term components.
- Econometric equations are constructed to be:
    - Theoretically sound in a Keynesian sense and using knowledge of the institutional setting of the UK economy and behaviour of households and firms.
    - Statistically significant terms, and passing other econometric tests
    - Provide a good fit for a within-sample dynamic simulation
    - Give plausible long term projections to 2025 with key ratios remaining within historical bounds (except where assumptions about household borrowing lead to extremes in both debt ratios and in the ratio of house prices to household incomes).

[12] Godley, W. and Lavoie, M. (2007) *Monetary Economics, An Integrated Approach to Credit, Money, Income, Production and Wealth*, Palgrave Macmillan.

- Forecasts tested by in-sample testing for using equations estimated over only previous periods with actual values for exogenous variables. Forecasts fit well for 2015 using only equations estimated up to 2014, subject to actual exogenous variables (see below for details). Longer period in-sample simulations also perform reasonably, again with actual values for exogenous variables including world trade (in which there was a major recession in 2009) and housing loans (which halved in number in 2008), and also how the UK fiscal and monetary authorities reacted to these shocks.

- No fixes. Equations are allowed to determine forecasts with no adjustment of residuals. No account is thus taken of current indicators beyond the latest ONS Blue Book data in setting forecasts.

- Current forecasts are from 2016 to 2025 with data only up to 2015. No data beyond 2015 is used except for fully exogenous variables.

Consumption with credit super-cycles

This consumption function is conventional in that consumption depends on disposable income and both financial wealth and housing wealth. It is less conventional in that the real value of new housing loans is also included. These loans are taken out to purchase housing rather than for consumption,

Equation 1 Consumption Function

Dependent Variable: D(CV)
Method: Least Squares
Date: 06/02/16 Time: 22:05
Sample: 1975 2015
Included observations: 41

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	14916.77	10221.86	1.459302	0.1556
CV(-1)	-0.404039	0.075487	-5.352461	0.0000
(YD(-1)))/(CP(-1)	0.314626	0.063779	4.933070	0.0000
FASN(-1)/(CP(-1))-DEBT_LT(-1)/(CP(-1))	0.014105	0.004709	2.995679	0.0057
KHN_HI(-1)/(CP(-1)/100)	0.009596	0.004134	2.321169	0.0278
DEBT_ST(-1)/(CP(-1))	-0.270049	0.059366	-4.548922	0.0001
NEW_HOUSING_LOANS(-1)/CP(-1)	0.334586	0.054455	6.144223	0.0000
D(YD/(CP))	0.365814	0.079283	4.614051	0.0001
D(FTSE/(CP))	1345.753	267.4622	5.031563	0.0000
DLOG(HPI/CP)	59280.46	14566.95	4.069518	0.0003
D(GINI_COEFF_IFS(-1))	-73558.97	121838.7	-0.603741	0.5509
D80	-11881.28	4959.458	-2.395681	0.0235
D88	25134.62	5508.337	4.563013	0.0001

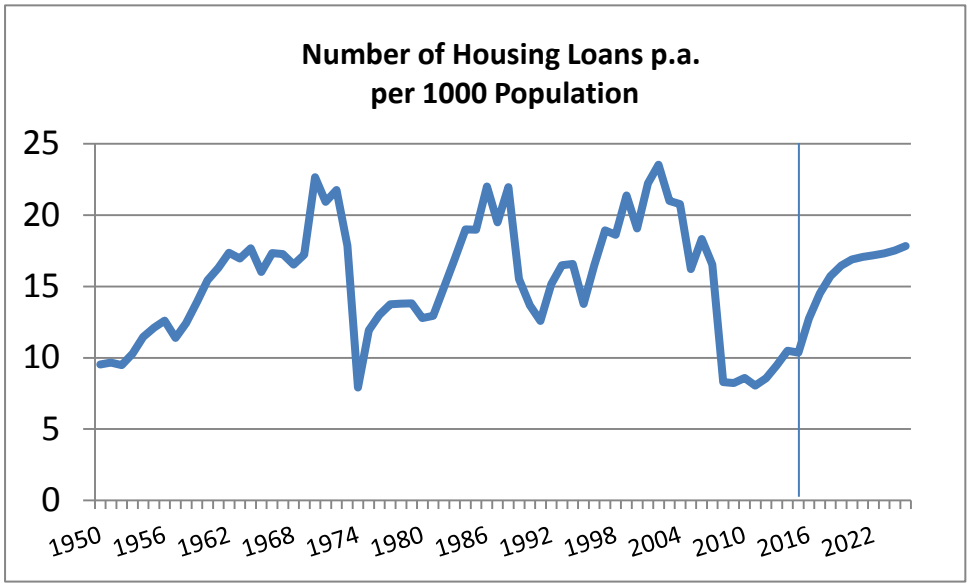
R-squared	0.950526	Mean dependent var	18639.83
Adjusted R-squared	0.929323	S.D. dependent var	16770.60
S.E. of regression	4458.483	Akaike info criterion	19.89578
Sum squared resid	5.57E+08	Schwarz criterion	20.43911
Log likelihood	-394.8636	Hannan-Quinn criter.	20.09363
F-statistic	44.82970	Durbin-Watson stat	1.917978

NOTE: Variables are listed and identified in Annex A

but around 80% of the value of loans are used to purchase existing property rather than for investment (i.e. new houses or extensions etc.). The spending on existing houses is a transfer from one household or buy-to-let landlord to another, and the evidence is that part of this gets spent on consumption.

The importance of such lending comes from its volatility. The number of housing loans fluctuates in what Mario Borio of the BIS calls credit super-cycles[13]. In the UK there have been 3 major cycles over the last sixty years and a fourth cycle is now in its early stages. Chart 2 shows these cycles. These cycles have a large influence on business cycles in the UK. The first cycle from 1950-74 was ramped up by the decisive switch in 1971[14] from direct controls over mortgage lending controls to market

Chart 2 Number of Loans to Household Sector for Housing



mechanisms. This led to the largest annual house price inflation in any year over the last seven decades, and contributed to an economic boom followed by a sharp bust occasioned by the oil price hike of 1973/4. The next credit cycle in the 1980s partly explains why the 364 economists were wrong in forecasting economic doom for the 1980s under Thatcherite policies[15].

The most recent credit cycle began in the mid-1990s and peaked in 2006 with 1.1 million housing loans. By 2007 this was down a little, but then slumped to only 500,000 loans in 2008. The recession of 2008 was initiated by declines in consumption and household investment leading to a collapse in construction output. The recession deepened in 2009 as the impact of equivalent changes abroad

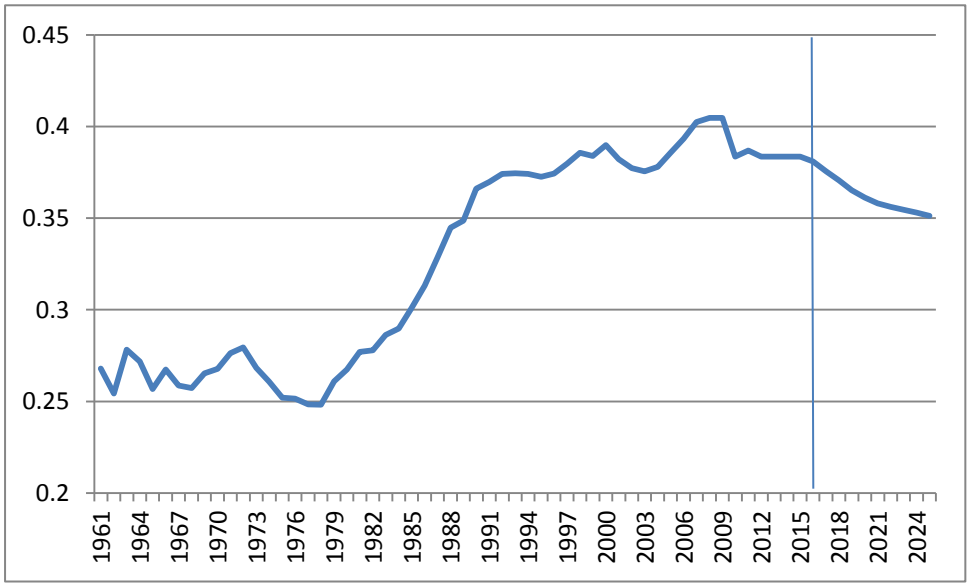
[13] Borio M (2012) Financial Cycles and Macro-Economics: What Have We learnt? BIS Working paper 395
[14] Under the Competition and Credit Control of 1971. See Goodhart C.A.E. (2014) Competition and Credit Control, LSE Financial markets Group Special Paper Series 229.
[15] University of Cambridge forecasts undertaken in 1980, were much too pessimistic for GDP but not for unemployment which rose from 1 million to 4 million if allowance is made for hidden unemployment in the form of people switching from unemployment benefits to invalidity benefits.

led to a slump in UK exports. The number of housing loans remained very low, at close to 500,000 loans from 2018-12 as the response to the banking crisis caused banks to restrict loans in an attempt to repair their balance sheets and to meet more stringent reserve requirements.

- **The Role of Inequality**

The consumption function above (equation 1) shows that an attempt to introduce a measure of inequality into the equation meets with failure. The measure used here is the IFS Gini Coefficient based on post-tax incomes for a 2-person household after housing costs. No long-term relationship could be found, and a short-term impact (via the annual change in the coefficient) was not significant, but did have the expected sign when lagged one year. An unlagged difference term for the Gini coefficient was significant, but had the wrong sign. This is likely to indicate reverse causation. i.e. rapidly growing consumption (probably associated with rapidly growing incomes) is associated with an increase in measured inequality. Chart 3 indicates that inequality in the UK grew rapidly during the 1980s but has changed little at other times. In our forecast inequality is projected to decline as household mortgage borrowing for housing rises to a new peak.

Chart 3 The IFS Gini Coefficient (based on 2 person household after tax income)



It should be noted that the consumption function used here includes measures of wealth. Hence the coefficient on the Gini coefficient should be interpreted as the impact of extra inequality controlling or the level of wealth. This is a somewhat artificial interpretation of the impact of inequality, but it does indicate that the level of wealth influences consumption, while the degree of inequality at that level of wealth, adds little to consumption.

Equation 2 Gini Coefficient

Dependent Variable: GINI_COEFF_IFS
Method: Least Squares
Date: 06/05/16 Time: 17:51
Sample: 1988 2015
Included observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.800734	0.040410	19.81534	0.0000
(FASN(-1)/(CP(-1)))/POPN(-1)	0.102420	0.006317	16.21349	0.0000
(KHN(-1)- DEBT_LT(-1))/(CP(-1))/POPN(-1))	0.025075	0.012083	2.075250	0.0526
TAX_INC_TOP_RATE	-0.002296	0.000277	-8.283910	0.0000
TAX_CAPGAINS_THRESH/CP	-0.001192	0.000209	-5.692237	0.0000
TAX_CAPGAINS_RATE	-0.000879	0.000174	-5.053826	0.0001
POPN65/POPN	-1.530757	0.180327	-8.488776	0.0000
NUMLOANS(-1)	-2.55E-08	4.05E-09	-6.291856	0.0000
D((FASN_HI/(CP_M))/POPN)	0.070872	0.018036	3.929501	0.0010
D2007	0.014264	0.003436	4.151534	0.0006

R-squared	0.970521	Mean dependent var	0.380217
Adjusted R-squared	0.955781	S.D. dependent var	0.013526
S.E. of regression	0.002844	Akaike info criterion	-8.614511
Sum squared resid	0.000146	Schwarz criterion	-8.138723
Log likelihood	130.6031	Hannan-Quinn criter.	-8.469058
F-statistic	65.84385	Durbin-Watson stat	2.097526

NOTE: Variables are listed and identified in Annex A

Equation 2 for the Gini coefficient illustrates this point. The main influences on the Gini coefficient is the level of gross financial assets. The top rate of income tax and measures of capital gains tax are also important. Other influences are the proportion of retired people in the population and the position of the economy in the credit super-cycle, as measured by the number of housing loans. The coefficient in the latter case is negative indicating that inequality falls when the housing finance market is buoyant.

Gross financial wealth is itself strongly correlated with real equity prices measured in chart 5 below e by the FT All-share index deflated by the consumer prices deflator. The message appears to be that growth in financial wealth jointly influences both consumption and inequality. There may thus not be a direct influence between inequality and consumption. Instead rising financial wealth, heavily, influenced by equity prices, leads both to higher consumption and greater inequality.

Stock-Flow Consistency

There is a major insight to be gained by re-arranging the national income-expenditure identity to show the financial balances of income less spending of the main expenditure sectors. When these balances, also known as flow of funds balances, reveal persistent surpluses or deficits, they imply continued accumulation or decumulation of assets and liabilities over time, relative to the flows of income. The insight is that stocks of net assets or debts cannot indefinitely change relative to the

flows of income without some change in the behaviour of spending. There must be limits to the variability of stocks relative to flows.

Keynesian macroeconomic models that take account of this insight must ensure that period-by-period, the balances of each sector's disposable income over its current and capital expenditure, must be equal to that sector's change in its net financial assets. This in turn must be consistent with the sector's change in its balance sheet, (including changes arising from gains or losses because of changes in the prices of assets and liabilities). This is the stock-flow consistent approach to macroeconomics. In recent years, it is most closely associated with Wynne Godley, who used it to warn that the continued rise in US private sector debt in the 1990s, financed by growing borrowing, was unsustainable and would lead to a crisis:

> "The growth in net lending to the private sector and the growth *in the growth rate* of the money supply cannot continue for an extended period. Moreover, if, *per impossibile*, the growth in net lending and the growth in the money supply growth were to continue for another eight years, the implied indebtedness of the private sector would then be so extremely large that a sensational day of reckoning could then be at hand." Godley (1999)[16]

Eight years later, the global financial crisis began.

In our model we can illustrate the SFC approach by looking at the household sector's consumption expenditure. Household expenditure is financed by some combination of the flow of disposable income, the sale of assets or the increase in debts. The typical form of consumption behaviour in a stock-flow framework is for consumption to depend partly on the flow of disposable income and partly on the stock of net assets.

$$cv = \alpha yd + \beta v$$

where:

cv is consumption
yd is real disposable income
v is real net wealth
$\dot{v}$ is the change in real wealth

Using the identity that saving $s = v = \dot{y}d - c$ this gives the following steady state wealth to income ratio when $v \doteq 0$:

$$\frac{v^*}{yd^*} = \frac{1-\alpha}{\beta}$$

[16] Godley, Wynne (1999), *Seven Unsustainable Processes*, Special Report, Jerome Levy Economics Institute of Bard College Blithewood.

In an economy growing steadily at a rate g, and the corresponding steady state savings-income ratio converges to:

$$\frac{v}{yd} = \frac{\beta}{g+\beta}.\frac{1-\alpha}{\beta}$$

For the derivation of these expressions, see Annex B. Although the specification is similar in form to life cycle or permanent income hypotheses, the behavioural motivation is distinct from consumption smoothing which is the micro-foundation of the latter.

Equation 3: Modified Consumption Function

Dependent Variable: **D(CV)**
Method: Least Squares
Date: 06/07/16 Time: 14:17
Sample (adjusted): 1975 2015
Included observations: 41 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	21462.04	12705.96	1.689131	0.1009
CV(-1)	-0.448737	0.091055	-4.928196	0.0000
((YD(-1)))/(CP(-1)/100)	0.330690	0.060456	5.469962	0.0000
(FASN(-1)+KH(-1)-DEBT_LT(-1))/(CP(-1)	0.014361	0.005286	2.716654	0.0105
DEBT_ST(-1)/(CP_M(-1))	-0.226068	0.069282	-3.262996	0.0026
NEW_HOUSING_LOANS(-1)/CP(-1)	0.284020	0.063002	4.508078	0.0001
D(YD/(CP))	0.394613	0.078135	5.050372	0.0000
D(FTSE/(CP))	1092.633	346.1411	3.156611	0.0035
DLOG(HP/CP)	82445.12	17617.37	4.679762	0.0001

R-squared	0.890100	Mean dependent var	18639.83
Adjusted R-squared	0.862625	S.D. dependent var	16770.60
S.E. of regression	6215.875	Akaike info criterion	20.49879
Sum squared resid	1.24E+09	Schwarz criterion	20.87494
Log likelihood	-411.2252	Hannan-Quinn criter.	20.63576
F-statistic	32.39675	Durbin-Watson stat	1.851505

NOTE: Variables are listed and identified in Annex A

For this simple example in a growing economy, the steady state wealth-income ratio will be *lower* the faster is the growth rate of income. The savings ratio will be *higher* the faster is the growth rate of income. Although this example gives a constant stock-flow norm, in empirical applications, one could specify the consumption function such that the stock-flow norm is constrained within empirically plausible limits.

Another property of the stock-flow norm is that, being the ratio of a stock at a point in time to a flow during a period of time, the ratio has a time dimension and constrains the dynamics governing the

speed with which expenditure adjusts to changes in flows of income. Godley and Cripps (1983) showed that the stock-flow norm implied a mean lag to the adjustment of spending to income[17].

The long-run wealth to income ratio in the CBR model can be deduced from a version of the consumption function in which wealth terms are combined. In this case wealth is defined as gross financial wealth (FASN) plus equity in the housing stock (KH – DEBT_LT). The equation above shows that the estimate is specified as an error correction mechanism (ECM) in consumers' expenditure. The ECM is of the form:

$$\Delta CV_t = a_0 + b_0 CV_{t-1} + b_1 YD_{t-1} + b_2 V_{t-1} + c_0 NL_t + c_1 \Delta YD_t + \text{other}$$

To find an empirical counterpart to the stationary state stock-flow norm, we set all variables in changes to zero, set new borrowing, which, implies a change in debt, to zero and equate disposable income and consumption. This gives:

$$b_0 YD_t + b_1 YD_t + b_2 V_t = 0$$

The stationary state wealth to income norm is then:

$$\frac{V_t}{YD_t} = -\frac{b_0 + b_1}{b_2}$$

From the coefficients in the equation above we obtain a stock-flow norm of 8.2. The actual wealth-income ratio for the UK is shown in the chart 4. The ratio of total wealth to household disposable income is currently at 8.0 and has been mostly in the range 7-8 for 15 years. The ratio of gross financial assets to income rose sharply in the 1980s but has been close to 4.5 for two decades. The main rise in the wealth ratio in the last 20 years has come from housing equity, but this has also stabilised in the range 2.5-3.

Part of the increase in both gross financial wealth and net housing wealth comes from capital gains. Chart 5 shows the close association between gross financial wealth and the UK all-share index deflated by the consumer price index. Since the modified consumption function above has a measure of wealth including capital gains, the predicted wealth: income ratio should approximate the observed wealth: income ratio including capital gains. Although UKMOD is not yet a fully SFC empirical model, it already has some important stock-flow properties such as those implied by consumption behaviour.

[17] Godley, W. and Cripps, F. (1983) *Macroeconomics* , Oxford University Press.

CHART 4: Components of Household Wealth (% of Disposable Income)

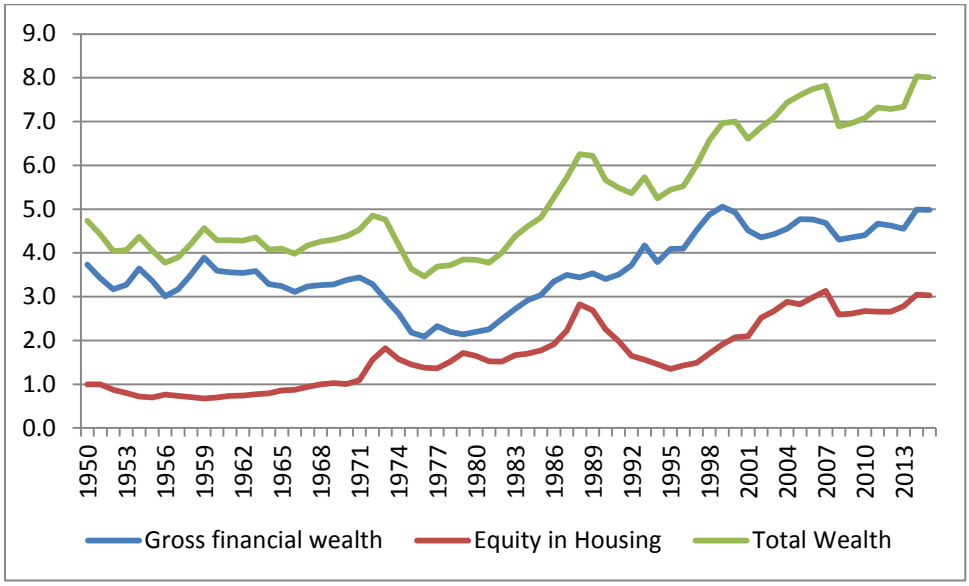
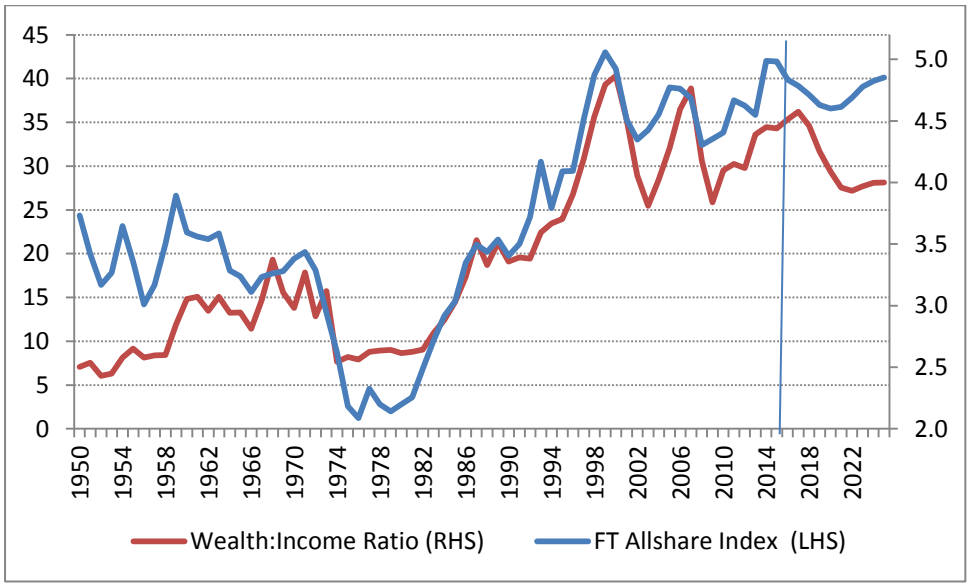


CHART 5: Ratio of Gross Financial Wealth to Disposable Incomes and Real Equity Prices



Wages and Inflation

The model contains equations for the deflators for each expenditure component in real terms with equations for each deflator to generate forecasts in nominal terms. Aggregate nominal GDP is the sum of the nominal components, and the GDP deflator is obtained as nominal GDP divided by real GDP. The key consumer price deflator equation has long-run terms in private sector wages, imports and private sector productivity. Long-term interest rates are also an influence since debt interest forms an element of business costs. Short-term influences include annual changes in world oil prices and other import prices. The collapse in the oil price in the second half of 2014 led in 2015 to the lowest rise in consumer price inflation for almost a century.

Separate equations are used to project wages in the public and private sectors. The former uses government's own assumptions from the OBR. In the private sector wage equation (equation 4) wages are determined by private sector productivity and employment rates. Wages have broadly kept pace with productivity since the 1980s with cycles influenced by the employment rate. Other influences are the minimum wage (positive) and cumulative migration (negative). The rapid projected rise in the minimum wage, averaging 8% per annum over each of the next three years, is forecast to raise the annual growth of private sector wages to 3-4% per annum in place of the apparent 'norm' of 2% pa established over recent years.

Equation 4: Private Sector Wages

Dependent Variable: DLOG(EARNINGS_PRIV_AWE)
Method: Least Squares
Date: 06/04/16 Time: 18:47
Sample (adjusted): 1981 2015
Included observations: 35 after adjustments

Variable	Coefficient	t-Statistic
C	0.85	3.1
LOG(EARNINGS_PRIV(-1))	-0.30	-4.4
LOG(GDPV_PRIV(-1)/LFSE_PRIV(-1))	0.22	4.3
LOG((LFSE(-1))/POPW(-1))	0.49	6.8
LOG(MINIMUM_WAGE(-1))	0.16	2.8
Cumulative MIGW	-4.07E-06	-1.9
D2009	-0.04	-5.1
D90	0.03	3.4

R-squared	0.95	Mean dependent var	
Adjusted R-squared	0.94	S.D. dependent var	
S.E. of regression	0.007	Akaike info criterion	
Sum squared resid	0.001	Schwarz criterion	
Log likelihood	129	Hannan-Quinn criter.	
F-statistic	74.7	Durbin-Watson stat	2.0
Prob(F-statistic)	0.00		

NOTE: Variables are listed and identified in Annex A

Short-term interest rates are exogenous within the model and are used to control inflation (subject to changes in the world oil prices) with a long-term target for consumer price inflation of 2% per annum. The Brent Crude price is assumed to recover slowly toward $75 per barrel by 2021 with potential production from US 'frackers' assumed to keep the price from rising more rapidly. A recovery in oil prices results in the CPI inflation of over 3% per annum by 2020 with the Bank rate rising to 5% by 2019 to prevent further escalation in prices and to lead inflation to converge back towards 2% pa.

Employment, Unemployment & Migration

An important feature of this model is that private sector employment is determined by equations, unlike the OBR which uses assumptions. Public sector employment is determined by OBR projections

of real government current spending and our own projections of the government current price deflator. The important private sector employment equation relates employment to output and hence also determines productivity. Unlike the relationship in Godley-Lavoie that simply assumes a fixed exogenous rate of productivity increase, the relationship in the CBR model is more behavioural and depends on companies' capital stock, investment and real wages, as well as lagged interest rates and lagged equity prices.

Equation 5: for Private Sector Employment (LFSE_PRIV)

Dependent Variable: DLOG(LFSE_PRIVX)
Method: Least Squares
Date: 06/04/16 Time: 19:41
Sample (adjusted): 1983 2015
Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.357526	0.483270	0.739806	0.4676
LOG(LFSE_PRIV(-1))	-0.427032	0.096028	-4.446958	0.0002
LOG(GDPV_PRIV(-1))	0.335032	0.065225	5.136602	0.0000
LOG(KIVLV_COS(-1))	-0.119190	0.021844	-5.456395	0.0000
LOG((EARNINGS_PRIV(-1)/(GDPP(-1)))/LFSE_PRIV_EE(-1))	-0.259310	0.054201	-4.784236	0.0001
DLOG((EARNINGS_PRIV/(GDPP))/LFSE_PRIV_EE)	-0.280378	0.065889	-4.255341	0.0004
LOG(FTSE(-1)/CP_M(-1))	0.037311	0.008778	4.250550	0.0004
BR(-1)	-0.003169	0.000876	-3.618899	0.0016
TAXWEDGE(-1)	-0.313413	0.155321	-2.017844	0.0566
D(TU_MEMBERS_PRIVPC)	-0.309897	0.170418	-1.818447	0.0833
LOG(DKV_COS)	0.050427	0.016184	3.115742	0.0052
DLOG(GDPV_PRIV)	0.177280	0.087647	2.022645	0.0560

R-squared	0.945227	Mean dependent var	0.010235
Adjusted R-squared	0.916536	S.D. dependent var	0.017273
S.E. of regression	0.004990	Akaike info criterion	-7.487339
Sum squared resid	0.000523	Schwarz criterion	-6.943154
Log likelihood	135.5411	Hannan-Quinn criter.	-7.304237
F-statistic	32.94533	Durbin-Watson stat	2.348856

NOTE: Variables are listed and identified in Annex A

The path of employment (including the self-employed) has surprised most forecasters and the pre-crisis relationship between jobs and GDP has broken down. Since 2007, employment has risen much faster than would have previously been predicted. It is important that any equation is capable of predicting the rapid rise in the numbers of people employed. The change in the labour market is likely to be connected with the major increase in immigration to the UK since migration controls were relaxed by the Labour Government from 1997, and especially since the accession of the East European countries to the EU in 2004. In the quarter century up until the mid-1990s the number of people in work had fluctuated in the range 26-27 million, but there-after began to rise steeply. Of the additional 4.5 million people employed since 1997, 75% were born outside the UK[18].

[18] Labour Force Survey

However the number of migrants does not enter the equation directly (many of the immigrants work in the public sector). Instead, it is likely that the impact of migration on employment in the private sector is captured within the equation by the real wage terms. Private sector earnings are reduced by migration in our wage equation, and the positive impact of lower wages acts to increase the forecast for jobs. The result in the forecasts is that lower numbers of working-age migrants would lead to much lower levels of employment and higher levels of labour productivity. For instance, if net working age migration were to average 50,000 per annum over the next decade, instead of the 300,000 actually forecast, then employment would be 3.5% lower in 2025 than in the baseline and labour productivity would be 1.5% higher. Unemployment would also fall to 3% of the labour force.

Unemployment and Migration

The unemployment variable used in the CBR model is the LFS definition of people self-defined as available and looking for work. Our equation is relatively simple with terms for the total number of people employed, the number of people aged over 65 who are employed and the net number of migrants of working age. Employment of people over 65 has been rising rapidly since the turn of the century, increasing from 450,000 in 2001 to 1.2 million today. Improved health is one factor, and age-discrimination legislation and inadequate pensions are likely to be others. The evidence is that retired people are displacing working-age people into unemployment at any given level of employment.

The coefficient on lagged migration is greater than unity indicating a high level of displacement of existing labour. However this is in an equation which controls for the level of employment. In practice migration leads to higher employment and many employers in low wage sectors say that alternative labour is unavailable. Nevertheless, as the previous section argued, there clearly is displacement and this is likely to work through the depression of wages.

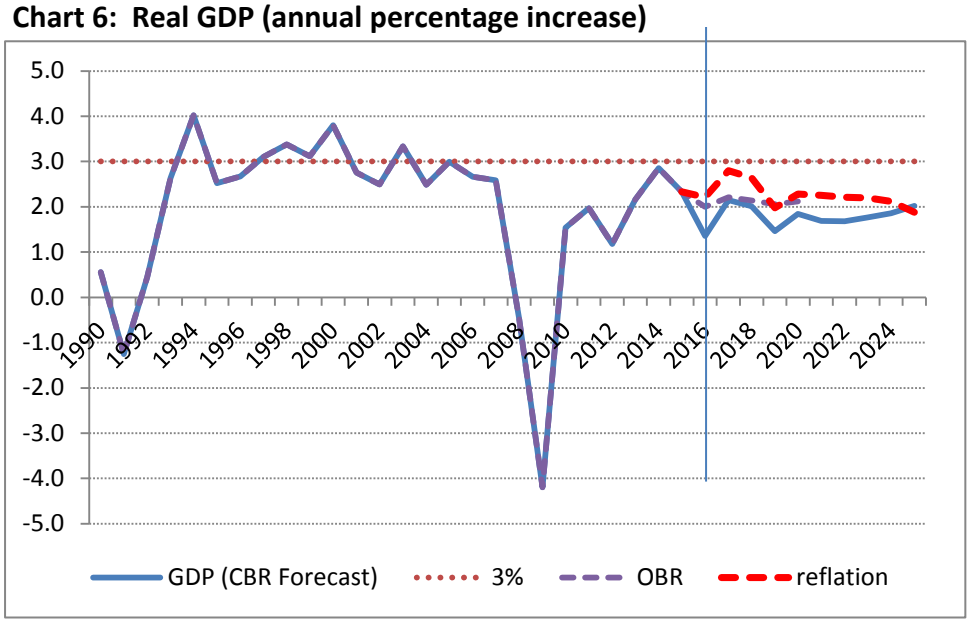
The equation for working-age migration in the CBR model has long-term variables in total employment, UK real wages and the lagged difference in minimum wages between the UK and Poland. Short-term influences are the average wage difference between the UK and Germany, the natural increase in working-age population in the UK and the level of house building. The forecast for our model is that net working-age migration into the UK will remain close to 300,000 per annum until the middle of the next decade. The OBR use the ONS assumptions for net migration. These are determined by past trends and 'arguments about the future', and have greatly under-estimated the rise in net migration. Current ONS assumptions are that net migration levels will fall back to a level of 185,000 per annum from the current level of 330,000.[19]

[19] Bijak J (2012) Migration Assumptions in the UK National Population Projections: Methodology Review.ONS. The head of ONS has stated to us that a committee is involved in setting levels. It is not clear whether this is the Migration Advisory Committee chaired by professor Metcalf set up in 2010 to advise government on how to reduce net migration to the low tens of thousands.

Policy Implications

The public expenditure multiplier that emerges from these equations is close to unity. Hence any cuts in government spending lead to reductions in GDP of similar magnitude. The OBR calculate that real current and capital spending will grow slowly, at less than 1% per annum. The CBR model uses the OBR growth rates for nominal government spending on goods and services, but calculates its own government expenditure deflator. This differs from the OBRs deflator even though assumptions

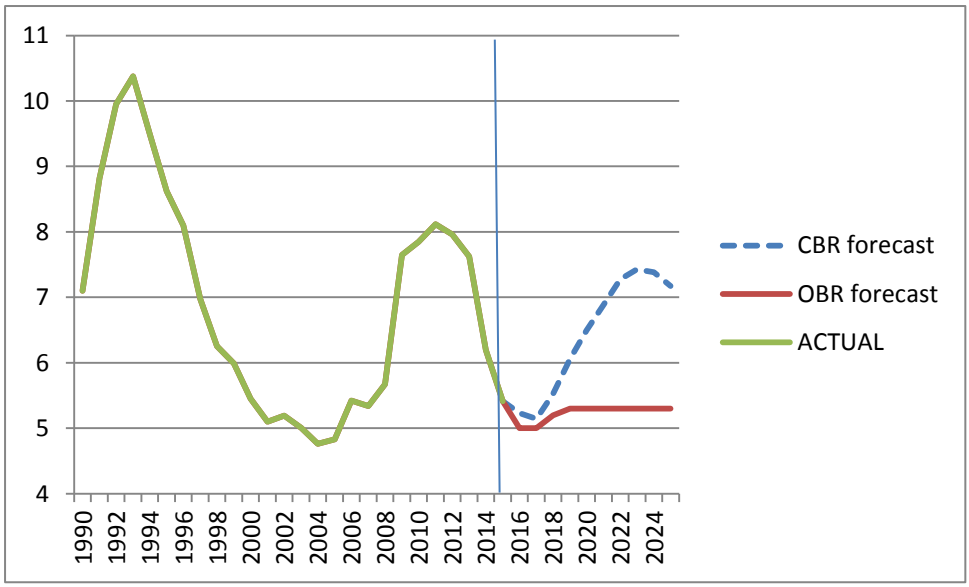
Chart 6: Real GDP (annual percentage increase)



on public sector wage increase are the same, differences mainly reflect public sector productivity which the OBR calculate using judgment while we use an equation. Our deflator gives similar growth in real government spending on goods and services to those of the OBR up to 2018 but lower thereafter.

Our forecasts for GDP are usually below 2% per annum (see chart above), giving growth in per capita GDP at under 1% per annum for the rest of this parliament. This is below the OBR forecast for GDP at 2.1% per annum by assumption. The most striking difference between the BBR and OBR forecasts is in unemployment which we forecast will begin rising again in 2017.

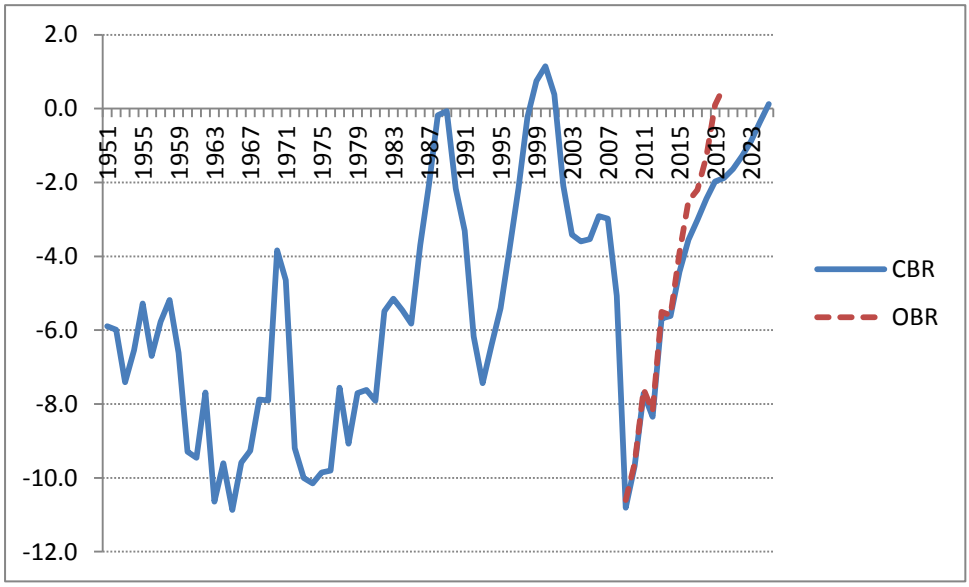
Chart 7 Unemployment Rate (% of labour force)



Note: OBR Forecast 2016-21 from EFO March 2016 extended to 2025 at 2020/21 value.

The minimal growth in government spending projected by the OBR aim at achieving fiscal balance by 2019/20, even though this has rarely been achieved in any year over the last 65 years even when

Chart 8: Government Financial Deficit (% of GDP)



government debt levels were higher than today. The chart below shows the CBR model forecast for the government deficit alongside that for the OBR. In our case fiscal balance is eventually achieved, but not until 2025. Our forecast for public sector net debt in 2020 is 79% of GDP compared with the OBR's 75%. Once again a Keynesian model with a multiplier predicts that attempts to reduce debt through austerity policies will be less successful than the OBR would predict.

The CBR model is designed for policy simulation and our main simulation thus far has been a fiscal reflation scenario based on higher government spending on goods and services. This is described in our first forecast report at www.cbr.cam.ac.uk/publications/special-reports/. In short real

government spending on goods and services is assumed to grow at an average rate of 3% per annum with unchanged tax rates and similar short-term interest rates. The main impacts are GDP growing faster by 0.6% per annum, and unemployment lower in 2020 by 300,000. The costs of this policy are CPI inflation marginally higher (0.3 pp) by 2020 and public sector net debt higher by 5% of GDP in 2020 and 10% by 2025. Public sector net debt still declines in this scenario but on a slower trajectory.

Annex A Names of variables used in equatios

BR	Short-term interest rate (Bank rate)
C	Constant
CUMULATIVE_MIGW	Cumulative net migration of working-age people 000s
CV	Real Consumer Expenditure
DEBT_LT	Household Long-term secured debt
DEBT_ST	Household Short-term unsecured debt
DKV_COS	Real company investment
EARNINGS_PRIV	Average weekly earnings private sector
FASN	Gross Financial Assets £bn
FTSE	Financial Times All-Share Index
GDPP	GDP Deflator 2012-100
GDPV_PRIV	Real GDP in the private sector
GINI_COEFF	Gini Coefficient. IFS measure post-tax after housing costs
HPI	House Price Index
KHN	Value of Housing Stock
KIVLV_COS	Real capital stock of companies incl. public corporations
LFSE_PRIV	Number of people working. Private sector incl. public corporations. LFS data
LFSE_PRIV_EE	Number people employed as employee private sector incl. public corps. LFS data
MIGW	Net migration of people of working age 000s
MINIMUM_WAGE	Minimum wage £ per hour (Living wage from 2016)
NEW_HOUSING_LOANS	Value of Number of new loans for housing (CML data)
NUMLOANS	Number of new loans for housing (CML data)
POPN	Total population 000s
POPN_65	Population aged 65 and over
POPW	Working-age population 000s
TAX_CAPGAINS_RATE	Capital gains tax rate
TAX_CAPGAINS_THRESHOLD	Capital gains tax threshold
TAX_TOP_RATE	Income tax top rate of tax
TAXWEDGE	tax wedge between compensation of employees and take-home pay after VAT
TU_MEMBERS_PRIV	% of people employed in the private sector who are members of a trades union
YD	Household Disposable Income

Annex B Derivation of SteadyState Stock-Flow Ratio

The typical form of consumption behaviour in a stock-flow framework is for consumption to depend partly on the flow of disposable income and partly on the stock of net assets.

$$cv = \alpha yd + \beta v$$

where:

cv is consumption
yd is disposable income
v is net wealth
$\dot{v}$ is the change In net wealth

Saving is the change in wealth, $\dot{v}$:

$$\dot{v} = yd - cv$$

implying:

$$\dot{v} = (1-\alpha)yd - \beta v = \beta\left[\left(\frac{1-\alpha}{\beta}\right)yd - v\right]$$

The second equality shows that the consumption function is equivalently an asset accumulation function in the form of a partial adjustment towards the stationary state stock-flow norm:

$$\gamma = \frac{v^*}{yd^*} = \frac{1-\alpha}{\beta}$$

The first equality can be expressed as:

$$\dot{v} + \beta v = \beta\gamma yd$$

Where: $\gamma = (1-\alpha)/\beta$.

Assume a steady-state growth rate for disposable income:

$$yd = yd_0 e^{gt}$$

Where: g is the growth rate.

The key results are that the dynamics of net wealth are given by:

$$v = \left(v_0 - \frac{\beta\gamma yd_0}{g+\beta}\right)e^{-\beta t} + \frac{\beta\gamma yd_0}{g+\beta}e^{gt}$$

where v_0 and y_0 are initial values of wealth and income respectively. The steady state wealth-income ratio is converges to:

$$\frac{v}{yd} = \frac{\beta}{g+\beta}\gamma$$

and the corresponding steady state savings-income ratio to:

$$\frac{\dot{v}}{yd} = g\frac{\beta}{g+\beta}\,.(1-\alpha)/\beta$$

Where: γ is the stationary state stock-flow norm.