Department for Business, Innovation & Skills

**Guide to the simplified student loan repayment model
(December 2013)**

This model is being released as an updated version of that published in August 2012. If you have any feedback on the model please send it to helen.woodward@bis.gsi.gov.uk

Purpose of the simplified loan repayment model

This is an update of the simplified loan repayment model which was published in August 2012. It has been updated with the macro economic forecasts which were published by the OBR in December 2013. It is being released to illustrate how BIS arrives at its estimate for the long-term resource cost of student loans (its estimate of the costs of write-offs and interest subsidies). It is a simplified and standalone version of the full loan repayment model used by BIS but the key principles behind it are consistent with the version of the full loan repayment model adopted in spring 2011. That model was used to arrive at the cost estimates included in the June 2011 White Paper.

Like the full repayment model, the simplified model operates at the level of individual borrowers (it is a micro-simulation model) and considers a sample of these to arrive at an indication of the likely resource cost of the loans. Unlike the autumn 2010 ready reckoner, this simplified model uses an approach to simulating borrower earnings that is consistent with the latest, winter 2013, version of the full model.

The main simplifications are the way in which this model:

- only considers entrants in 2012, not other years;
- only considers young graduates from three-year degree level courses;
- only considers a uniform amount of borrowing across every borrower;
- ignores the possibility of early repayments; and
- ignores the possibility of death or disability.

The full loan repayment model therefore contains many additional stages of simulation and many additional inputs and is normally run for a much larger sample of borrowers (100,000 rather than 10,000). The results from the full and simplified models are therefore not directly comparable and represent slightly different things. This simplified model gives a RAB charge of around 34% whereas the full model currently gives an estimate of around 35-40%.

However, the simplified model can be expected to give a reasonable illustration of the general sensitivity of future repayments and the expected cost of loans to:

- key assumptions such as future graduate earnings and the discount rate; and
- policy parameters such as the loan repayment threshold, repayment rate, interest rate and maximum repayment period.

To illustrate the above points, the table on page five contains a summary of some sensitivity analysis performed with the full repayment model in summer 2012 (as shared with the Office for Budget Responsibility for the July 2012 Fiscal Sustainability Report) and shows the equivalent results from the simplified model using the OBR macro economic forecasts which were available at the time.

Methods and inputs

For each individual borrower, the model: simulates an earnings path over a 35 year period; calculates the resulting repayments for each year; and then converts that future stream of repayments into a net present value. The cost of the loans is the difference between the npv of repayments and the npv of the outlay.

The flow diagram on page four summarises the key stages in the process. These are common to both the full and simplified versions of the repayment model:

1) A 'percentile path' for the individual

The simplified model contains a database of percentile paths for 10,000 male and 10,000 female individuals. These paths represent the earnings rank of the individual compared to other graduates of the same age and gender and are needed as any change in a borrower's earnings over time will affect the repayments that are due. They are derived from the British Household Panel Survey, 1991 to 2008.

2) An earnings path in 2009 terms

The model then uses graduate income distributions derived from the Labour Force Survey (2001 to 2009) to convert the percentile paths into actual earnings in 2009 terms. The implicit assumption here is that the earnings of past graduates are indicative of the earnings of future graduates.

3) An earnings path in nominal terms

Projections of earnings growth from the Office for Budget Responsibility are then used to convert the 2009 earnings paths into nominal terms. The implicit assumption here is that earnings growth will be uniform across the graduate income distribution.
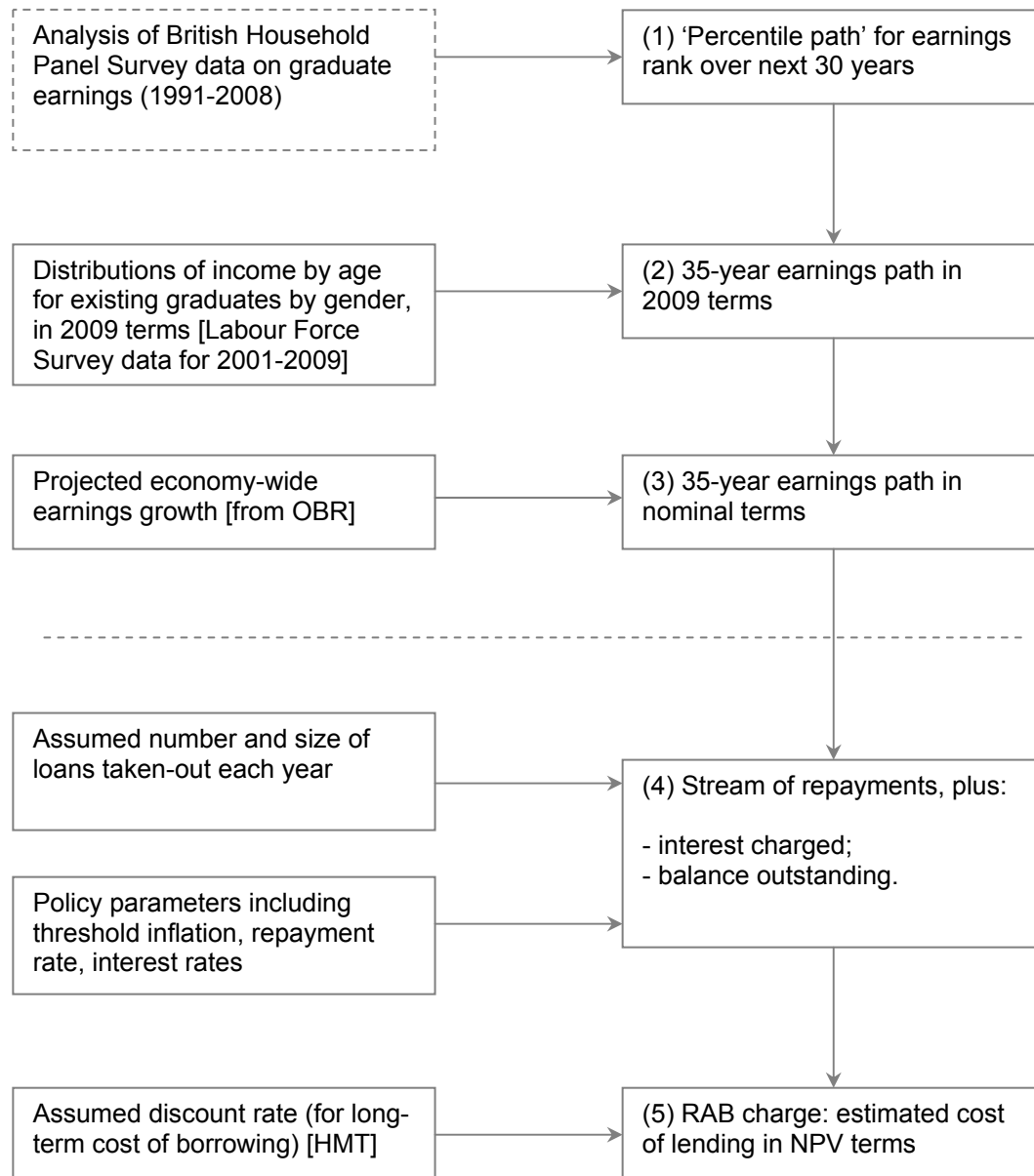
4) Repayments by year

The next stage brings together: the earnings path for the individual; the assumed original borrowing; and the projected values of all relevant repayment policy parameters. From those inputs it is possible to derive a stream of repayments for an individual by calculating the resulting loan balance and interest in each year.

5) Estimated RAB charge for the individual

With an assumed discount rate, the stream of future repayments can be converted into a net present value. The difference between this and the value of the original lending is the public cost of the interest subsidies and write-offs. The Resource Accounting and Budgeting (RAB) charge then expresses these costs as a percentage of the original lending.

Key stages for each individual borrower:

The first few stages below simulate a 35-year earnings path for an individual. This is then combined with the assumed initial borrowing and the terms of repayment to arrive at a simulated stream of future repayments and therefore an expected public cost of the original lending:

Analysis of British Household Panel Survey data on graduate earnings (1991-2008)	(1) 'Percentile path' for earnings rank over next 30 years
Distributions of income by age for existing graduates by gender, in 2009 terms [Labour Force Survey data for 2001-2009]	(2) 35-year earnings path in 2009 terms
Projected economy-wide earnings growth [from OBR]	(3) 35-year earnings path in nominal terms
Assumed number and size of loans taken-out each year	(4) Stream of repayments, plus: - interest charged; - balance outstanding.
Policy parameters including threshold inflation, repayment rate, interest rates	
Assumed discount rate (for long-term cost of borrowing) [HMT]	(5) RAB charge: estimated cost of lending in NPV terms

All of the above stages are also part of the full repayment model.

Outputs and sensitivity analysis

The RAB charge estimate from the simplified model is not directly comparable to the official estimate from the full model as it only represents the likely cost for the most typical subset of student loan borrowers (see page two).

However, this estimate does respond in a similar way to the official estimate when inputs to the model are adjusted. In May 2012, BIS provided the OBR with some basic sensitivity analysis around the official estimate of the RAB charge. This is shown in the table below along with the corresponding outputs from the simplified model using the same OBR figures which were available at that time. The two differently defined RAB charge estimates rise and fall to a similar extent in response to the variation in inputs.

	Full model	Simplified model
Overall	32%	29%
Analysis for OBR (pre July 2012)		
Base estimate under OBR assumptions for average loan size (£200 more)	33%	30%
If earnings growth is assumed to be 0.5%pts less each year from 2017	35%	32%
If the maximum interest rate is assumed to be rpi+2.5% not rpi+3.0%	34%	32%
If the discount rate assumption is changed from rpi+2.2% to rpi+1.5%	25%	21%

Some outputs from the simplified model will differ significantly from the full loan repayment model. For example, the simplified model suggests that over 15% of borrowers will have a negative RAB charge. This proportion is lower in the full repayment model because it is affected by the consideration of students not on degree level courses, borrowers who die or become disabled and those who make large voluntary repayments.

The model also summarises the estimated RAB charge for each percentile of borrowers by lifetime earnings. This shows that the very lowest percentile of earners is expected to have an average RAB charge of close to 100% (it ranges between 90% and 100% for that group) whereas the very highest percentile of earners are expected to have an average RAB charge close to zero (it ranges between -10% and 20% for that group).

Annex A – details of model inputs and assumptions

i) Policy parameters

Repayment threshold (and long-term assumption): the repayment threshold of £21,000 applies from 2016 and is assumed to increase with earnings each year.

Repayment rate: is 9% of all income above the repayment threshold.

Maximum real interest rate: is 3.0% (above rpi). The maximum rate applies during study. After the borrower passes their Statutory Repayment Due Date (SRDD) the rate depends on their income: it gradually increases from zero real at £21,000 to 3.0% real at the upper threshold.

Threshold for maximum interest: the upper threshold is £41,000 in 2016 and is assumed to increase with earnings each year.

Maximum repayment period: is 30 years from the borrower's SRDD. With this model policy variants up to 35 years can be considered.

ii) Other inputs and assumptions

Assumed borrowing: each borrower is assumed to request the same amount of maintenance and fee loan. This is set to £11,700 for each of the three years. This is a simplifying assumption – a distribution of loan amounts is considered in the full loan repayment model.

Discount rate: for accounting and budgeting of student loans, BIS uses a discount rate of 2.2% real (above rpi) to discount future loan repayments to a net present value. This assumption is agreed with HM Treasury.

Male/female borrower ratio: is set to 55%. HESA data for 2010/11 shows that 54.3% of first degree students were female.

Earnings growth and inflation projections : the short term values – up to 2018 – are the OBR projections from December 2013 (the Economic and Fiscal Outlook) and the long-term values – for 2023 and beyond – are the OBR projections from July 2013 (the Fiscal Sustainability Report). For the years between 2018 and 2023 the values are simple interpolations between the final short-term figures and the long-term assumptions.

Constants: there are several constants in the model that cannot be changed. These include: age of students on entry to HE (18), age at SRDD (22), the base year of first borrowing (2012) and the final year considered in the simulation (2050).

iii) Percentile paths (based on the British Household Panel Survey)

The male and female 'percentile paths' represent the earnings rank of an individual in any one year compared to other graduates of the same age and gender. The paths are simulated for 35 years.

For example, if a male borrower has a path that starts 0.50, 0.61, 0.55… it means they are assumed to earn more than around 50%, 61% and 55% of their peers in each of those years.

The paths are derived from the British Household Panel Survey, 1991 to 2008.

iv) Income distributions (based on the Labour Force Survey)

The income distributions represent the earnings of past graduates broken-down by age and gender. These are derived from the Labour Force Survey (2001 to 2009). Unemployment is not represented explicitly but the parts of the distributions where graduates are shown to have zero earnings include the influence of unemployment.