BIS Student Loan Repayment Ready Reckoner: Background Note

Introduction

Lord Browne's Higher Education review made use of modelling of repayments provided by analysts at the Department for Business, Innovation and Skills. There is no single model that provides graduate earnings profiles, repayment calculations, and charts of repayments by decile (as shown on page 42 of the Browne Report).

The modelling used a set of lifetime earnings profiles for students graduating in 2015 and entering repayment at their Statutory Repayment Due Date (SRDD) in April 2016, generated from survey data. This approach to modelling earnings has been used for several years within the Department. The Annex at the end of this document describes the process in some detail.

To facilitate debate on the emerging proposals the Department is providing these earnings profiles in a spreadsheet. And to show how these can be used to look at different repayment options, a ready reckoner is also provided which takes those earnings profiles and calculates annual repayments, of a chosen typical debt for a 3 year degree course, for each graduate. Note that it does not taken into account the different types of courses that students enter, which will vary in length, nor the varying amounts of loans that they may take out each year.

The user of the spreadsheet can set the repayment policy parameters to values of his or her choice to illustrate the potential impact of changes to repayment policy. The annual repayments are discounted back to the year of issue and the Net Present Value (NPV) of the total repayments calculated. The graduates are grouped firstly by lifetime earnings decile then by percentile, and the average NPV of repayments are displayed in the results sheet.

It should be borne in mind that the generated earnings profiles are not directly comparable to other published graduate earnings figures, as they: refer to students entering repayment in 2016; include zero values for graduates who are inactive, unemployed, in further study, dead, permanently disabled and retired; make adjustments for time taken to enter the labour market after graduation; include investment income from which repayments may be taken; take into account delays in repayments being collected when graduates start work for the first time or change jobs; and take into account lower earnings for part-time workers.

Earnings profiles and ready reckoner

The Excel spreadsheet has 5 worksheets:

- Introduction – descriptions of the contents of the other sheets
- Parameters – repayment policy parameters that can be changed by the user
- Repayment Calculation – lifetime earnings profiles and calculation of annual repayments and interest added to loans
- NPV Repayments – calculation of the NPV of future repayments
- Results – the outputs of the ready reckoner, which are NPV of repayments by lifetime earnings decile/percentile

It takes the generated sample of graduate earnings profiles covering 35 years from 2016-17 to 2050-51, and ranks them on the basis of their total earnings in real terms over the 35 years. RPI = 2.75% is used to discount each year's earnings back to 2016 values.

It then calculates repayments of a chosen loan amount for a typical student on a 3 year First Degree course, entering HE in 2012/13. Repayments are calculated on an annual basis (in the middle of the year) as an approximation to the monthly repayments (at the end of the month) that would be made by most graduates via their employer through the PAYE system.

<u>Parameters</u>

Interest is assumed to be RPI plus the chosen real rate. Low income protection can be applied separately for the periods before and after the SRDD. The user can select:

- loan amount per year
- repayment term (up to 35 years)
- repay rate
- discount rate
- real interest rate
- low income protection before SRDD
- low income protection after SRDD
- type of low income protection
- repayment threshold growth
- repayment threshold
- threshold for full interest (for phased interest scenario)

Low income protection

The ready reckoner allows the user to choose one of two methods of low income protection. Low income protection in the Browne report works by preventing any individual's debt from increasing in real terms each year. If applied before the SRDD interest is simply added at RPI, otherwise interest is added at RPI + the real interest. If applied after the SRDD, the calculated end of year balance using the real interest rate is compared to value of the balance if it had simply increased with RPI from the end of the previous year. The lower amount is then selected to carry forward to the next year.

Real interest can also be phased in linearly based solely on income, from RPI at the level of the repayment threshold, to RPI+ full real interest at a second chosen threshold.

Repayment Calculation

The repayment calculations are carried out as follows:

1) Interest is added to the assumed loan amount per year (3 years for 2012/13, 2 years for 2013/14 and 1 year for 2014/15) to produce a loan balance at the SRDD.
2) At the start of year 1 (2016-17), any prepayments are subtracted from the loan balance.
3) 6 months of interest (RPI + full real rate for Browne or RPI + real rate dependent on earnings for phased interest) is added to the loan balance.
4) Repayments are calculated as the lower of:

   Amount of earnings above the repayment threshold x repay rate

   and

   Current loan balance
5) A further 6 months of full interest is added to the remaining balance, and, under the Browne scenario, if the resulting amount is less than the start of year balance (after prepayments are subtracted) increased with RPI, then the balance is capped so it cannot increase faster than RPI during the year.
6) Steps 3 to 5 are applied again for years 2 to 35.

NPV Repayments

7) Future repayments are discounted back to the SRDD using assumed RPIX (=2.75%) + the chosen discount rate.
8) Finally repayments are divided between the 3 years the loans were issued in proportion to the Present Value of each loan at the SRDD (i.e. the 2012/13 loan is increased by RPIX + discount rate for 3 years etc.) and discounted back to the year of issue. This is done so that repayments are fully discounted back to the year of issue and each year's loan is given an equal proportion of repayments.

   The NPV of repayments as a percentage of the original debt is known as the RAB (Resource Accounting and Budgeting) charge and is a measure of the long term cost of loans issued to students, due to

interest subsidy (where interest charged to borrowers is lower than the Government's cost of borrowing = RPIX + 2.2%) and write-off subsidy (due to outstanding loan amounts being cancelled due to permanent disability or at the end of the repayment term).

If the real interest rate and discount rate are the same, then a graduate who repays in full and does not receive any low income protection, will repay 100% of their loans in NPV terms and, hence a zero RAB charge.

Results

The 4041 earnings profiles are ranked by total real lifetime earnings over 35 years and split into lifetime earnings deciles/percentiles. The average NPV of repayments of the chosen debt for each decile/percentile is then displayed in a table and chart.

Example repayment calculations

The calculations can be illustrated with the aid of a simple example. The example will assume repayment parameters: loan amount per year = £10,000, repay rate = 9%, repayment threshold = £21,000, discount rate = 2.2%, real interest rate = 2.2%, no low income protection before SRDD, low income after SRDD, second threshold for phased interest = £41,000. It will also assume earnings of £25,000 in year 1 and prepayments of 20% of the balance at SRDD. Balances and repayments are rounded to the nearest £1.

Browne model

1) Interest of RPI (=2.75%) + 2.2% is added to produce a loan balance at the SRDD: Balance at SRDD = £10,000 x 1.0495^{3} + £10,000 x 1.0495^{2} + £10,000 x 1.0495 = £33,069.
2) At the start of year 1 prepayments of 20% subtracted from the balance: Balance at start of year 1 = £33,069 x 80% = £26,455.
3) 6 months of full interest added: Balance = £26,455 x $1.0495^{½}$ = £27,102.
4) Repayments = (£25,000 - £21,000) x 9% = £360. New balance = £27,102 - £360 = £26,742.
5) A further 6 months of full interest added: Balance = £26,742 x $1.0495^{½}$ = £27,396. Balance if increased only with RPI from the start of the year = £26,455 x 1.0275 = £27,183. The balance is therefore capped at £27,183 and £213 of real interest is effectively written-off.
6) If, for the purpose of the example, we assume repayments stop after year 1 then a total of £6,974 was repaid, £6,614 at the start of year 1 and £360 midway through year 1.
7) Repayments are discounted back to the SRDD: NPV of repayments at SRDD = £6,614 + £360 x $1.0495^{-1/2}$ = £6,965.
8) Repayments are divided between the 3 years the loans were issued in proportion to the Present Value of each loan at the SRDD. PV of first loan = £10,000 x 1.0495^{3} = £11,560, PV of second loan = £10,000 x 1.0495^{2} = £11,015, PV of third loan = £10,000 x 1.0495 = £10,495.

Loans 1, 2 and 3 hold 35.0%, 33.3% and 31.7% of the PV of the total balance at SRDD respectively.

The final NPV of repayments is calculated as: 35.0% x £6,965 x 1.0495^{-3} + 33.3% x £6,965 x 1.0495^{-2} + 31.7% x £6,965 x 1.0495^{-1} = £6,319. The RAB charge for this individual would be (£30,000 - £6,319) / £30,000 = 79%.

Phased interest

1) Interest of RPI (=2.75%) + 2.2% is added to produce a loan balance at the SRDD: Balance at SRDD = £10,000 x 1.0495^{3} + £10,000 x 1.0495^{2} + £10,000 x 1.0495 = £33,069.
2) At the start of year 1 prepayments of 20% subtracted from the balance: Balance at start of year 1 = £33,069 x 80% = £26,455.
3) With earnings of £25,000 the real rate of interest is (£25,000 - £21,000) / (£41,000 - £21,000) x 2.2% = 0.44%. 6 months of interest is added: Balance = £26,455 x $1.0319^{½}$ = £26,874.
4) Repayments = (£25,000 - £21,000) x 9% = £360. New balance = £26,874 - £360 = £26,514.
5) A further 6 months of interest added: Balance = £26,514 x $1.0319^{½}$ = £26,934.
6) If, for the purpose of the example, we assume repayments stop after year 1 then a total of £6,974 was repaid, £6,614 at the start of year 1 and £360 midway through year 1.
7) Repayments are discounted back to the SRDD: NPV of repayments at SRDD = £6,614 + £360 x $1.0495^{-1/2}$ = £6,965.
8) Repayments are divided between the 3 years the loans were issued in proportion to the Present Value of each loan at the SRDD. PV of first loan = £10,000 x 1.0495^{3} = £11,560, PV of second loan = £10,000 x 1.0495^{2} = £11,015, PV of third loan = £10,000 x 1.0495 = £10,495. Loans 1, 2 and 3 hold 35.0%, 33.3% and 31.7% of the PV of the total balance at SRDD respectively.

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For any queries about the ready reckoner please contact Stuart Younger – tel: 020 7215 1580, email: stuart.younger@bis.gsi.gov.uk

Annex: Lifetime Earnings Profiles

There are a number of components of the model of graduate earnings, which in combination provide a full range of potential lifetime earnings profiles, taking into account the transition from education into work, career progression, movement in and out of the labour market, part-time working, and death or permanent disability.

Starting Earnings

On reaching their SRDD in April the graduate is given a starting earnings amount. For each combination of gender and course type, starting earnings are assumed to follow a log-normal distribution around the mean. Individual earnings are determined by sampling from the distribution at random. Separate means and standard deviations were derived from Labour Force Survey (LFS) data for men and women. Women who work part-time are assumed to earn 46% of full-time workers both in their starting salary and throughout their careers.

Initial Employment Status

On graduation each graduate has a probability, determined by age, of entering postgraduate study (from the Moving On graduate survey), of either 1 or 3 years duration. If a graduate enters further study they are assumed to have zero earnings and hence make no repayments. Graduates who do not enter further study will either be employed full time, unemployed, inactive, employed part time (female only), dead or disabled. This initial employment status is determined at random from a distribution for each combination of gender and course type, from LFS and Government Actuary data (death and disability).

Expected Earnings Growth

Regardless of a graduate's employment status, their expected mean earnings are calculated each year. In the first year this will be the value described in the Starting Earnings section above. The growth of the graduate's expected earnings between the current year and the next one is then calculated. . For each combination of income band (Low, Medium or High) and gender the expected percentage earnings growth is derived from a linear regression model of British Household Panel Survey data based on age. For graduates with the same characteristics, earnings will grow quickest when they are in the Low band and slowest in the High band, so they experience what is known as mean reversion.

Adjusted Earnings Growth

An adjustment is then made to the expected earnings (in all years except the first). If the graduate is unemployed it increases with inflation minus an unemployment penalty rate (from BHPS). If the graduate is employed a random value is chosen from an assumed distribution around the expected value.

Actual Nominal Earnings

The earnings are set to zero if the graduate is unemployed, inactive, dead, disabled or retired. If the graduate is employed part time the earnings are multiplied by 46% (except in the first year as starting earnings are already adjusted).

Nominal Earnings adjusted for first year effects

Two adjustments to earnings are made here to account for the amount of time taken to find employment and the delays to repayment collections when graduates start work for the first time or change employers. Both are assumed to affect earnings only in the first two years. If the current year is the graduate's first or second in employment then their annual earnings are reduced in proportion with the number of months sampled at random from distributions of number of months spent in work and number of employers, both dependent on gender.

Investment Income

A logistic regression model of LFS data based on earnings, age and gender is used to determine the probability that the graduate has investment income above £2,000 in the current year. The amount of investment income is then sampled at random from an assumed distribution around the mean. Investment Income of £2,000 or more is then added to earnings to give the final income for the year.

Employment Transitions

The same as above are followed each year except that initial employment transitions are replaced with transition probabilities derived from a logistic regression model of LFS data based on age, gender and previous employment status.

Macroeconomic Assumptions

The earnings profiles assume inflation is applied to each year's earnings figure, at an assumed long term value of RPI = 2.75%. The income bands that determine whether graduates are low, medium or high earners for the purposes of calculating expected earnings growth, are assumed to grow in line with assumed economy wide nominal earnings at RPI + 2pp = 4.75%.

Prepayments

Student Loan Company data is used to model the propensity to repay loans early. A logistic regression model is used to identify probabilities of different borrowers to prepay. It depends on gender, size of principal, age, and time before or after graduation. The model predicts probability of making a prepayment in any year pre or post graduation. Prepayments in each year are then aggregated to give total proportion of the debt prepaid. For simplicity in the ready reckoner, we assume that all prepayments are made at the SRDD.