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Income contingent student loan design: Lessons from around the world

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ABSTRACT

The use of income contingent loans (ICLs) for Higher Education (HE) students is becoming increasingly prevalent around the world. Using a model of simulated lifetime earnings for graduates, in this paper we show that the impact of the design of ICLs on the magnitude and distribution of government subsidies is highly dependent on the institutional setting. In particular, the average debt level as a share of average earnings is a key determinant of the impact of various policy parameters. The variance of earnings within the graduate population is also shown to be a determinant of ICL taxpayer costs. This paper is the first comparative exercise of impact of the design of ICLs in different settings, and the findings are highly relevant to countries looking to implement or reform their student loan systems.

1. Introduction

The use of income contingent loans (ICLs) for Higher Education (HE) students is an increasingly popular funding solution for governments worldwide. As with private or government-backed mortgage-style loans, ICLs are typically used to alleviate credit constraints for those facing tuition costs. However, their salient advantage over these alternative funding sources is that they insure individuals against poor labour market outcomes by requiring loan repayment only if they are earning above a certain threshold, thereby removing the risk of large repayment burdens for those on low incomes, and reducing the impact of risk aversion on the participation decision (see Chapman, 2006).

Incorporating this insurance results in an inevitable cost, and it is a major challenge for governments to determine how these costs should be split between ICL borrowers and the taxpayer. Governments have several policy parameters at their disposal to try to address this challenge, and there is consequently significant variation in the design of loans around the world. In Australia, the level of insurance is set very high but the repayment schedule is steep, with individuals paying a fraction of their total rather than marginal income above a threshold, which extracts higher repayments from middle earners. In England, loans have positive real interest rates that increase with income to try to extract greater repayments from higher earners. In New Zealand, conversely, there is a zero nominal interest rate on debts, resulting in taxpayer subsidies to all borrowers. Alongside these well established systems, several countries including the US, the Netherlands, South Korea and Hungary have recently implemented full or partial ICL systems, while numerous other countries are considering introducing ICL schemes.

In this paper, we investigate the impact of various student loan parameters from systems around the world on the overall cost and the distribution of costs amongst graduates. As our baseline institutional setting we use England, a country which has had an ICL system for nearly 20 years, and has rich survey data that enables the development and use of a sophisticated model of lifetime earnings for graduates – something that many have argued is essential in order to quantify the true cost and distributional impact of student loans (for example, see Higgins & Sinning, 2013). We focus on design features from England, Australia, New Zealand – all of which have long-established ICL schemes for Higher Education – and the USA. There is considerable variation in the design of the ICLs within these countries that enable us to highlight a range of options that are possible within our modelling framework.[1]

In particular we investigate the impact of loan interest rates, the write-off period, the earnings threshold and the repayment rate on loans, each of which are key parameters of the student loan system. We consider the impact of these parameters on the overall cost of the system and distribution of subsidies amongst graduates.[2] The latter is

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[1] An example of a design that is beyond the scope of our model is repayments becoming contingent on joint family income upon marriage, as in the Netherlands.
[2] We use the term 'cost' and 'subsidy' interchangeably. See Section 3.2 for a discussion of the methodology used to calculate subsidies.

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important for policy makers who care not just about the cost of higher education, but also how that cost is distributed. We also know that different loan designs can have dramatically different effects on different graduates. For example, Belfield, Britton, Dearden, and van der Erve (2017) show that the significant student loan reforms in England in 2012, and further reforms since then, have dramatically affected the distribution of repayments and subsidies among graduates. While headline tuition fees were increased almost threefold to £9000, other parameter changes meant that the lowest 40% of graduates would expect to repay less as a result of the changes, while the highest earnings graduates would have to repay considerably more. This has important implications for welfare, the incentives of young people with different earnings potential to attend university, and for the way government subsidies are targeted. Although important, the lessons from the 2012 reforms in England may not be entirely clear for policy makers in different institutional settings, as several features of the ICL were changed simultaneously. This paper aims to outline more general lessons about the impact of parameter changes under different institutional settings.

We investigate the impact of the different loan parameters on the magnitude and shape[3] of the distribution of graduate subsidies under high and low debt scenarios, showing that debt size in relation to average earnings is crucially important in determining the impact of these parameters. We also demonstrate that the level of earnings variability across the population of graduates is key in determining the overall taxpayer subsidy and the distribution of subsidies in the system, something that is particularly pertinent for the US, where earnings variability is comparatively high. These findings are highly relevant to countries seeking to design and implement their own ICL systems, or for countries seeking to reform their HE finance systems.

The paper is set out as follows. In Section 2 we describe briefly the institutional background in England and also discuss ICL designs in New Zealand, Australia and the United States. We describe our methodology in Section 3 and the results of our modelling in Section 4. Section 5 concludes.

2. Institutional background

In this section we provide the institutional background and key features of the ICL system in England, and show some of the differences with the Australian and New Zealand ICL systems, as well as the partial system in the United States, to illustrate how policies vary around the world. We do not go into detail on aspects of ICL design nor advantages and disadvantages of ICL systems compared to alternative mechanisms for student loan financing, but instead point the reader to Chapman (2006) and Chapman, Higgins, and Stiglitz (2014) for background.[4]

Table 1 summarises the main features of the ICLs in England, Australia, New Zealand and the US. Universities in England can charge up to £9250 per year in tuition fees, and in 2016 all but three of the 90 largest institutions charged the maximum amount for all subjects. Students can take out an income contingent loan to cover the full amount of these fees. Furthermore up to an additional £11,002[5] per year in loans is available to cover living costs, with the amount being lower for students living at home, outside of London, or from households with incomes above £25,000. The average loan balance at graduation in England is one of the highest in the world, estimated at around £55,000 for the cohort starting university in 2017.[6]

Students are required to repay 9% of income above the repayment threshold, which is currently set at £25,000 per year and will increase with average earnings. During university an interest rate of RPI plus 3% is charged on the debt and after graduation the real interest rate charged ranges from 0 to 3%, depending on income. Those with income below the threshold of £25,000 per year are charged 0% interest and those with earnings above a higher threshold of £45,000 per year are charged 3%, with the interest rate increasing linearly with income between those two thresholds. Any remaining debt is written off 30 years after the graduate first becomes eligible for repayment.

Two other countries with long established ICL systems are Australia and New Zealand. These countries have a much lower average loan balance at graduation than England, due to lower tuition fees in both countries and maintenance loans not being available in Australia. Unlike in England where the repayment rate is applied to marginal income over the threshold, in Australia once the minimum threshold is reached the debtor repays a percentage of total income, generating a ‘cliff edge’ at the repayment threshold. A progressive stepped repayment schedule is also applied, where the repayment rate increases from 4 to 8% as income increases.[7] At A$55,874 (around £30,000 at the time of writing), the threshold is much higher than in England. Debt is indexed to CPI, which implies a 0% real interest rate, and any outstanding loan is written off upon death.

In New Zealand on the other hand, the repayment threshold is very low at NZ$19,448 (£10,000 at the time of writing), and students are required to repay 12% of income above this threshold. A 0% nominal interest rate is charged for those graduates who stay in New Zealand. That is, the loan is interest free. However, for those who live abroad, interest has to be paid (currently 4.3% nominal). Furthermore repayment becomes a function of the remaining loan balance, not of income. As with the Australian system, the loan is written off upon death.

In the United States, more than a quarter of graduates are on some type of income based repayment plan, and multiple plans with varying rules exist alongside each other. Borrowers who took out loans after July 2014 are eligible for Income Based Repayment (IBR), the most generous plan. Borrowers are not automatically enrolled in income based repayment plans, but can opt in voluntarily. Under IBR they have to repay 10% of income above a threshold - set at 150% of the poverty guideline for their household size ($24,360, or around £17,000, for a two-person household in 2017). The interest rate charged on loans is currently 4.45%.[8] After 20 years, no further income contingent repayments are required for an IBR, but any remaining outstanding debt is treated as income and taxed accordingly. This tax can imply high and potentially unaffordable repayment burdens, since it is not linked to the actual income received, and indeed the tax charged may even exceed income. For this reason, the IBR schemes in the United States are not income contingent for the full duration of the loan, and provide only limited insurance against default, unlike the ICL schemes in England, Australia and New Zealand.

There is a small, but growing literature on income contingent student loan systems in individual countries. The Australian and English system in particular have received a lot of attention. Chapman (2006) gives an overview of the Australian system. Barr and Crawford (2005) and Dearden, Fitzsimons, Goodman, and Kaplan (2008) analyse the 2006 English reforms, Johnston and Barr (2013), Chowdry, Dearden, and Wyness (2010) and Dearden, Goodman, Kaplan, and Wyness (2010) do this for the 2012 English reforms and

[3] The typical shape of the distribution of graduate subsidies is downward sloping when ordered from lowest to highest lifetime earning graduates, however, as demonstrated through the modelling in this paper, the specific shape of the distribution depends critically on loan size, earnings variability, and the choice of loan parameters.

[4] Also see Woodhall (1987), Baum and Schwartz (2006) and Salmi (2003) for discussions of excessive indebtedness.

[5] For the 2017/18 academic year.

[6] This figure includes interest accrued during university. It is based on the authors' estimates assuming full take-up of loans and no drop-outs.

[7] The repayment schedule for 2017–18 is given in the Appendix as Table A1.

[8] As of 2017–18. This interest rate applies to Direct subsidized and unsubsidized loans for undergraduate degrees. For different types of loans this rate can vary.

Table 1
Summary of main features of ICLs in selected countries.

	Repayment rate	Lower repayment threshold	Interest rate	Debt forgiveness
England	9% of marginal income	£25,000	RPI + 0–3%	30 years
Australia	4–8% of total income	£30,000	CPI	Upon death
New Zealand	12% of marginal income	£10,000	0%	Upon death
US	10% of marginal income	£17,000	4.45%	20 years[a]

[a] Debt is written off after 20 years, but at this point any outstanding debt is treated as income and taxed accordingly.

Belfield, Britton, and van der Erve (2017) look at the most recent reforms. Barr, Chapman, Dearden, and Dynarski (2018) focusses on ICLs in the United States. Related literature discusses some of the issues with income contingent student loans in less-developed economies; see for example Chapman and Lounkaew (2010) on Thailand.

3. Methodology

To calculate the government ICL subsidy and the distribution of this subsidy across graduates, we need to know how much students borrow and how much they earn throughout their lifetimes. We model this by first calculating loan entitlement for all individuals in a given cohort, based on their background characteristics and the location of their university.[9] We then simulate gross earnings of graduates over their lifetimes and link these lifetime earnings profiles to our population of students. From this we calculate the interest charged and the repayments made in the different ICL scenarios. Here we discuss a model of earnings, but in the later sections we assume that earnings is equal to income.

3.1. Modelling lifetime income

Our methodology for modelling lifetime earnings is the same as used in a number of previous papers, such as Chowdry, Dearden, Goodman, and Jin (2012), Crawford, Crawford, and Jin (2014) and Belfield, Britton, Dearden, et al. (2017). The method employed explicitly models and projects variability in individual earnings over time. This is in contrast to the conventional approach of modelling and costing ICLs by using static earnings profiles based on single or pooled cross-sectional data.[10]

We simulate lifetime earnings of graduates starting university in 2017, estimating everything separately for men and women. Using British Household Panel Data (BHPS), we estimate models of employment status and earnings on graduates only. We model earnings as:

$$y_{iat} = X_{iat}'\beta + e_{iat}, \quad (1)$$

where y_{iat} is log annual earnings of individual i at age a at time t. X_{iat} is a vector of observable characteristics including a quartic polynomial in age, a full set of year dummies, and dummies for region and ethnicity. We then impose an ARMA(1,1) structure on the residual term e_{iat}, such that:

$$e_{iat} = \alpha_i + \gamma_i a + \pi_{iat} + \epsilon_{iat}$$

$$\epsilon_{iat} = \phi\psi_{i,a-1,t-1} + \psi_{iat}$$

$$\pi_{iat} = \rho_a \pi_{i,a-1,t-1} + \eta_{iat}, \quad (2)$$

where α_i is an individual fixed effect and γ_i is an individual-specific deterministic linear trend in age. Together, α_i and γ_i allow for cross-sectional heterogeneity in both the level and age-profile of the deterministic component of earnings. The idiosyncratic stochastic component comprises two parts: π_{iat} is a first-order autoregressive persistent shock and ϵ_{iat} is a first-order moving-average transitory shock. We allow the auto-regressive parameter ρ to be cubic function of age and the transitory shock ψ_{iat} and the permanent shock η_{iat} to be a quartic function of age. The moving average parameter, ϕ, is assumed to be fixed across ages.

We then estimate employment dynamics via three models: the probability of job loss, the probability of finding a job for the currently unemployed and earnings upon re-entry into the labour market. The probability of job loss is estimated using a probit model of age and the earnings residual e_{iat} from Eq. (1). The probability of job finding is estimated using a probit model with age and duration of non-employment. The re-entry earnings residual of previously unemployed workers depend on age, duration of unemployment and the earnings residual when last employed. Individuals who are unemployed in a given period according to our employment models receive zero earnings in that period.

We then simulate 10,000 lifetime earnings profiles using our earnings residual and employment models and reinserting the X's using the β's from Eq. (1). We then pin the age-gender-specific cross-sectional earnings distributions to the corresponding distributions for graduates in the Labour Force Survey (LFS). Specifically this means we calculate the rank of all our simulated earnings profiles by age and gender and then assign to it the earnings level from the corresponding percentile in the LFS from the same age-gender group. So, for example, a man at the 75th percentile of the earnings distribution at age 25 in our simulated earnings model will be assigned earnings from the 75th percentile of 25 year old graduate men from the LFS. We do this so the earnings dynamics come from the BHPS, which is ideal for estimating dynamics because it tracks the same individuals over long time periods, while the cross-sectional distributions come from the LFS, which is more reliable on the cross section due to the larger sample sizes.[11]

For the LFS cross-sectional distributions, we pool data from 1993 to 2016 (adjusting for inflation) to boost sample sizes. In order to match the absolute level of earnings to that of recent graduates we scale earnings at all ages so that for each gender the average earnings of 25- to 30-year-olds match that observed in the LFS in 2016, scaled up by the Office for Budget Responsibility's (OBR) forecasts for earnings growth between 2016 and 2021 (the year our cohort of graduates would enter the labour market). We further uprate all earnings in later years by the OBR earnings growth forecasts from 2021 to each given year.

These earnings profiles are then assigned to individuals from the population of students to enable us to link the size of the student debt of each graduate with their future earnings, which determine their repayments and thereby the government subsidy implicit in the loan.

3.2. Determining taxpayer costs

When offering an ICL, the government outlays funds up front.

[9] The population of students come from administrative data that links the National Pupil Database (NPD) and Higher Education Statistics Authority (HESA) datasets.

[10] We briefly discuss the difference between dynamic and static approaches, and the consequences to ICL cost estimation in Section 3.3 below.

[11] The LFS has a very limited panel element where by individuals' earnings are observed up to a maximum of two times, one year apart. We therefore cannot use it to model long run earnings dynamics which we consider a significant limitation.

Although these initial costs may be substantial, in determining the long-run taxpayer costs of an ICL, one needs to consider both the up-front spending and the lifetime repayments of graduates.

We do this by comparing the net present value (NPV) of the loan with the NPV of the stream of projected future repayments from graduates. These are calculated using the matched lifetime earnings from the simulated model described in the previous section. In a typical ICL, repayments R for individual i at age s, with income Y and debt D are then given by[12]:

$$R_{is} = min(max(\tau(Y_{is} - \psi), 0), D_{i,s-1}) \tag{3}$$

$$D_{is} = (1 + r)(D_{i,s-1} - R_{is}) \tag{4}$$

where τ is the repayment rate, ψ is the repayment threshold and r is the real interest rate. For example, in England $\tau = 0.09$, ψ=£25,000 and $r_{is} \in [0, 0.03]$, and is a function of Y_{is}.

The difference between the loan amount and repayments is a measure of the taxpayer subsidies (government costs) associated with the ICL scheme:

$$Government\ cost = \sum_{s=1}^{T} \left(\frac{1}{1+d}\right)^{s} L_s - \sum_{s=1}^{T} \left(\frac{1}{1+d}\right)^{s} \overline{R}_s \tag{5}$$

where

$$\overline{R}_s = \sum_{i} R_{is} \tag{6}$$

L_s is the loan in year s, $\overline{R}_s$ are the repayments made in year s, d is the real discount rate used by the government and T is the final year of repayments. We assume in the equation that loan amounts and repayments are discounted to time 0. The amounts are discounted to account for the fact that repayments recovered in the future are worth less to the government than repayments made today. This is because repayments made today immediately reduce government debt, thereby reducing the interest that government would have to pay on this debt.

The cost to government can be expressed as a percentage of the loan amount issued. In England, this long run cost is known as the Resource Budgeting and Accounting charge (RAB charge). For example, a subsidy ratio (RAB charge) of 30% means that for every £1 the government lends to a student, the government subsidy is 30p. A negative subsidy ratio is possible when the government makes a profit on the loans.

We are not only interested in the average government subsidy, but also how this subsidy is distributed across graduates. In our results we therefore show both the mean RAB charge, and the RAB charge at each decile of the lifetime income distribution of graduates.

Fig. 1 illustrates the government loan subsidy (RAB charge) on the vertical axis against the decile of lifetime income on the horizontal axis for the current English system. On the far right we show the average subsidy in England across the entire population of graduates, which is 47%, nearly half of the loan value. An important feature of the English system is that a very high share - more than 80% - of graduates are not expected to have cleared their debt (including accumulated interest) in full by the end of the repayment period.

There are constraints in presenting results in this way, since two individuals with the same lifetime income can have different subsidies. This is predominantly because income can transition above and below the repayment threshold. As an example, an individual with income just below the threshold for their entire lifetime can have a 100% subsidy, while someone with the same lifetime earnings, but with income just over the threshold for 30 years and under the threshold for the remainder of their lifetime, will repay a larger fraction of their debt and receive a smaller subsidy. As a consequence, the size of the subsidy corresponding with a particular level of lifetime income is not a single value, but instead follows a distribution.[13] For clarity of exposition we collapse this distribution and throughout the remainder of this paper only present the mean subsidy ratio at each decile. We calculate the mean subsidy for each decile and then connect those points to create a smooth line.

In Fig. 1 the loan parameters and loan size correspond to the cohort of students that started university in the Autumn of 2017 under the English ICL system. We take this as our baseline, and starting from this baseline we change the debt size and loan parameters and show how this affects the mean and distribution of the loan subsidy.

As seen in Eq. (5), ICL costs depend on d, the discount rate applied to future loan repayments. Currently, in England, the real discount rate assumption is 0.7%. This assumption is used when generating Fig. 1 and is maintained throughout the paper. If we use a higher real discount rate, future repayments would be worth less in present value terms and the subsidy would be higher. Changing the discount rate to 2.2% - used by the English government before 2016 - increases the subsidy from 47% to 61%, illustrating the sensitivity of cost estimates to this figure.

In addition to the government discount rate, assumptions are required for the real growth in earnings. In England, real earnings growth in the long run is projected to be 1.3%[14] and we maintain this assumption throughout. If real earnings growth was instead zero per cent the loan subsidy would be 53%, while it would be 39% with 3% long run real earnings growth.

3.3. A dynamic vs. a static model

As described above, we use a dynamic model of earnings for our estimation rather than a static model, such as that used in Nascimento (2016), Doris and Chapman (2016) and Cai, Chapman, and Wang (2016). In a static earnings model, individual earnings and employment dynamics are not incorporated, and individual debtors are assumed to stay in the same percentile of earnings over the projection period, rather than transitioning between labour force states and earnings percentiles. As demonstrated by Higgins and Sinning (2013) and Dearden (2017), ignoring these dynamics will generally lead to overestimates of aggregate debt and subsidies.

We investigate this within our context in Fig. 2, which shows the distribution of the government subsidy under the dynamic and static models. Consistent with the previous literature, we find the static model overestimates the government subsidy, in this case by seven percentage points. It dramatically overestimates the subsidy going to low earners, while underestimating that going to the highest earners. This highlights the value of the dynamic approach we have taken here.[15]

4. Results

In this section we present the results of the modelling, investigating the overall government subsidy and the distribution of that subsidy amongst graduates.[16]

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[12] As mentioned above, we assume income equals earnings due to limited data availability for investigating income.

[13] See Fig. A1 in the Appendix for a graphical exposition of the distribution of RAB charges within income decile.

[14] This figure is based on the estimates of the Office for Budget Responsibility in their January 2017 Fiscal sustainability report.

[15] A constraint is that this modelling approach requires high quality panel data. While this is feasible for the UK and Australia, it will not be in many countries. Dearden (2017) provides a discussion of the empirical methods available for modelling and costing ICLs, including arguments for incorporating individual earnings variability in model development, and also options for dynamic modelling when limited panel data is available. Research is ongoing to explore the feasibility of combining models of earnings dynamics derived from panel data to countries with cross-sectional data only.

[16] It is important to note that our analysis excludes those who may have accrued a debt but who did not graduate. As such, the results presented are limited to graduates only rather than all debtors.

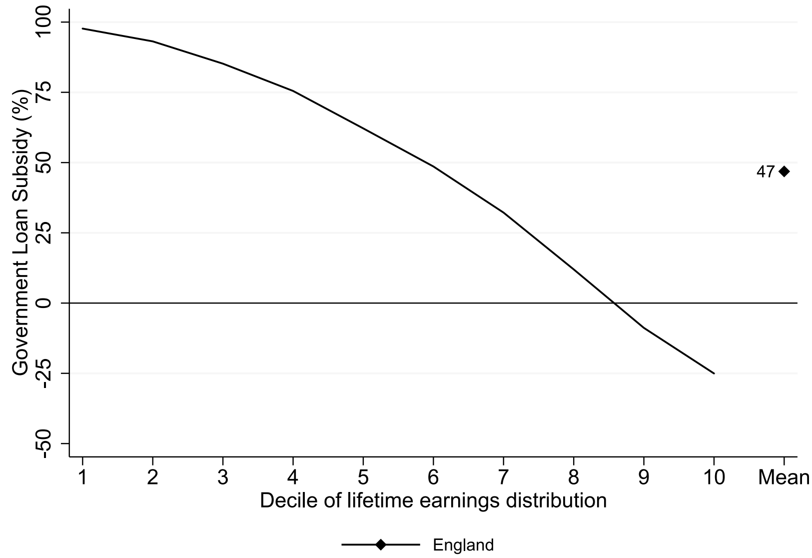

Fig. 1. RAB charge across the income distribution in England.

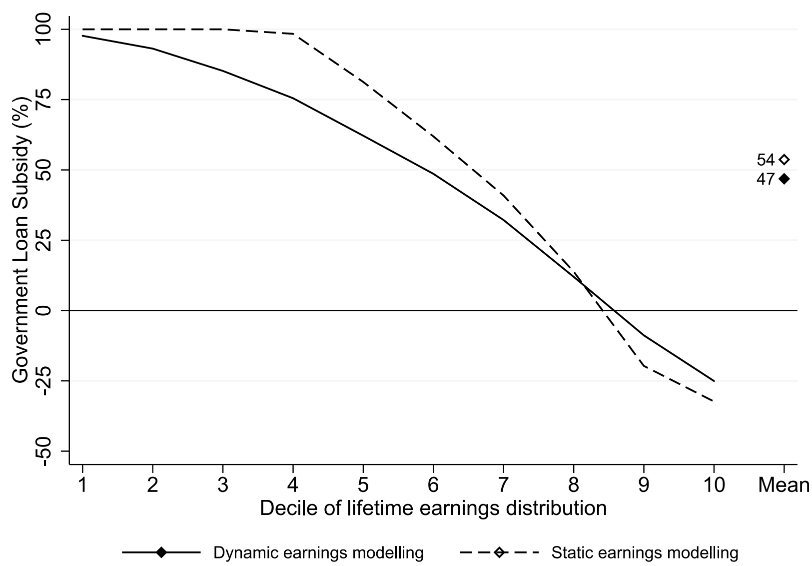

Fig. 2. RAB charge using static income modelling.

For Sections 4.1–4.3, we present results for loan interest, write-off, and repayment thresholds and rates. In each of these sections, we illustrate the importance of taking into account the debt level by showing the results for two scenarios: a high debt case and a low debt case. Rather than debt alone, it is the debt to income ratio that determines how long it may take to repay the loan. We define the "high debt case" as that based on projected English graduate incomes and debt levels, and we define the "low debt case" as 0.4 times the English debt level. This level is used so that the resulting English loan to income ratio approximately matches the Australian loan to income ratio.[17] While in the current English "high debt case" around 80% of graduates are not expected to clear their debt in full during the repayment period, under the "low debt case" only around 50% of individuals would be expected to have part of their debt written off after 30 years.

For Section 4.4, we investigate how minor changes to the variability of graduate earnings can affect subsidies.

4.1. Loan interest

If interest is charged on outstanding loans at a rate below the government cost of borrowing, this leads to an interest rate subsidy. This is the case in Australia where debt amounts are indexed to changes in the Consumer Price Index (CPI), and in New Zealand, where zero nominal interest is charged for debtors who remain in the country.

The level of subsidies associated with loan interest depends on the spread between the interest rate charged to graduates and the government discount rate, which is often based on the government's long-

[17] Based on a English loan size of around £55,000 (in 2017 prices), the English loan to graduate income ratio is approximately 1.7 for graduates with median earnings between the ages of 25 and 40, whereas the Australian loan to median income ratio (based on a loan size of approximately A$32,000) is 0.7. This implies that if the English debt amount is multiplied by 0.4, reducing the amount to approximately £22,000, this would reduce the English loan to income ratio to a level broadly comparable with the Australian loan to income ratio. Note that these calculations take into account full-time and part-time earnings as well as differences in the age and gender-specific employment rates

(*footnote continued*)
in the two countries and are averaged across males and females.

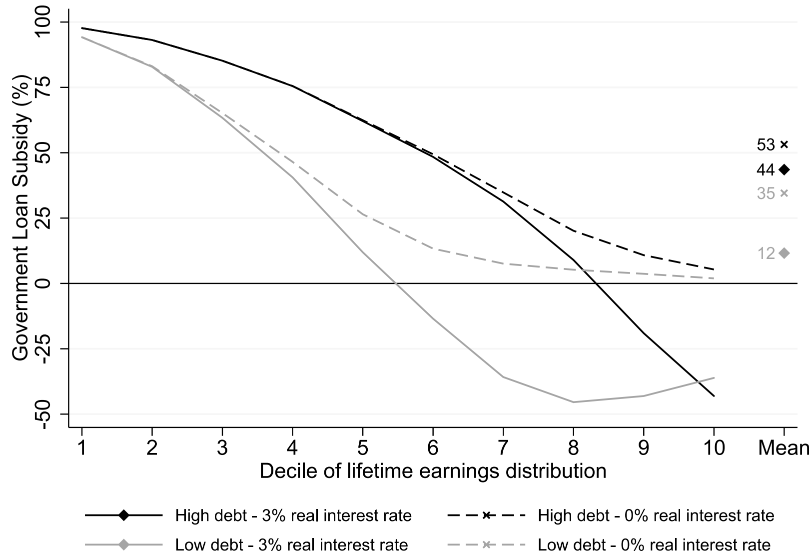

Fig. 3. RAB charge under different interest rates.

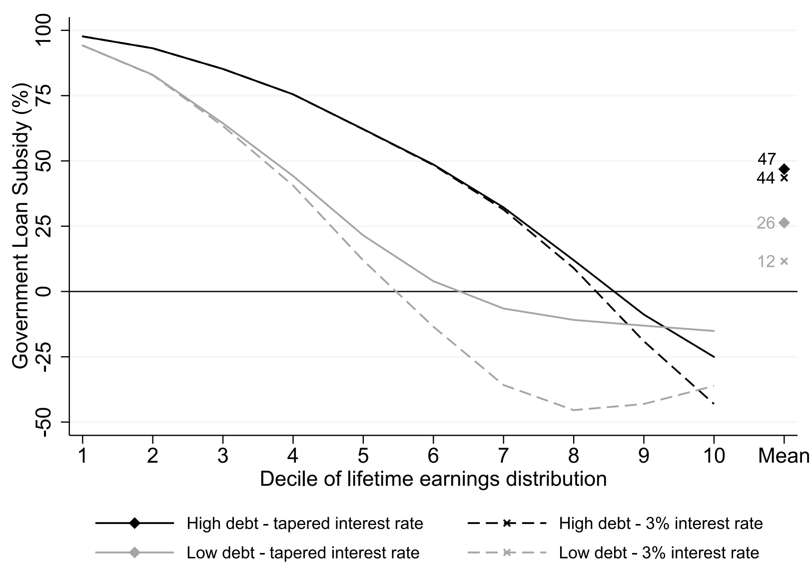

Fig. 4. RAB charge for a flat interest rate of 3% and England tapered interest rate.

term cost of borrowing.

In Fig. 3 the subsidies are given for two different loan interest levels and for the high debt and low debt cases. The loan interest levels shown are a 3% real interest rate, which equals the English rate for persons earning over £45,000 per annum (and is also comparable to the loan interest rate in the United States), and a 0% real interest rate like that used in Australia. Following English government policy, in all cases a real discount rate of 0.7% is assumed.

The interest rates used in these examples are assumed to apply to all debt, regardless of graduate incomes (unlike the current English system, where interest rates are linked to income). A real 3% interest rate should imply a "profit" for taxpayers, since this rate exceeds the government discount rate of 0.7%.[18] However, this is dependent on a reasonable share of graduates repaying their debt in full. If the level of debt is high relative to income so that some or all of debt is not repaid, then the cost of unpaid debt may exceed the profit derived from high loan interest. This is seen in Fig. 3, where subsidies are positive for more than 80% of graduates when debt is at the high English level. In contrast, when debt levels are commensurate with Australia, the high real interest rate results in positive government subsidies for only around 55% of graduates.

In both of the positive real interest rate cases, higher earning individuals cross-subsidize the loans of those with low lifetime earnings. In the low debt case, the cross-subsidy from higher earning graduates nearly compensates for the loss from lower earning graduates and results in an overall subsidy of 12% of the total loan value. However, the subsidy curve follows a U shape implying that graduates in the seventh to ninth earnings deciles repay more than those in the highest decile. This is because debt is sufficiently low that the vast majority of these

[18] Note that ICLs that incur a long-run negative subsidy for graduates are not necessarily unattractive to borrowers. An ICL provides a source of funding for higher education that may not otherwise be available to the student, and affordable repayments even in the event of income shocks, allowing consumption smoothing. However, there is an risk that if real interest charged was very excessive, wealthy students may choose to opt out, which would reduce the level of cross-subsidisation and may increase the aggregate subsidy.

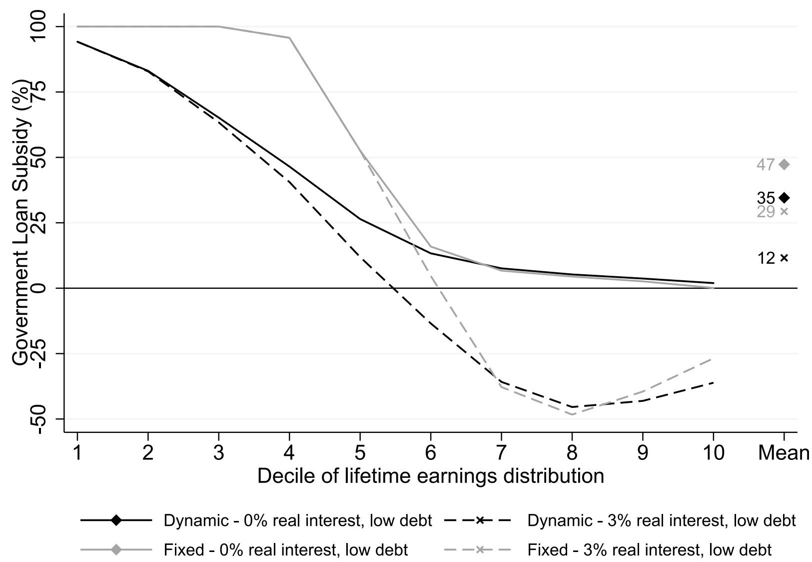

Fig. 5. RAB charge with dynamic and fixed earnings under different interest rates (low debt case).

individuals clear in full, but the lower earning individuals repay more slowly and therefore incur the positive real interest rate for longer. In the high debt case, the overpayments from high-earners do not come close to compensating for the losses on lower earners and the overall taxpayer subsidy is 44%. However, the U shape is replaced by a monotonically decreasing relationship between the government subsidy and earnings. This is because it is only the very highest earners who are able to clear their debt in full.

Under the 0% real interest rate, there is no cross subsidisation and consequently the overall government subsidies are much higher. Due to the discount rate applied to future repayments being higher than the interest rate, losses are incurred even on the highest earning graduates. Although the U shaped relationship does not exist, the relationship between the subsidy and graduate earnings is much flatter, with the subsidy for seventh decile earners nearly equal to the subsidy for the very highest earners in the low debt case. Barr (2012) comments that 0% real indexation results in poorly targeted subsidies, and the funds should instead be used more efficiently rather than benefiting high earning graduates who are highly likely to attend HE even in the absence of concessional loan interest.

In Fig. 4 we investigate the impact of moving from a flat positive real interest rate similar to the one used in the US to the tapered rate in the English system,[19] where the real interest rate charged on the loan depends on income. The intention of the tapered rate was to ensure that a smaller fraction of the subsidy went to high earnings graduates. However, we show that the impact on the shape of the subsidy distribution of the tapered interest rate between 0 and 3% relative to a flat 3% rate depends crucially on the debt to income ratio. In the low debt case, we do indeed see that the tapered interest rate prevents the U shaped relationship between subsidy and income decile that we observed in Fig. 5. However, in the high debt case the tapered interest rate actually results in a larger portion of the subsidy going to high earning graduates as it only reduces repayments for the highest earning graduates. The explanation for this observation is that in the high debt scenario, lower earners do not get close to clearing their debt so are unaffected by the interest rates. The higher earners benefit in the periods when they are earning below the upper interest rate threshold of £45,000.

The investigation of the U shapes of positive real interest rates is important, and many have argued that alternative approaches such as a loan surcharge should be used instead to avoid this feature (Barr et al., 2018).[20] We have shown here that the U shape is very dependent on the size of debt. In Fig. 5 we also show that it is affected by the choice of modelling. For a static model of the nature discussed in Section 3, we see that there is more curvature of the subsidy curve (meaning the loan design is more regressive amongst high earning graduates) for the static model than for the dynamic model. The static model also drastically underestimates the share of graduates affected by interest rates compared to the dynamic model. This shows that using a static model can affect not just the overall subsidy, but also conclusions about the impact of the different loan parameters. This is an important consideration for countries without sufficient panel data for modelling dynamic earnings.

4.2. Loan write-off

We now consider the point at which loans are written off by government. In England, loans are written off after 30 years, while in Australia and New Zealand they are written off at death. Fig. 6 shows the impact of write-off at death versus loan write-off at 30 years under the high and low debt cases.[21] We also show the impact of a shorter 20

[19] A tapered interest rate was also feature of the New Zealand student loan system between 1992 and 2000. The interest rate charged was equal to 1% above the government cost of borrowing, but for those graduates with income so low that repayments would cover less than the interest on the loan, the loan was kept at constant value in real terms. Chapman and Higgins (2014) raised a similar criticism to recent Australian government plans to introduce a real loan interest rate, and proposed a tapered interest rate to address the circumstances when interest charged exceeds compulsory repayments. Changes to loan indexation arrangements were rejected by the Australian Senate and the current 0% real indexation arrangements continue to apply.

[20] As an alternative to a real interest rate, Australia applies loan surcharges for some students. Under a loan surcharge of 20%, for example, if a student borrows A$100 they would be required to repay A$120, regardless of the speed at which they repay. This removes the possibility of a U shaped subsidy curve.

[21] We have made some simplifying assumptions about pension contributions and incomes for this section for estimating income for those aged over 60. We assume a retirement age of 70 for our cohort (born in 1998). During the individual's working life a contribution of 8% of earnings towards a private pension is made (in line with what will be the mandated total contribution over qualifying earnings under automatic pension enrolment in England). A real return of 5% on the accumulated pension pot is achieved each year. Upon retirement an individual will get 1/20th of their pension pot each year and in addition will receive the current English state pension of £8092 which we assume will be kept constant in real terms.

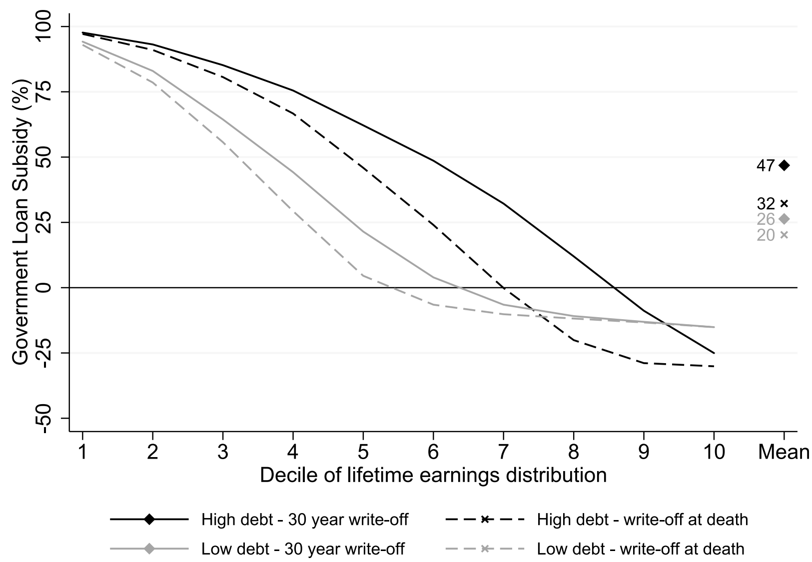

Fig. 6. RAB charges when debt is written off after 30 years and on death.

year write-off period in Fig. A2 in the Appendix. This is similar to the debt write-off in the US system, but excluding the treatment of outstanding debt as taxable income.

The figure shows that the debt write-off period is more important when debt is high, as in that case the majority of graduates do not pay off their student loan in full. Increasing the number of repayment years so that debt is only forgiven on death has most impact on reducing subsidies for those in the middle of the lifetime earnings distribution. This is an important finding in the English policy context; although there was concern that extending the write-off period would only affect those with very low lifetime earnings, this shows that it is middle earning graduates that are most affected, with very limited impact on the lowest earners (who are below the threshold in retirement) and the highest earners (who clear their debts in less than 30 years). This has a dramatic impact, nearly reducing the overall loan subsidy by half.

In the low debt case, it is indeed only those in the bottom half of the earnings distribution who are affected, as most graduates in the top half of the distribution clear their debt within 30 years. Consequently the percentage point impact on the overall loan subsidy is much more limited.

Fig. A5 in the Appendix displays the differences not in terms of government subsidies, but rather from the perspective of graduates by reporting repayments as a percentage of lifetime earnings.[22] It is clearly seen that extending the repayment period beyond 30 years leads to a dramatic increase in repayments (and commensurate reduction in taxpayer costs) in the high debt case, whereas extra repayments are low and restricted to a small proportion of the population in the low debt case.

4.3. *Threshold and repayment rate*

In the section we consider the repayment threshold - the income at which graduates start making repayments - and the repayment rate - the share of marginal income above the threshold that they have to repay. These are core parameters of all ICL designs, and it is therefore important to understand their impacts under different scenarios. We investigate the impact of these parameters separately, under high and low debt scenarios. We also consider the Australian system where graduates repay a share of their total rather than marginal income above the threshold.

In Fig. 7 we plot the subsidies under the current English threshold of £25,000, and also under a threshold of £17,000[23] - similar to the current threshold in the US - to illustrate the impact that lowering the threshold can have on costs. In these examples the repayment rate is 9%. In Fig. 8 we retain the English threshold of £25,000 and apply the English repayment rate of 9% and the New Zealand rate of 12% for comparison.

As can be seen in these figures, the effect of lowering the threshold is broadly similar to the effect of increasing the repayment rate, with the difference being that threshold reductions will have a greater effect on lowering subsidies than a higher repayment rate for graduates with the lowest lifetime earnings. When the threshold is lowered, graduates whose annual earnings fall between the previous threshold and new threshold would now make repayments. Since the repayment rate is charged on marginal earnings, a lower threshold increases both the number of graduates repaying but also all graduates who exceed the threshold would pay a larger portion of their total income than previously. In contrast, if the threshold is kept constant but the repayment rate is increased, no new graduates will repay. Instead, those graduates who previously repaid will repay greater amounts.

If debt is high relative to income, and most graduates do not pay off their loan in full, graduates in the middle of the income distribution are affected most. In the case of low debt relative to income, reducing the threshold or increasing the repayment rate has a very small impact on subsidies among graduates who already pay off their loan in full. The amount paid back each year increases, but this just leads to faster repayment while not increasing the total amount repaid. If the loan interest rate exceeds the government cost of borrowing, as it does in this example, higher loan repayment even implies marginally smaller negative subsidies for high earners (less “profit” for government) as a consequence of them paying off the loan faster and hence paying less compound interest. However, for lower lifetime earners who do not repay their loan in full, a lower threshold or higher repayment rate lead to larger loan repayments and therefore reduced subsidies.

Unlike England and New Zealand where the repayment rate is applied to marginal income above the threshold, in Australia once the minimum threshold is reached, the debtor pays a proportion of *total*

[22] For each of our results we show the representation using the percentile of lifetime earnings in the Appendix.

[23] Throughout the paper, we give values of the thresholds in 2017–18, but assume these will go up with earnings growth, as is the case in the UK. This means the threshold in place when the cohort entering university in 2017 will graduate will be higher.

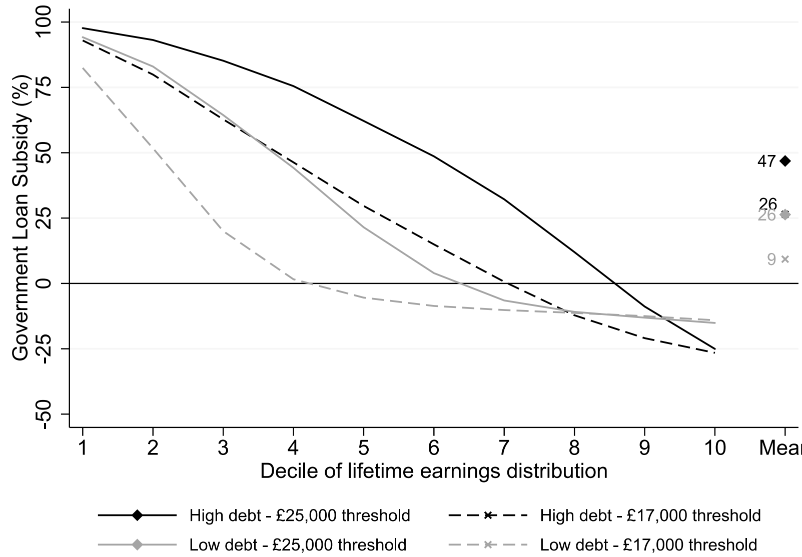

Fig. 7. RAB charges with threshold at £17,000 and £25,000.

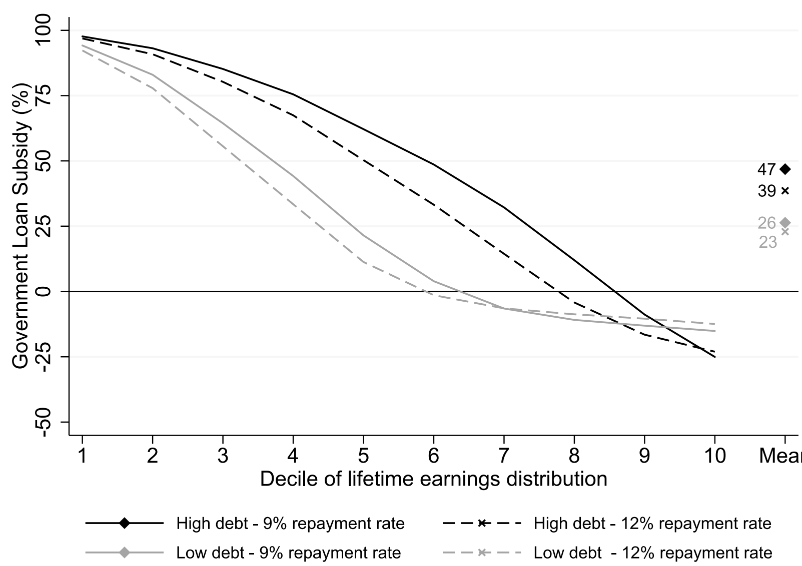

Fig. 8. RAB charges under 9% and 12% repayment rates.

earnings. The Australian system results in a "cliff-edge" in repayments at the first threshold, at which point an earnings increase of A$1 means repayments immediately increase by A$2235. This cliff-edge in repayments is potentially distortionary, as a graduate earning just below the minimum threshold will be made worse off by earning slightly more, and hence may have an incentive to find deductions in order to shift their taxable income below the threshold. This effect also exists, albeit less strongly, at the higher thresholds where the percentage of income paid increases. Research has found evidence of bunching of reported income just below the thresholds (see Highfield & Warren, 2015), though the economic impact of this effect appears small and only lasts for short periods. Nevertheless, incentives for repayment avoidance could be expected to increase as average tuition fees and ICL debt levels rise.[24]

We consider whether the distribution of subsidies emerging from the Australian threshold and repayment system can be replicated with a marginal threshold system like that of England and New Zealand. We explore this possibility by starting with the English loan rules[25] and we apply Australian debt to income levels (by multiplying the English loan size by 0.4) and the Australian thresholds and repayment system. In this example we convert the Australian thresholds to pounds by using the exchange rate (approximately 0.55) and a cost of living adjustment (approximately 0.9), which results in a lower and upper threshold of approximately £28,000 and £51,000 respectively in 2017–18. In order to replicate the subsidy outcomes from this arrangement with a less distortionary marginal repayment system, we apply a threshold of £20,000 and a repayment rate of 9%.

The solid line in Fig. 9 shows the results with the Australian

[24] Note that recently legislated reductions in the Australian minimum threshold to $51,957 with a 2% repayment rate from 2018–19 will reduce this potential distortion somewhat, since minimum annual repayments will fall to $1039.

[25] We use the English loan write-off, but use a flat 3% rather than the English tapered 0–3% interest rate, in order to remove any impact of interactions of the interest rate threshold with the multiple Australian loan thresholds.

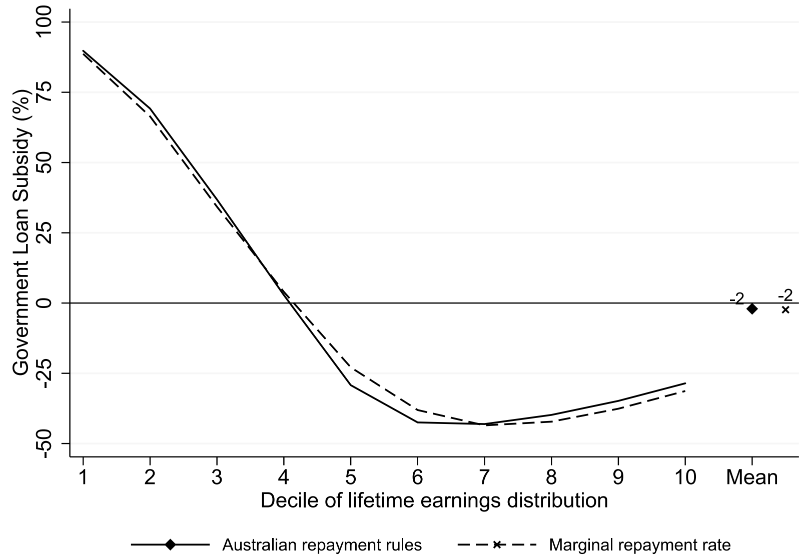

Fig. 9. Australian repayment system compared with marginal repayment system with similar mean subsidy outcomes.

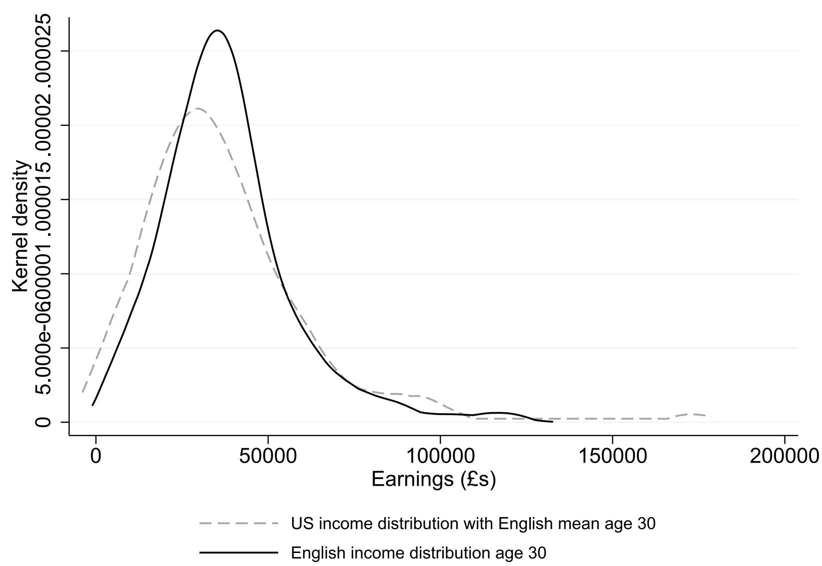

Fig. 10. English and adjusted-US cross-sectional income distribution age 30.

repayment thresholds (adjusted to UK currency and prices). The dashed line shows that by setting the threshold at an appropriate level (£20,000 in this example), we can replicate a broadly similar distribution of average subsidies as a non-distortionary system where individuals repay a percentage of income above the threshold. The figure also shows that the aggregate subsidy under the two repayment systems is almost identical.

Although the mean subsidy is similar, this masks differences in the distribution of subsidies within each decile of lifetime earnings. Fig. A9 in the Appendix displays the same results as Fig. 9, but also includes the 10th and 90th percentile of subsidies at each earnings decile. The figure shows that for the bottom half of lifetime earnings, the spread of subsidies at each decile is wider under the Australian system than a comparable marginal system.

The key consequence of moving to a marginal repayment system is that the lower repayment threshold would lead to repayments from a portion of the population that previously did not repay. Under the Australian repayment system applied to the English context as above, where the initial threshold is set at £28,000 (when adjusted to UK currency and prices),[26] 10% of debtors will not repay any of their debt compared to 3% under the comparable marginal system where the initial threshold is set at £20,000. A 100% subsidy can arise even with moderate lifetime earnings if the individual earns just below the minimum threshold consistently over their lifetime. This is particularly notable under the Australian repayment system where the initial threshold is set high relative to the threshold under the comparable marginal repayment system considered here.

The potential economic savings may not currently be high enough to justify the bureaucratic time and costs of making such a change to the Australian repayment structure, particularly in light of recent reductions to the first threshold and corresponding repayment rate. There would also likely be political resistance to extending repayment obligations, albeit small, to lower earners. Nevertheless, this exercise demonstrates that comparable aggregate government costs can be

[26] Converting into pounds at the current exchange rate gives a threshold of approximately £31,000. Further adjusting for the different price level in Australia gives the £28,000 threshold.

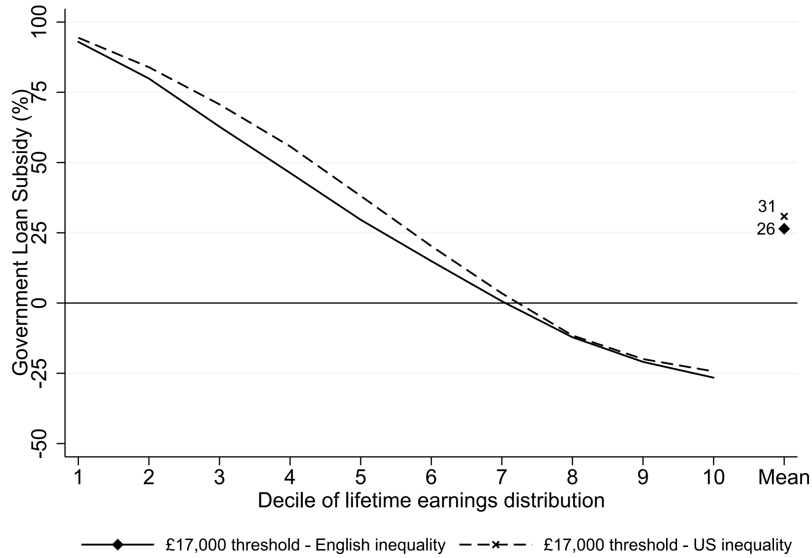

Fig. 11. RAB charge under low and high cross-sectional graduate earnings variability.

achieved by introducing a threshold and repayment system with marginal repayments.

4.4. Earnings variability across graduates

Another potentially important factor in determining the overall cost and the distribution of student loan subsidies is the variation in income across graduates. In this section we compare the distribution of the loan subsidy for English graduates with a counterfactual case where variation in the cross-sectional earnings distribution at each age replicates the degree of earnings variation across US graduates. This comparison is particularly relevant as the US has some of the highest earnings inequality amongst advanced economies, and is also considering expansion of its ICL system.[27]

We model US graduate earnings using the 2015 US Current Population Survey. In order to isolate the effect of the change in income distribution from the change in mean income between the two countries, we then scale the resulting US graduate earnings profiles so that at each age the mean of non-zero earnings is the same as that of UK graduates at the same age. This generates an earnings distribution with the same average income as in the UK, but preserves the US cross-sectional variation. Fig. 10 displays the resulting cross-sectional income distribution at age 30 under the English graduate distribution and under the adjusted-US distribution. Despite having the same average earnings, the US distribution displays greater variation compared to the English income distribution.

Fig. 11 shows the impact this change in the graduate income distribution has on the cost to the government, using the approximate current US threshold (converted to pounds) of £17,000. Increasing income variation from English to US levels increases the government subsidy from 26% to 31%. The extra cost under the higher variation is predominantly because the lower half of the US earnings distribution earns less relative to the English distribution.

It should be noted that the subsidy increases by 5ppts despite the relatively minor change in the variability in graduate earnings (the English and US cross sectional distributions are not markedly different). This may seem like a small number, but it can translate into a large amount in money; in England in 2017, for example, increasing the loan subsidy by 5ppts adds nearly £1 billion per cohort to the long run cost of the ICL. For countries with very high earnings variability among graduates - or indeed, countries with very large informal sectors - these differences would potentially be considerably more stark. The key message from this exercise is that when selecting the loan repayment parameters for an ICL, it is important to take into account the distribution of graduate earnings rather than just the mean or median.

4.5. Summary of results

Table 2 provides a summary of our findings from the previous sections. It summarizes the changes in the subsidies as a consequence of modifications to the interest rate, length of repayment period, repayment rates and threshold, and graduate earnings variability, as reported in Sections 4.1–4.4. We include discussion of results both for the high and low debt cases in the table.

5. Conclusion

While descriptive international comparisons of student loans systems exist (see, for example, Chapman, 2006; Shen and Ziderman, 2009), there is scant discussion of how loan size, earnings variability, and specific ICL rules affect ICL costs and the distribution of costs among cohorts of borrowers.

In this paper we have demonstrated that even in developed countries with similar institutions, the magnitude and distribution of ICL taxpayer costs among graduates can vary significantly when loan sizes differ. In particular, loan size (specifically, the ratio of loan size to average income) can alter conclusions regarding how subsidies are distributed among graduates with low, medium and high lifetime incomes under different assumptions pertaining to loan interest, thresholds and repayment rates, and debt write-off. We have further shown how costs can vary for two populations with the same average income, if faced with different levels of earnings variability.

Understanding the impact of ICL parameters on the distribution of ICL costs among graduates is of considerable policy interest, in particular as some countries now considering ICL have different institutional and economic environments than countries in which income contingent loans have been established for many years, such as England and Australia. A clear extension of this work would be to incorporate and compare other existing ICL schemes (e.g., Hungary and Korea), and also utilise graduate lifetime income projections for countries with variants

[27] The findings here have wider relevance. For example, repayment thresholds in England and Australia are increased annually at the rate of increase of average earnings. However, if the distribution of that average earnings growth is not constant throughout the distribution, subsidies can change over time.

Table 2
Summary of results.

ICL parameter	Description of effect on subsidies
Interest rate below government discount rate	If the interest rate is less than the government discount rate, there is no cross-subsidization between high and lower earnings graduates, and overall subsidies will be higher than if a real interest rate applies. For both high debt and low debt scenarios, interest rate subsidies will be positive for all debtors, including those with the highest earnings.
Flat positive interest rate above government discount rate	Costs depend on whether a graduate repays in full. High earning graduates who repay in full cross-subsidize those with lower lifetime earnings. High debt can lead to a large proportion of graduates not repaying in full. In these cases, the cost of unpaid debt may exceed profit from high loan interest, resulting in positive subsidies for a high proportion of graduates, and a high mean subsidy (mean RAB) overall. Low debt conversely can lead to a greater proportion repaying in full. If a graduate repays in full this results in negative subsidies. For graduates who repay in full, the profits to government are greater for those who repay slowly rather than quickly because slow repayers incur the real interest rate for longer.This results in a U shaped relationship between subsidy and income decile.
Tapered interest rate	A tapered interest rate, where the rate depends on income, applies in the English system. Compared to e.g. a flat 3% rate, a tapered rate of 0–3% reduces the accumulated loan size and thus reduces required repayments. For lower earners who do not repay their debt in full, a tapered rate has minimal effect on subsidies. For graduates who repay their debt in full, a tapered rate can lead to an increase in subsidies. For high debt, the majority of graduates do not repay their debt in full and so subsidies are unaffected. Subsidies increase only for graduates with the highest lifetime earnings who benefit from the taper during periods when their incomes are below the taper threshold. For low debt, a greater proportion of graduates repay in full, and the tapered interest rate prevents the U shaped curve that is observed with a flat 3% interest rate.
Repayment period increase	For high debt, the majority of graduates do not repay their debt in full, and extending the number of repayment years can lead to large a reduction in the overall subsidy. The greatest subsidy reduction is for graduates in the middle of the lifetime earnings distribution. For low debt, higher earning graduates repay quickly, and so extending the years of repayment predominantly increases subsidies for the bottom half of the lifetime earnings distribution.
Threshold decrease	Lowering the threshold increases the number of graduates who will make repayments, and if the repayment rate is charged on marginal earnings (as in England and New Zealand), all graduates who exceed the threshold will pay a greater portion of their total income. For high debt, the vast majority of graduates would experience a drop in subsidies, but the largest drop is in the middle of the income distribution. For low debt, there is only a small impact on subsidies for the top half of the earnings distribution who already pay their debt in full, but there is a large reduction in subsidies for graduates in the lower half of the lifetime earnings distribution.
Repayment rate increase	Increasing the repayment rate will not increase the number of graduates who repay, but will increase the portion of income repaid for those graduates who previously repaid. The effect of a repayment rate increase on the shape of the subsidy distribution is broadly similar to that of a threshold decrease for both high and low debt, however, higher repayment rates will have less effect on lowering subsidies for graduates with the lowest lifetime earnings.
Earnings variability increase	Relatively small increases in graduate earnings variability can result in an economically material increase in subsidies.

of ICL schemes (such as the United States), or for countries contemplating ICL adoption. Future research along these lines would assist policy makers to better understand the implications of ICL design choices. A further extension of this work would be to include all debtors, rather than just graduates, so as to produce a clearer picture of the distribution of subsidies.

It is clear from this research that policy makers should not just consider current loan amounts and graduate earnings distributions, but should be mindful that increases to loan sizes (be it through converting maintenance loans to ICL, or through passing a greater share of the costs of higher education directly to students) can potentially have unintended and adverse consequences to both the magnitude of ICL costs and the distribution of these costs among graduates.

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Appendix A

Table A1
Australian repayment rates and thresholds for 2017–18.

Repayment rate (%)	Threshold (A$)
4	55,874
4.5	62,239
5	68,603
5.5	72,208
6	77,619
6.5	84,063
7	88,487
7.5	97,378
8	103,766

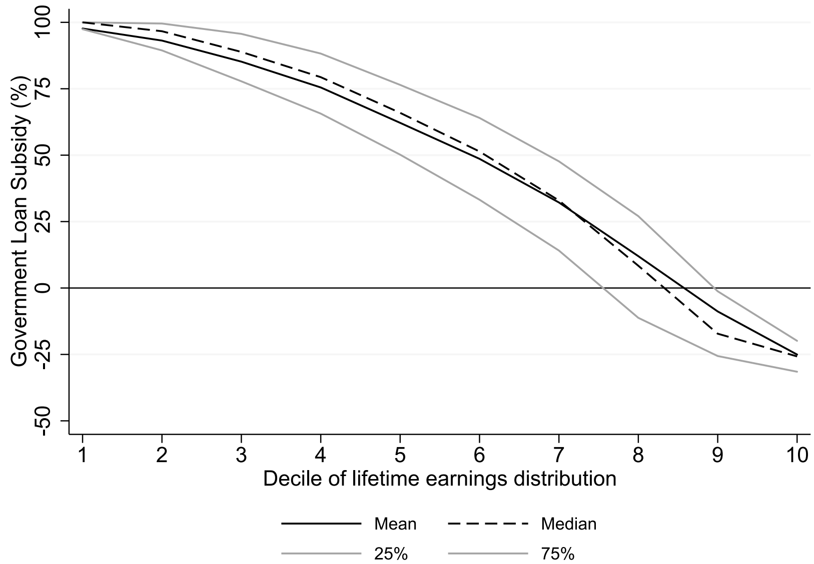

Fig. A1. Distribution of ICL subsidies within deciles of lifetime income.

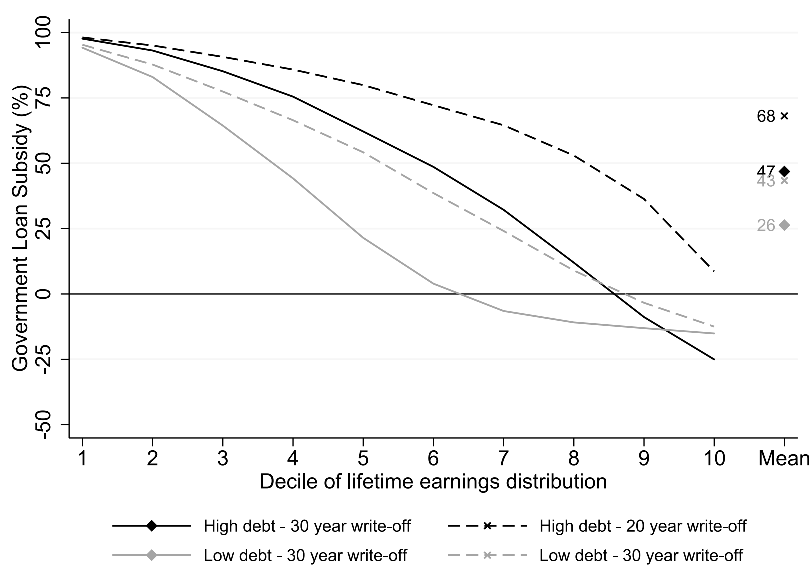

Fig. A2. RAB charges when debt is written off after 20 years and after 30 years.

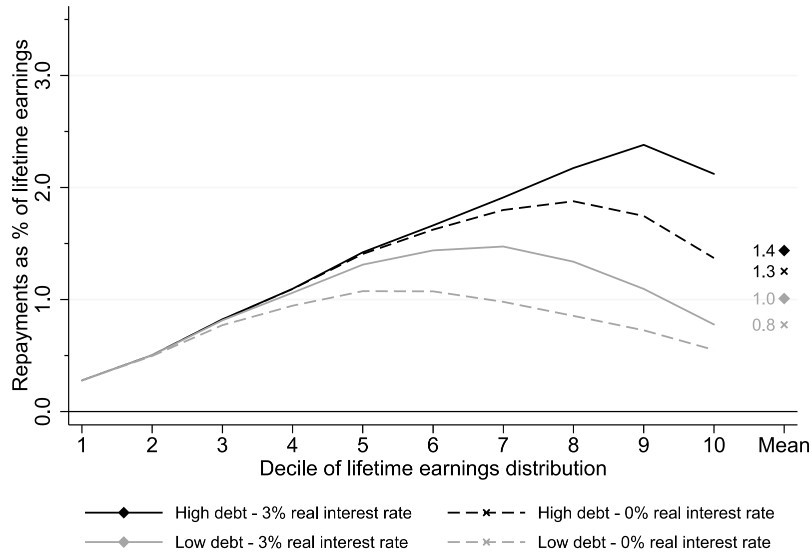

Fig. A3. Graduate repayments under different interest rates.

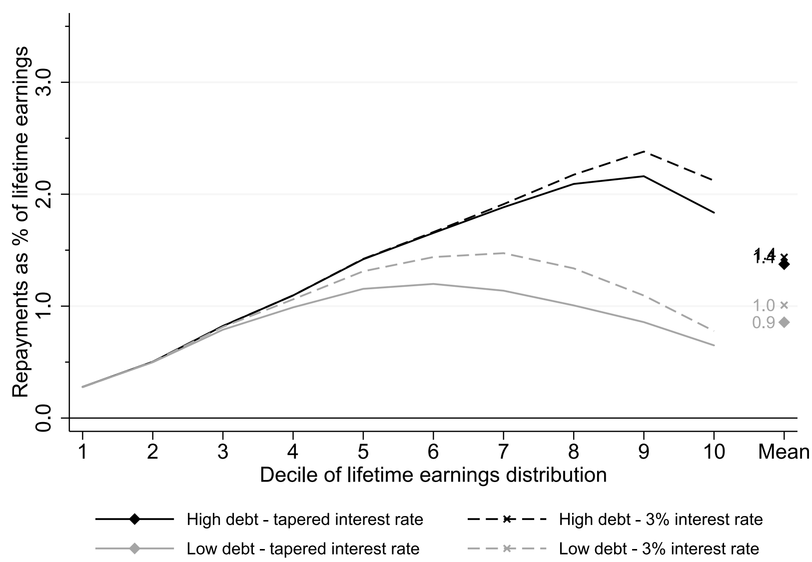

Fig. A4. Graduate repayments under the English tapered interest rate system.

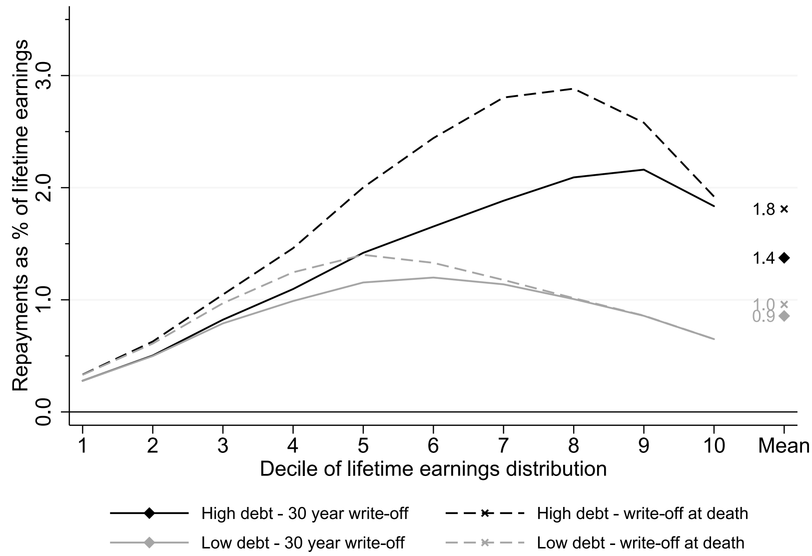

Fig. A5. Graduate repayments when debt is written off after 30 years and on death.

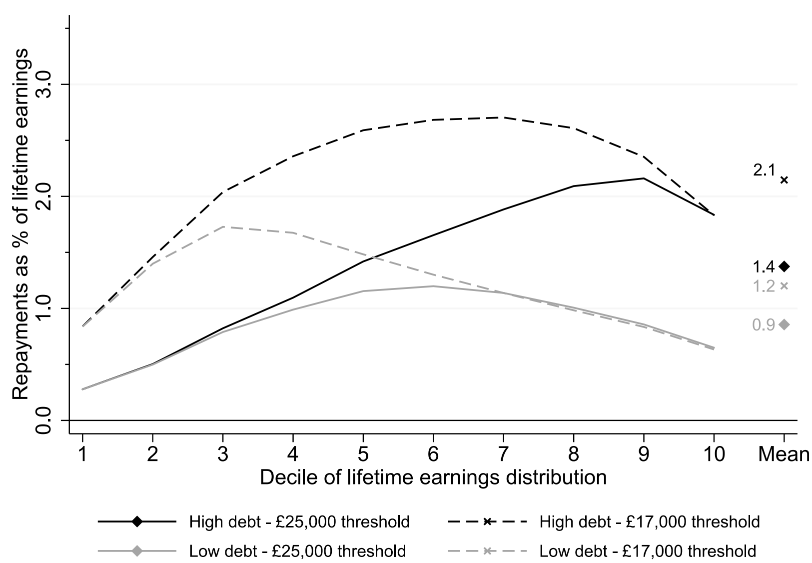

Fig. A6. Graduate repayments with threshold at £15,000 and £21,000.

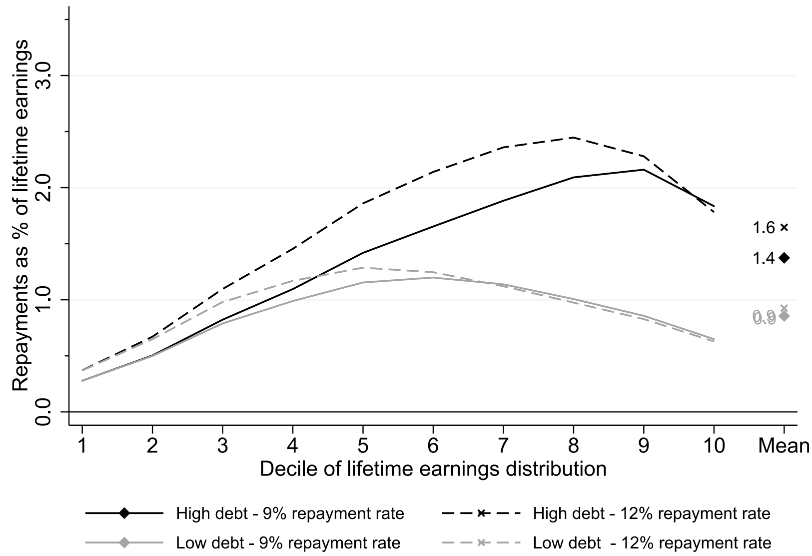

Fig. A7. Graduate repayments under 9% and 12% repayment rates.

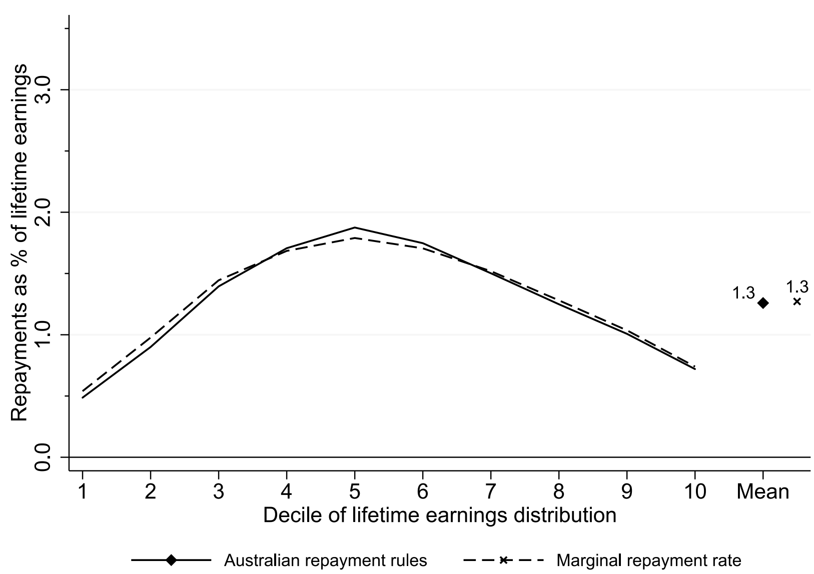

Fig. A8. Graduate repayments under Australian repayment system and marginal repayment system with similar mean subsidy.

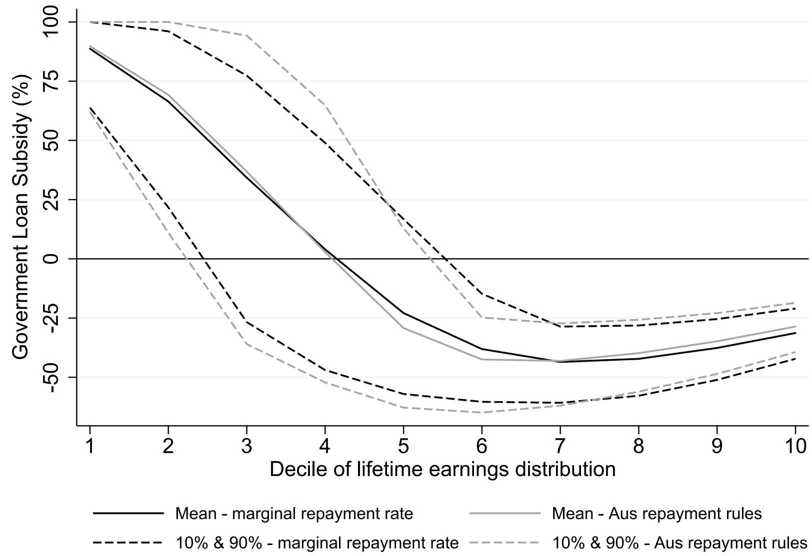

Fig. A9. Australian repayment system compared with marginal repayment system. 10th and 90th subsidy percentiles included.

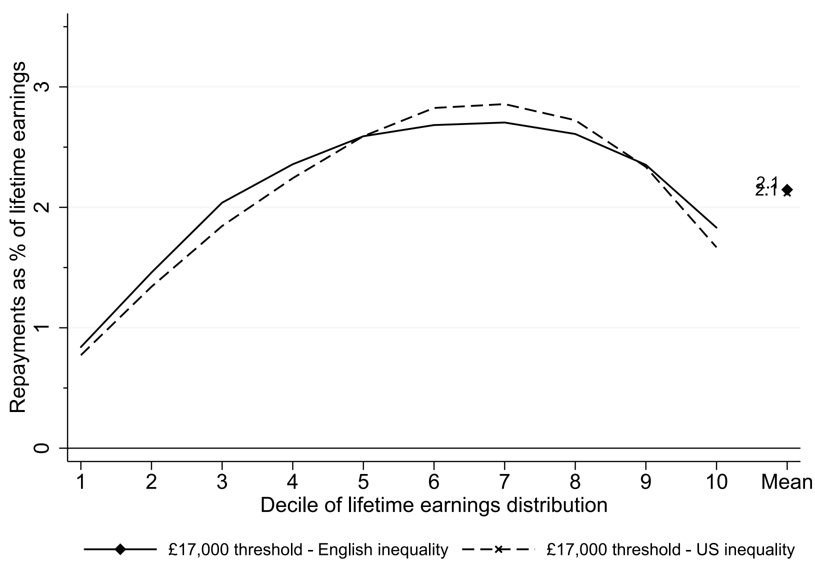

Fig. A10. Graduate repayments with US graduate earnings variability.

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