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Using Income Contingent Loans for the Financing of the Next Million Australian Solar Rooftops

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Using Income Contingent Loans for the Financing of the Next Million Australian Solar Rooftops+#

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Short description

The accessibility of solar energy by low income households is financially constrained. We demonstrate that income contingent loans can address this financing issue with little or no cost to government.

(30 words)

Abstract

Rooftop solar systems have two major benefits: a reduction of carbon emissions (a public good) and future energy bill savings for consumers. However, the availability of solar energy systems to low-income households is constrained by access to finance for the initial investment cost, an issue which could potentially be addressed with the use of income contingent loans (ICLs). By applying unconditional quantile econometric methods to HILDA income data we illustrate that for a $10,000 loan for home owners ICLs can be used with little or no cost to government to help finance the next one million solar energy devices.

(99 words)

Keywords: income contingent loans, solar energy

1 Background

Productive responses to climate change include the adoption of energy strategies that diminish reliance on fossil-fuel and increase the use of solar power systems. A critical aspect of such a reorientation involves the purchase by households of solar energy devices, which have the additional benefit of decreasing consumers' electricity bills. However, credit constrained low income households lack the financial capacity to purchase these devices and this can be argued to result in two problems: less use of solar power than is socially desirable, and adverse disposable income distribution outcomes because the lowest income households will be paying the highest prices for electricity.

A possible solution which could facilitate the installation of the next million panels in Australia is the topic of this paper. The policy under consideration involves the use of income contingent loans (ICLs)[1] which could be made available to low income households for the purchase of solar energy systems, an arrangement we refer to as the Solar Energy Contribution Scheme (SECS); the conceptual basis of ICLs is examined in Section 2 and what now follows provides background to the solar energy installation issue.

Currently in Australia there are around 1.3 million households[2] with solar photovoltaic (PV) systems, and a further 900,000 solar hot water heating[3] systems. At the end of 2013 this translates into there being 3.1 million Australians living in or working at a property with solar panels installed[4]. This represents a significant market penetration rate with well over 20 per cent of homes having solar installations[5], although it is also clear that there is considerable potential for additional take-up.

As electricity costs continue to rise, national electricity demand continues to fall, and over the past five years has decreased by around 9 per cent since its peak in mid-2008 (Pitt and Sherry, 2014). Electricity prices have risen in part due to the increase in electricity network investment required to cope with higher peak (as opposed to average) demand (Simshauser and Nelson, 2013).

The higher demand peaks have in part been driven by higher household energy use as caused, for example, by air conditioners operating at the hottest times of the day. Price rises have in turn led to customers installing solar PV systems to generate their own electricity behind the meter, as well as installing other energy saving devices, further decreasing the customer base and potentially leading to an "electricity death spiral" (Severance, 2011):

> "The unspoken fear of all utility managers is the 'Death Spiral Scenario'. In this nightmare, a utility commits to build new equipment. However, when electric rates are raised to pay for the new plant, the rate shock moves customers to cut their kWh use. The utility then raises its rates even higher—causing a further spiral as customers cut their use even more…In the final stages of that death spiral, the more affluent customers drastically cut purchases by implementing efficiency and on-site power, but the poorest customers have been unable to finance such measures …"

Even if such a dramatic situation is not realised, higher prices and declining demand exacerbate social disadvantage: those who can afford to do so install energy-saving devices, leaving those least able to afford it to bear the brunt of increased electricity prices to cope with the declining customer base. As a clarifying example we note that customers who can't afford air conditioners are paying the higher electricity prices caused by demand-peaking due to air conditioner use.

Equity issues also arise with the installation of rooftop PV systems. While it is currently the case that investment in rooftop PV is economic in almost every State when amortised over the lifetime of the system (some 15 - 20 years), it is nevertheless the case that up-front investment cost and lack of access to credit are limiting factors when it comes to making a decision to install, even though the household would reap an immediate benefit through lower electricity bills. This barrier to adoption can be thought of as a market failure, as it is often difficult for low-income families to obtain bank loans for solar energy systems (and they may be reluctant to take out bank loans even when they are available because of concerns with potential repayment hardship or even default).

A key outcome of SECS is to enable a significant section of the population to participate in access to renewable energy, and thereby enable them to contribute to the next one million Australian solar rooftops. This will further reduce Australia's greenhouse gas emissions – a positive spillover benefit representing a public good.

2 Income contingent loans in theory and practice

An ICL is a government risk management instrument in which citizens are provided financial assistance in the form of a loan, with the associated repayment of the assistance coming into effect if and only if the assisted individuals receive a given level of income. The best known example of an ICL is the Higher Education Contribution Scheme (HECS), in which the government effectively pays the tuition costs for students enrolling in Australian universities, with this loan being repaid only when the former student's annual income exceeds around $52,000 per year, with repayments being set at a given percentage of income and on a progressive scale[6].

The basic motivation for the use of these types of loans for policies such as SECS concerns the insurance aspects of ICL, which are all related to the fact that the loan is only repaid when borrowers have the financial capacity to do so; as a result, ICLs are able to deliver both consumption smoothing. Further, because no repayments are required when borrowers' incomes are low, an ICL ensures that compared to a "normal" loan, there is loan default protection (Chapman, 2006; Chapman, Higgins and Stiglitz, 2014).

Moreover, as well as consumption smoothing and default protection, Stiglitz (2014) and Dennis (2014) emphasise the transaction efficiencies of using the income tax system as a financial insurance system since the marginal collection costs of an ICL are extremely low. In this context Chapman (2006) reports that the average annual costs of the operation of HECS are less than 5 per cent of the annual revenue.

By now there have been myriad research applications of ICL to a host of disparate economic and social reform issues. It all began with respect to student loans for higher education, but over the last twenty years or so studies have gone way beyond this, and now include applications, *inter alia*, to policy reform including for: drought relief (Botterill and Chapman (2009); the payment of low level criminal fines (Chapman, Frieberg, Quiggin and Tait, 2006); housing relief for low income earners (Gans and King, 2006); R & D financing (Gupta and Withers, 2014); mature aged training living allowances (Chapman, Higgins and Taylor, 2009); paid parental leave (Higgins, 2010); extensions of unemployment insurance in the US (Stiglitz, 2014); and brain drain reparations (Clarke and Chapman, 2014). The conceptual and practical bases of ICL are examined in Chapman, Higgins and Stiglitz (2014).

One justification for developing this policy tool for solar energy installations - which is emphasized in the existing work on ICL - is that of distributional equity: the purchase of renewable energy devices provides access to future energy bill savings to poor people who otherwise would not be able to finance such a purchase. Thus SECS allows the provision of a private good which has the capacity to reduce energy costs in the future but would otherwise be unavailable to the poor. Government intervention in this area can be seen to be progressive policy reform.

There are potentially some important collateral benefits to the scheme. One example is with respect to the application of the policy to rural and regional areas, which are traditionally characterised by low incomes, with family farm income often being in this category. Expanded access to rooftop solar systems would reduce the need for additional network investment in regional areas to meet any increase in electricity demand, thereby putting downward pressure on the retail price of electricity in these areas.

3 Method

Our aim is the development of a modeling tool that will provide an analysis of the costs to the government of such a policy, motivated by the dual goals of social equity and of widespread installation of energy saving/energy generating devices such as solar PV systems for greenhouse gas reduction. The proposed scheme could equally be applied to solar water heating, “smart” meters and/or building management systems, which would also (in combination with solar PV systems) increase the likelihood of the reduction of greenhouse gas emissions.

There are several costs to the government associated with the SECS, the most obvious being that the government would need to provide up-front finances to allow the purchase. However, because a large proportion of the ICL would be repaid, the initial outlays would be offset by future loan reimbursements. Thus there are two aspects of the total subsidy:

(i) loan outlays that will never be repaid; and

(ii) the implicit interest rate subsidy on debts repaid, which results from the loan having a rate of interest which is lower than the cost of borrowing for the government.

What now follows reports the modeling of SECS for a subset of the potential future population of users: individuals and couples who either own their own home or are in the process of owning their own home with the use of a mortgage. Therefore the results with respect to the budgetary costs are not comprehensive.

The basic approach employed in the pilot study is the use of a cross sectional data set which identifies the relationships between age and income for males and females in the adult Australian population. With these data we are able to make forecasts of the likely stream of repayments of an ICL for a given level of debt and with respect to different policy parameters associated with the repayment obligations of the policy. Given an estimate of the time streams for incomes it is straightforward to calculate the amount and timing of debt payments, and from there compute the subsidies and thus the net cost of SECS to the Budget.

The simplest way to do this is to use the average age-earnings profiles by sex that are estimated through the ordinary least squares (OLS) earnings function. While this is straightforward, such an approach has the major disadvantage of estimating incomes only at the average. To take into account the distributions of income at different ages (and for each sex) we have extended the method to incorporate “unconditional quantile regression”, which allows measurement of impacts and repayments across a disaggregated range of incomes. This is important in terms of the accuracy of the results because income distributions are very broad by age and sex and are summarised quite poorly with the use of averages only.

With such an exercise there are a very significant number of possible scenarios that could be examined, so we have limited the calculations in what follows on the basis of assumed SECS policy parameters. These are illustrative only, the aim being to clarify the method and to offer some possible estimates of the net costs.

The scenarios explored in our illustration are defined by the following eligibility rules:

(i) individuals (both single and married) with incomes lying between $13,000 and $110,000 per annum[7] and who are not self-employed;

(ii) couples who live in households with total incomes not exceed $150,000 per annum; and

(iii) individual borrowers with an age range of 25 to 55 years.

Because incomes vary significantly by age we illustrate the expected streams of repayments for those qualifying for the loans for particular ages in years. That is, we assume that the men and women qualifying for assistance acquire the loans at age 25, 35, 45, and 55, and we offer calculations for each of these groups separately.

With respect to the actual loan policy we have assumed the following:

(i) The loan amount is set at $10,000, with no repayments being required for one year;

(ii) The loan is only available to individuals or couples who are not renters and who are not living with their parents;

(iii) Couples qualifying for assistance are both obligated to repay the debt from their individual incomes until repayments total $10,000 (or $12,500 – see below);

(iv) The income basis of repayment is wage and salary, and pension, income, but not social security receipts[8]; and

(v) The repayment parameters are as follows: a first income threshold of $20,000 per annum at which two per cent of income ($400 per annum) will be used to repay the debt. For every increase in annual incomes of $5,000 beyond $30,000 per annum the repayment rate will be increased by 0.5 per cent, meaning that the repayment rate will be 4 per cent of incomes at $50,000, which at this point is roughly the same as the repayment regimes for the tertiary education loan schemes, HECS-HELP and FEE-HELP.

For this study it is assumed also that the individual has no other income contingent debt liabilities.

Importantly, there are two effective interest rate regimes: we add a surcharge of 25 per cent to the loan obligation (which is the same as for the current FEE-HELP scheme), and we also model the system with no surcharge (which replicates the current HECS-HELP scheme).

We note that even with the payment of a surcharge, SECS could be very attractive to recipients of the loan because of expected future energy bill savings, as well as for the on-going interest rate subsidies implicit in the design of the scheme.

The method is as follows. The age-income profiles are estimated starting with the bottom 20 per cent of incomes (Q20) and ending with the top 20 per cent (Q80). As well we will examine the results for Q30, Q40, Q50, Q60, and Q70. The simplest function of the age-income profiles will be used with the log of annual income $Ln(Y_i)$ as the dependent variable, the equation taking the following simple form with respect to age for individual i:

$$Ln(Y_i) = b0 + b1*age_i + b2*age_i^2 + error_i$$

We run separate estimations for single males and females, and married males and females.

We compute total nominal repayment streams for the multitude of groups considered with respect to policy parameters explained, and then compute the total present value (TPV) of repayments using a 3 per cent per annum discount rate (similar to current CPI). These figures are then compared with the $10,000 initial outlay for the solar PV system paid for by the government to the subsidy associated with the implicit interest rate inherent in the schemes' design (subsidy (ii) above).

The TPV of the repayment calculations are given by:

$$\text{TPV repayment} = \frac{\text{Nominal repayment}}{(1+0.03)^{(\text{Current age – age when receiving the loan})}}$$

The results can then be used to calculate the implicit interest rate subsidy, in percentage terms given by:

Subsidy Rate (per cent) = (10,000 – TPV repayments).100/10,000

These rates are estimated for each of the groups separately and these can be combined to show the weighted average for the whole sample, under the assumption that take-up rates for SECS are equal for each group.

4 Data and Results

We have used a single cross-section of data, collected in 2011, available from the Household Income and Labour Dynamics of Australia (HILDA) survey. The main statistical characteristics of the sample are shown in Table 1.

[Table 1 about here]

The data were used in estimations of age-income profiles for each of the groups and the results are summarised in Figures 1-4, showing the relationships by different disaggregations of the distributions.

[Figure 1 about here]

[Figure 2 about here]

[Figure 3 about here]

[Figure 4 about here]

These results are very similar to those reported in a host of similar Australian studies (see Higgins, 2011).

It is important to recognise that the size of the subsidy will depend on the age of the debtor, because incomes differ significantly over the life-cycle. Accordingly we have estimated loan repayments and subsidies for debtors at different ages. Obviously this could be done for a very large number of examples, but to keep it straightforward we did the analysis for four groups only, those receiving the loan at ages 25, 35, 45 and 55. Figures 5 – 8 show the overall subsidies for each of the demographic groups and in total weighted by partnership status.

[Figure 5 about here]

[Figure 6 about here]

[Figure 7 about here]

[Figure 8 about here]

5 Summary and Discussion

It is feasible to calculate aggregate subsidy rates for each group under the assumption that the take-up of loans is the same for all people. The data can also be weighted according to the sex, age and partnership proportions from the sample and an overall aggregate subsidy for SECS can be computed. These aggregated results are shown in Figure 9 below.

[Figure 9 about here]

These results illustrate four main points:

(i) The subsidies associated with SECS differ importantly between groups depending on partnership status and sex;

(ii) For no groups is the subsidy more than about 25 per cent (for single women taking a loan without a surcharge), and for one group the subsidy is negative (for couples taking a loan with a 25 per cent surcharge);

(iii) Loan design is very important in calculation of the subsidy, with the loan scheme involving a 25 per cent surcharge being associated with subsidies that are of the order of 15-20 percentage points lower than is the case for loans without a surcharge; and

(iv) Overall, using the surcharge loan arrangement, the best approximation of the weighted total subsidy is -4.0 per cent, which implies that the effects on the government budget are negligible or even very slightly positive. This compares with calculations of HECS-HELP subsidies that are of the order of +15 per cent [9].

There are of course boundaries to these point estimates, but the basic conclusion is not affected taking these into account.

An important caveat concerning these pilot study results is that there will inevitably be self-selection into SECS by groups more likely to receive subsidies, and this aspect of the process has not been modeled so far. Corrections for the selection phenomenon will inevitably reduce the level of aggregate subsidies.

6 Future Research

As noted, the initial results reported here could be seen to be only the beginning of a full costing analysis of SECS. But what seems to have been illustrated implies strongly that the policy outlined has significant potential to help fund the purchase of renewable energy devices with minimal, or even zero, cost to government.

In research terms there are seven main areas that require further analysis: the broadening of the policy to include the self-employed, renters and/or landlords; the use of both more sophisticated econometric methods and panel data to incorporate life-cycle income dynamics; the low repayment possibilities for some groups (such as pensioners); the different calculation basis for those with existing HECS liabilities; addressing the selection issue noted above; allowing an early repayment option; and, including the rapid technology learning rate (the price reduction arising from an increase in the number of units of production).

In addition, the effects of varying the initial assumptions involving income capping, the loan amount, the size of the surcharge, the repayment threshold and the repayment rate, all need to be evaluated within each of the studies outlined below.

6.1 *Extending SECS beyond wage and salary earners and home owners*

A very significant number of potential purchasers of solar PV systems are not wage and salary earners or home owners. This means that the results of the above exercises constitute a part only, albeit a very significant part, of the prospective population of beneficiaries. Thus in order to cost the policy comprehensively modeling needs to be done involving the self-employed, renters and landlords. This will require both much more attention being directed to policy design to take into account the different circumstances and incentives to borrow of members of these groups, and different data to be able to analyse properly their lifetime financial circumstances.

6.2 The use of dynamic econometric techniques and panel data

The unconditional quantile approach used in the current exercise has the major advantage of being able to explore loan subsidies across disparate income distributions by age and sex. However, the fact that we have used only one cross-section (that is, at a particular point in time) of data is associated with notable limitations. Most importantly, like all cross-sectional econometric methods, there is no scope to examine the role and impact of dynamic processes that economists recognize as being extremely important in estimations of life-time experiences. One of the most basic inadequacies of what has been presented, for example, is to constrain individuals to remain in the same income group over their entire lifetime.

There are emerging techniques that allow cross-sections to be used for this type of exercise which take into the likelihood of individuals experiencing changes in their employment status at different ages, with the method being known as dynamic stochastic modeling. The use of such an approach provides more meaningful estimations of projected lifetime income streams and its use has now been extended to illustrate the extent to which OLS approaches are inaccurate with respect to calculations of ICL subsidies[10].

Finally, explorations of cross-sections of data need to be supplemented with information available from panel data. Fortunately, HILDA is a longitudinal data set and there are now 12 different years (2001-2013) available to allow the actual income experiences of the same people over time. We intend to examine all the data in order to compare subsidy results of both cross-sectional and dynamic stochastic modeling with the observed outcomes of the panel data.

6.3 Low repayment possibilities for some groups (such as pensioners)

Under the scheme as described, with repayments based on income, some groups such as pensioners will face the attractive possibility of being unlikely to repay the loan. This kind of situation and what it means for repayment arrangements is addressed in Botterill and Chapman (2009) with respect to the suggestion of a revenue contingent loan for farms affected by drought. In this example the debt becomes a financial obligation linked to the sale of the property. The issue requires further development and modeling through exploration of the financial circumstances of the pensioner population.

6.4 The different calculation basis for those with existing HECS liabilities

As modeled so far, SECS assumes that debtors are liable to begin repayments one year after the solar PV system is purchased. However for those with current HECS-HELP or FEE-HELP liabilities the policy would need to be modified, with one simple option being to add SECS to other HELP debts. This in effect would then mean that SECS debts would be paid after other ICL obligations have been met, which necessarily adds to the time involved in the recovery of SECS loans. Consequently and *ceteris paribus* the interest rate subsidy would be greater for members of this group and this then requires additional modeling. In principle and method terms this would be a straightforward extension of the analysis. Alternatively, there is the option to require that the SECS debt be repaid first, which would add to the recovery time for the HELP debt.

6.5 Addressing selection

As noted in a caveat with respect to the overall weighted subsidy calculations, SECS - like all voluntary ICL arrangements - will involve members of different groups self-selecting into the program. The basic economics of the matter is that those groups receiving the highest subsidies (such as single females) will be more likely to take advantage of the loan, and those groups receiving the lowest (even negative) subsidies (such as married persons) will be less likely to be involved. These biases mean that the calculations presented above understate the likely extent of subsidies, and some way of correcting for this is necessary.

We intend to address this issue by imposing a range of SECS take-up probabilities for particular groups. Further, the results from this investigation would inform policies (such as differential surcharge amounts depending upon the marital status) which could enable a more even distribution of the subsidy between these groups.

6.6 Early repayment option

As with FEE-HELP, we intend to explore an option for the borrower to repay the loan early. Given the low interest rate on the loan they would need an incentive to do this, and this could be achieved, for example, by discounting the 25 per cent surcharge. It should be noted that the decreased energy bills arising from the solar PV system effectively represents an increase in income, thereby allowing the borrower to be able to afford to repay the loan more rapidly.

6.7 Including the rapid technology learning rate

The learning rate for solar PV systems has been rapid and more or less consistent over the past few decades, representing a 20 per cent reduction in price for a doubling in the units of production. Recently this has yielded a halving of the costs of PV every 3 years. In order to account for the propensity to delay the purchase of a PV system we will include an option for the borrower to install part of the system initially (say half - worth $5,000 now) with the balance some time later when the cost of the remaining units has fallen.

7 Conclusions

As indicated earlier, significant social equity issues exist in the changing national electricity market, with ICLs being a prospective tool for addressing one of those issues: the barrier to investment in solar rooftop and energy saving systems for low-income households. However, as pointed out by Simshauser and Nelson (2013), low household income is not necessarily an indication of hardship when it comes to coping with electricity bills. Their demographic analysis showed that household hardship (as indicated by electricity bill payment defaults) peaked in the mid-40 year old cohort – the so-called family formation cohort for which the income per householder is at its lowest.

This has implications for further research into the use of ICLs, as potentially the income level for such households may already be above the SECS repayment threshold.

The encouraging aspect is first that given the age demographic, the income level of mid-40s households is likely to increase over time, and the income per household member will rise again as children become independent. Second, the immediate reduction in electricity costs arising from the installation of solar PV will contribute to the household's ability to repay the SECs loan, thereby reducing the number of payment defaults on electricity bills.

Such considerations will increase the complexity of determining the impact of SECS over the lifetime trajectories of households. However, it seems likely that the initial government-revenue-neutral estimates from this paper may be reproduced without the need for a significant increase in the SECS surcharge.

References

Australian Journal of Labour Economics 2009, Special Issue on Applications of Income Contingent Loans, Vol. 12 (2), September.

Botterill, L. and Chapman, B. J. 2009, ‘A Revenue Contingent Loan Instrument for Agricultural Credit with Particular Reference to Drought Relief’, *Australian Journal of Labour Economics,* vol. 12, no. 2, pp. 181-196.

Chapman, B. J. 2006, *Government Managing Risk: Income Contingent Loans for Social and Economic Progress,* Routledge, London.

Chapman, B. J., Higgins, T. and Stiglitz, J. E. (eds) 2014, *Income Contingent Loans: Theory, Practice and Prospects,* Palgrave McMillan, New York.

Chapman, B., Freiberg, A., Quiggin, J. and Tait, D. 2004, ‘Using the Tax System to Collect Fines’, *Australian Journal of Public Administration*, vol. 63, no. 3, pp. 20-32.

Chapman, B., Higgins, T. and Taylor, D. 2014, ‘Income Contingent Loans for Mature Age Training’, *Australian Journal of Labour Economics*, vol. 12, no. 2, pp. 167-179.

Clarke, P. and Chapman, B. 2014, ‘Internationalisation of ICLs to Deal with Human Capital Trade Imbalance’, in *Income Contingent Loans: Theory, Practice and Prospects,* eds B. J. Chapman, T. Higgins and J. E. Stiglitz, Palgrave McMillan, New York.

Dennis, R. 2014, ‘Utilising the Transactional Efficiencies of Contingent Loans – A General Framework for Policy Application’, in *Income Contingent Loans: Theory, Practice and Prospects,* eds B. J. Chapman, T. Higgins and J. E. Stiglitz, Palgrave McMillan, New York.

Gans, J. and King, S. 2006. ‘The Housing Lifeline: A Housing Affordability Policy’, *Agenda,* vol. 11, no. 2, pp. 143-155.

Gupta, N. and Withers, G. 2014. ‘Income Contingent Loan for Business Innovation’, in *Income Contingent Loans: Theory, Practice and Prospects,* eds B. J. Chapman, T. Higgins and J. E. Stiglitz, Palgrave McMillan, New York.

Higgins, T. 2010, ‘Essays in Development and Costing of Income Contingent Loans’, PhD thesis, The Australian National University.

Higgins, T. and Sinning, M. 2013, ‘Dynamic Stochastic Modeling of Income Contingent Loan Subsidies’, *Economics of Education Review*, vol. 37, pp. 273-285.

Pitt and Sherry 2014, *Carbon Emissions Index* (CEDEX), viewed July 2014, <www.pittsh.com.au/cedex>.

Severance, C. 2011, ‘A Practical, Affordable (and Least Business Risk) Plan to Achieve 80 per cent Clean Electricity by 2035’, *Electricity Journal* vol. 24, no. 6, pp. 8–26.

Simshauser, P. and Nelson, T. 2013, ‘The Consequences of Retail Electricity Price Rises: Rethinking Customer Hardship’, *The Australian Economic Review,* vol. 47, no. 1, pp. 13–43.

Stiglitz, J. E. 2014, ‘Remarks on Income Contingent Loans: How Effective Can They be at Mitigating Risk?’, in *Income Contingent Loans: Theory, Practice and Prospects,* eds B. J. Chapman, T. Higgins and J. E. Stiglitz, Palgrave McMillan, New York.

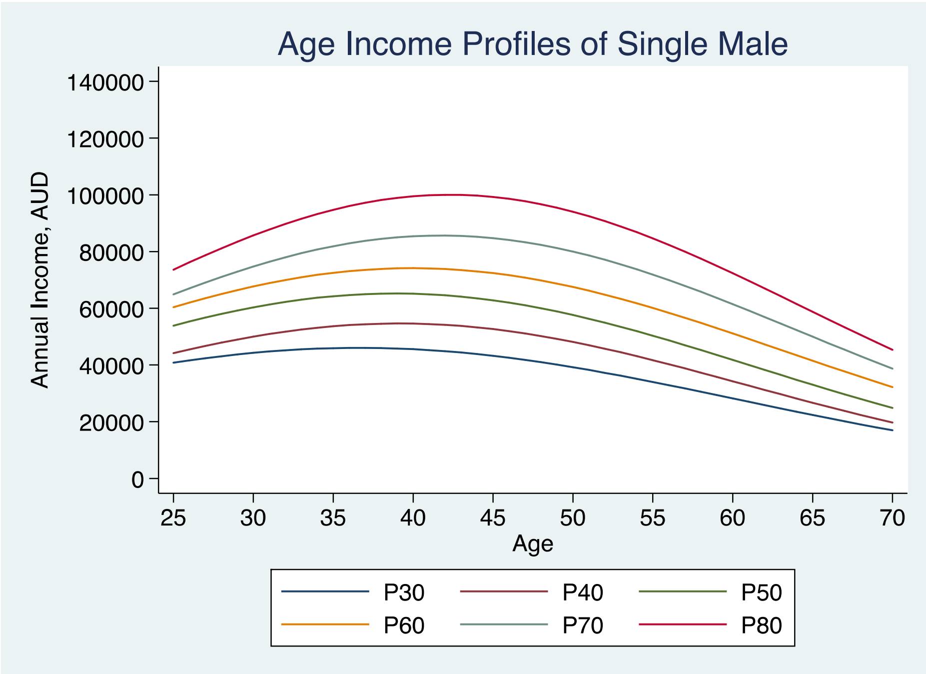
Table 1 (revised) Statistical Characteristics of the Data

Group	*Variables*	*N*	*Mean*	*Standard deviation*	*Min*	*Max*
Single male	Age (years)	505	48	13	25	70
	Wages and salaries ($/year)	505	53,734	48,637	0	360,000
	Pensions ($/year)	505	7,629	16,904	0	127,290
	Total individual income ($/year)	505	61,363	45,954	13000	378,000
Single female	Age (years)	746	52	12	25	70
	Wages and salaries ($/year)	746	41,346	36,986	0	300,000
	Pensions ($/year)	746	7,104	12,197	0	125,000
	Total individual income ($/year)	746	48,449	32,015	13000	300,000
Married female	Age (year)	2244	48	12	25	70
	Wages and salaries ($/year)	2244	24,182	25,844	0	688,457[a]
	Pensions ($/year)	2244	2,647	8,534	0	125,000
	Total individual income ($/year)	2244	26,828	25,251	0	688,457[a]
	Total household income ($/year)	2244	76,435	41,659	0	963,457
Married male	Age (year)	2244	51	12	25	70
	Wages and salaries ($/year)	2244	44,741	38,570	0	688,457[a]
	Pensions ($/year)	2244	4,866	12,668	0	250,000
	Total individual income ($/year)	2244	49,607	35,918	0	728,457
	Total household income ($/year)	2244	76,435	41,659	0	963,457

Note: (a) HILDA sets wage and salary incomes at $688,457 for individuals earning over $500,000 per annum, to ensure confidentiality.

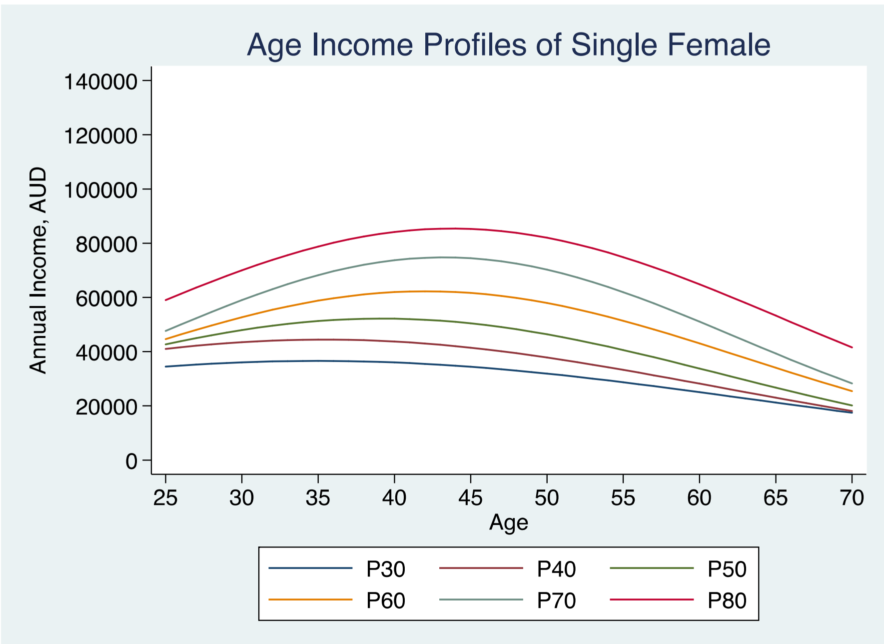
Source: Authors' analysis from HILDA 2011

Figure 1 Age Income Profiles of Single Male



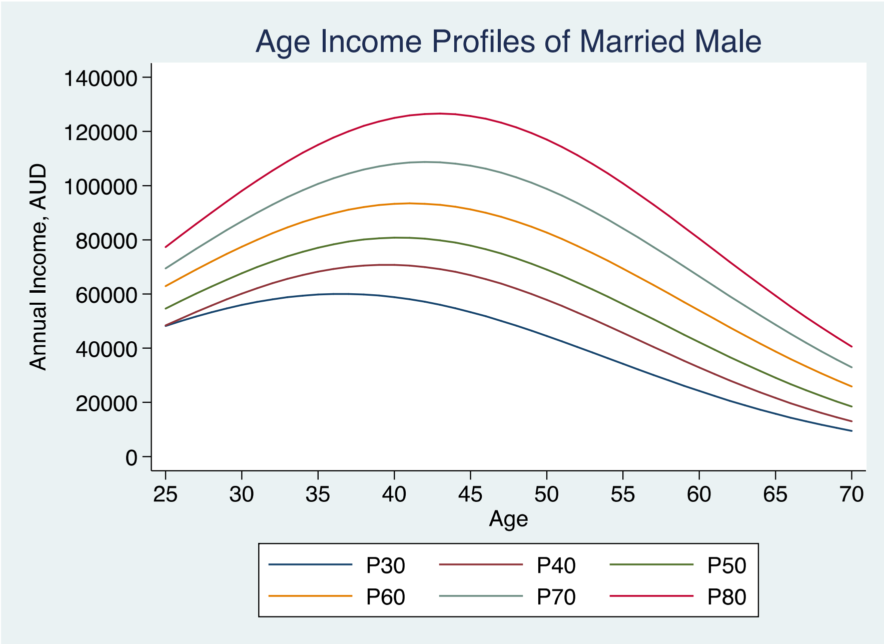
Source: Authors' analysis from HILDA 2011

Figure 2 Age Income Profiles of Single Female



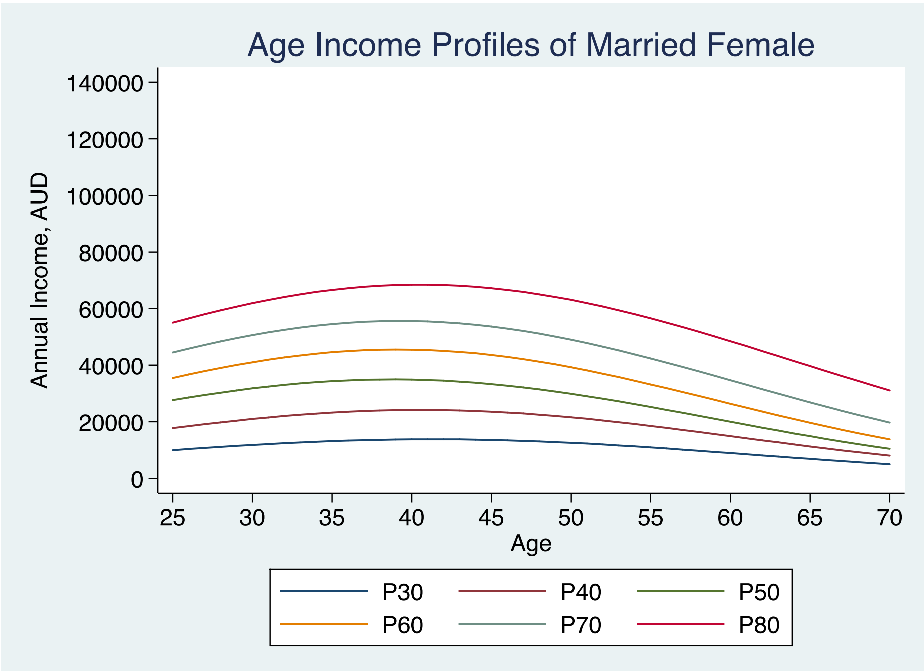
Source: Authors' analysis from HILDA 2011

Figure 3 Age Income Profiles of Married Male



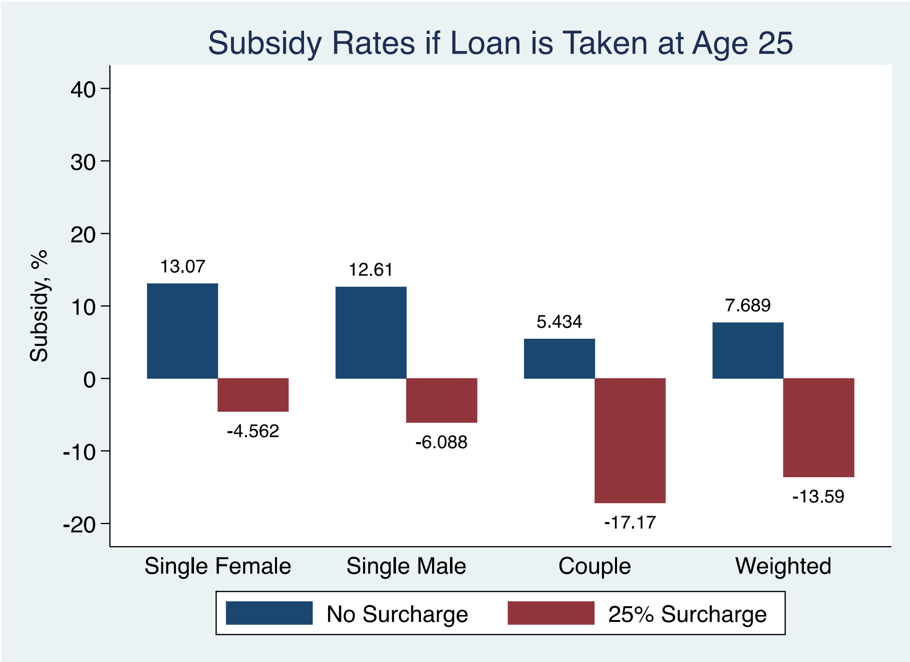
Source: Authors' analysis from HILDA 2011

Figure 4 Age Income Profiles of Married Female



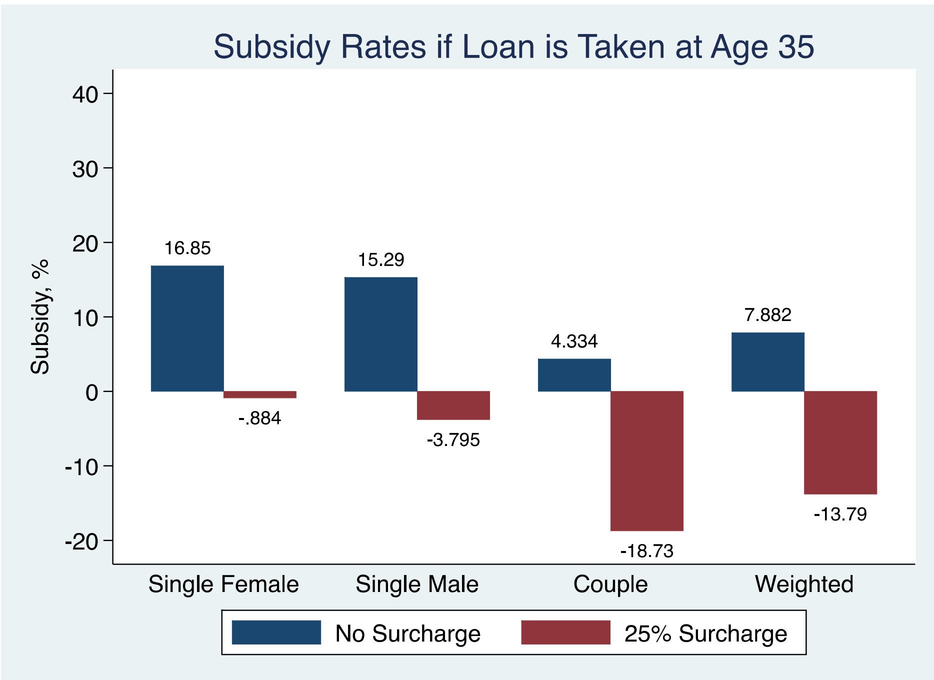
Source: Authors' analysis from HILDA 2011

Figure 5 Subsidies Rates if Loan is Taken at Age 25



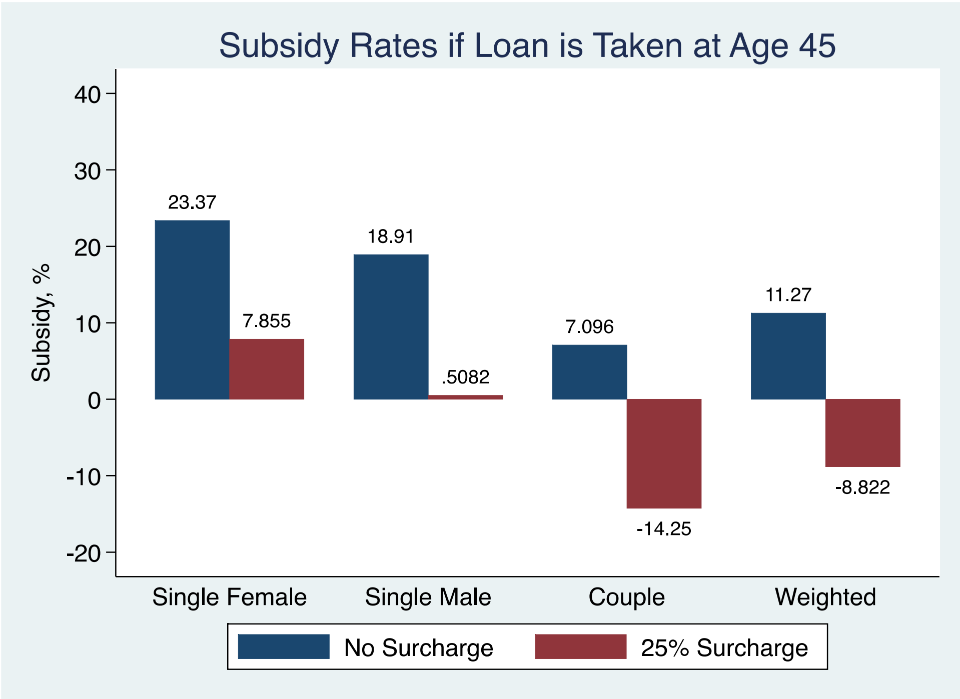
Source: Authors' analysis from HILDA 2011

Figure 6 Subsidies Rates if Loan is Taken at Age 35



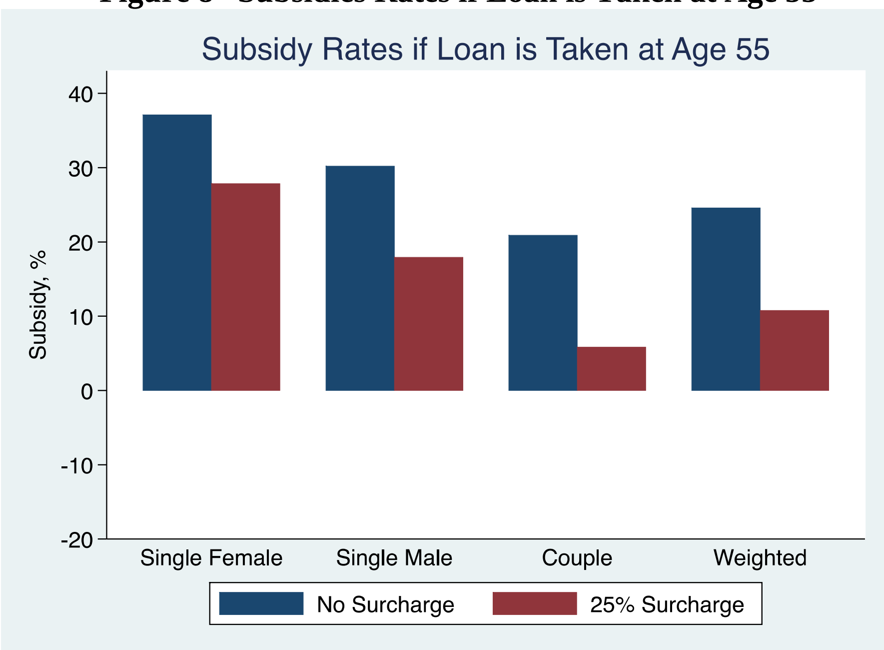
Source: Authors' analysis from HILDA 2011

Figure 7 Subsidies Rates if Loan is Taken at Age 45



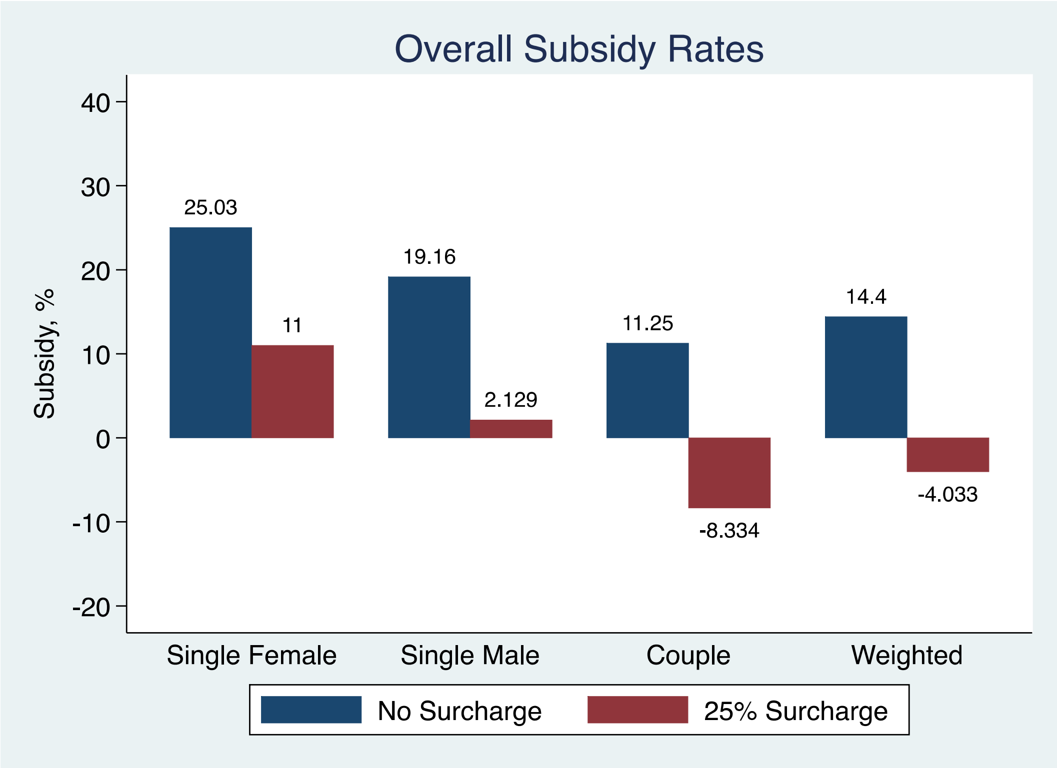
Source: Authors' analysis from HILDA 2011

Figure 8 Subsidies Rates if Loan is Taken at Age 55



Source: Authors' analysis from HILDA 2011

Figure 9 Overall Subsidy Rates



Source: Authors' analysis from HILDA 2011

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[1] There are a large number of similar exercises in which ICLs have been modeled and costed for many disparate social and economic potential reforms. See Chapman (2006), AJLE (2009) and Chapman, Higgins and Stiglitz (2014).
[2] Australian Clean Energy Regulator report, 14 August 2014, http://ret.cleanenergyregulator.gov.au/REC-Registry/Data-reports
[3] *ibid*
[4] Clean Energy Australia report 2013, Clean Energy Council.
[5] *ibid.*
[6] The required proportion of income begins at 4 per cent and rises to a maximum of 8 per cent.
[7] The income of $13,000 is close to, although somewhat lower than, the actual lowest income that would be received by a person on social security with a dependent child under the age of 8. Our means-testing is a judgement that the policy would be too generous if it applied to individuals receiving more than $110,000 per annum.
[8] Social security receipts are not included as part of the income stream because of the potential of harm in such an approach to the welfare of children.
[9] Higgins and Sinning (2013)

[10] Higgins and Sinning (2013) show that this approach reduces estimates of the interest rate subsidies associated with HECS by about half.