

**ESSAYS IN THE DEVELOPMENT
AND COSTING OF
INCOME CONTINGENT LOANS**

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Declaration of Originality

I declare that this thesis is an original work and is an account of research carried out by myself while enrolled as a PhD candidate at The Australian National University. This thesis does not contain material that has been accepted for the award of any other degree or diploma in any University, nor material published or written by another person, except where due reference is made.

Timothy Sean Higgins

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Abstract

Income contingent loans (ICL) are policy instruments that can enable participation in activities that yield both public and private benefits, with repayment conditions that promote equity, remove the risk of loan default, smooth consumption, and thus increase utility for loan recipients. This thesis presents three essays on the development and costing of ICLs. The first two essays consider application of ICLs to paid parental leave and to student income support, and they are approached from the perspective of financial product design: context and motivation are described; product features are chosen to balance consumer needs and affordability with provider costs; models are developed and populated with assumptions and parameters; and the models are used to undertake risk assessment and costing. There are a variety of new ICL designs proposed and innovative scheme features considered in the first two essays. In the third essay, original dynamic stochastic models are developed which are shown to have important implications to ICL cost estimates.

In Chapter 2, an ICL is motivated and developed as an extension to the recently introduced Australian statutory paid parental leave (PPL) scheme. It is argued that the statutory scheme does not maximise the social and private benefits of parental leave, yet a lack of liquidity and market failure prevents families from financing an extension of leave. An ICL is proposed to provide a source of funds, enabling consumption smoothing, and encouraging participation through the provision of default insurance and contingent payments. Design features for the ICL are proposed to mitigate adverse selection and moral hazard: eligibility is confined to persons with previous workforce attachment; the minimum repayment threshold is set lower than that of HECS; and, repayments are made the obligation of both parents. Modelling of debt, repayments and taxpayer subsidies is performed for various loan durations, loan amounts, indexation arrangements, and discount rates. It is shown that a carefully designed scheme can be a cost effective and equitable means of providing parents with the necessary leave so as to optimise both private and public returns.

In Chapter 3, an ICL is motivated and developed for the shortfall in student income support for higher education. It is shown that, despite recent improvements to

policy, there remains a deficiency in existing income support arrangements, which may result in sub-optimal educational achievement and reduced participation. It is suggested that after allowing for existing income support and practical levels of student employment, as little as an additional \$2,000 per annum could make up the shortfall for many students. As with HECS, a market failure exists, and an argument is made for an ICL to address this shortfall. Modelling is undertaken with emphasis on the implications to taxpayer costs under different indexation arrangements in the presence of HECS debts. While it is shown that plausible parameter choices can produce results that differ with respect to expected taxpayer costs and loan recipient outlays, it is speculated that a loan surcharge with nil real indexation could encourage greater participation and face less opposition than a real interest rate, while maintaining equity through cross-subsidisation. The case of mature aged students is separately considered, and an ICL sourced from superannuation is proposed for income support that could be structured to almost eliminate moral hazard and default risk, yet would increase individual utility and help address the skills shortage crisis.

The viability of the ICLs developed in Chapters 2 and 3 will depend on aggregate taxpayer costs. In Chapter 4, a range of labour force and earnings models is developed with the view of exploring how ICL cost estimates are affected by model structures and assumptions. Nested bivariate logistic models for labour force transitions are developed that incorporate lagged labour states. Hourly wage is modelled, and residuals from the mean fit are partitioned into permanent and transitory components, incorporating serial dependency and non-normal shocks. A non-parametric model for weekly hours worked is developed that incorporates conditional transition probabilities. Monte Carlo simulation is used to estimate ICL debt, repayments and subsidies under the fitted models. It is found that under a wide range of conditions, dynamic stochastic earnings models lead to greater repayments, lower projected debt, and significantly lower aggregate taxpayer subsidies when compared with models that ignore earnings mobility.

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1 Introduction

1.1 Background and overview

Income contingent loans (ICL) are policy instruments that can enable participation in activities that yield both public and private benefits, with repayment conditions that promote equity, remove the risk of loan default, smooth consumption, and thus increase utility for loan recipients. This thesis presents three essays on the development and costing of ICLs. Chapters 2 and 3 consider application of ICLs to paid parental leave and to student income support. There are a variety of new ICL designs proposed and innovative scheme features considered in these chapters. In Chapter 4, original dynamic stochastic models are developed which are shown to have important implications to ICL cost estimates.

The idea of a loan where repayments are dependent on income can be traced back to Friedman (1955), who made the suggestion when confronted with the problems of higher education funding. The argument for an ICL for higher education is briefly outlined below. Public returns to education arise through economic growth, innovation and development, but higher education also yields significant private benefits in the form of higher wages. Free education is regressive – taxpayers cross-subsidise the tuition fees for those who will, on average, earn higher wages. While it makes sense to charge at least partial fees so that the beneficiaries of private returns to education contribute to the costs, the majority of students cannot afford up-front fees, and commercial lending institutions do not offer loans for human capital investments without sufficient collateral. Default risk could be managed by the government guaranteeing student loans offered through the commercial sector, yet there are problems with this approach. First, such loans require fixed payments over a set period, which can lead to both repayment hardships and student default with implications to credit ratings. This concern can lead to sub-optimal university participation. Second, such a system is costly because the guarantee can lead to moral hazard on the part of the commercial lending institution – in the event that debt is not collected they can call upon the guarantee. Third, because of the potential for taxpayer subsidies, schemes such as these are typically limited in coverage

implying that many prospective students in need of assistance will be left out of the system.

A solution that addresses the market failure and avoids the pitfalls of government guaranteed loans is an ICL. An ICL was applied to university fees for the first time anywhere in the world in Australia in 1989 (Chapman, 2006). The Higher Education Contribution Scheme, or HECS as it was originally known, was initially met with substantial resistance by students whose counter-factual was free education, yet it has developed into a mature system and has been accepted as equitable by the majority of the student and broader population (Higgins and Withers, 2009). Moreover, there is substantial evidence that the introduction and continued operations of fees through HECS has not deterred university participation from students from low-income backgrounds (for example, see Chapman, 2006). Indeed, the success of the Australian experience has led to the adoption of similar systems internationally.

The specific advantages of income contingent loans will depend on the area of application, however, there are certain features that are common to ICLs generally. Details are given within Chapters 2 and 3, and a brief summary is presented here.

Consumption smoothing

As repayments are a function of income, higher incomes necessarily mean higher repayments, while lower incomes lead to lower repayments. While a traditional loan requires fixed repayments regardless of the financial circumstances of the debtor, income is smoothed over the term of an ICL, reducing the risk that the loan will adversely compromise consumption.

Insurance

The income contingent mechanism ensures affordability of repayments, and provides a hedge against the uncertainty in investment returns. In the case of higher education, the investment is in one's education, and the income contingent feature protects against the risk that the investment fails to yield returns to income, for example, due to insufficient ability or lack of demand for skilled employment in the student's field of study. Those whose incomes fall below the minimum repayment threshold are not liable for repayments, and their credit reputation remains intact.

This feature mitigates the risk of default and helps smooth consumption, leading to increased participation in the activity and higher utility for loan recipients.

Equity

In general and in the presence of interest rate subsidies, ICL repayment thresholds are very likely to be progressive – a greater repayment rate is charged for higher incomes. This implies that those who gain most economic benefit from the investment (through high lifetime income) repay more quickly. Under a variety of loan indexation arrangements, such as that which applies to HECS¹ or those proposed in Chapters 2 and 3, debtors who repay more slowly are cross-subsidised by higher earners who repay more quickly. Regardless of the indexation arrangements, a degree of equity is ensured by the minimum repayment thresholds; for individuals whose incomes persist below the minimum threshold, the ICL becomes a grant.

While there are notable benefits of an ICL, risks remain. Like traditional social insurance mechanisms, an ICL can suffer from adverse selection and moral hazard, and these issues must be carefully managed through scheme design.

While ICLs have, to date, only been applied in the field of education, there has been research into the development and application of ICLs to other policy settings. These have included innovation financing (Denniss *et al.*, 2009), drought relief (Botterill and Chapman, 2004; 2009), white collar criminal penalties (Chapman and Denniss, 2005), social and community investments (Chapman and Simes, 2006), housing finance for low-income households (Gans and King, 2004), and the financing of childcare (Martin, 2005), among others.

More recently, Chapman and Higgins (2009) have explored the potential application of an ICL for paid parental leave. Higgins' contribution to this research is the topic of Chapter 2 of this thesis. In Chapter 3, an ICL is proposed to address the shortfall in higher education student living costs. This chapter refers to recent work into mature-aged training by Chapman, Higgins and Taylor (2009), though the focus of Chapter 3 is much broader, motivating and describing the features of an ICL to address the shortfall in living costs for all university students. While they may first

¹ e.g., zero real interest.

appear to be disparate topics, paid parental leave and student income support for higher education have important features in common which make these natural candidates to benefit from ICL schemes. The cost of participation in the activities (the shortfall in living costs for higher education, and lost employment income for paid parental leave), should arguably be met by both public and private sources. Both are activities with public spillovers, and therefore, participation should be encouraged and partially subsidised. Additionally, both activities yield private returns, and therefore, some of the costs should be borne by the individual. Lastly, many individuals who wish to participate in the activities will be liquidity constrained, and a market failure exists in that commercial lending institutions are unwilling to lend without sufficient collateral or a guarantor.

It is important to stress that these ICLs are not being advocated for leisure activities, but rather are being suggested for activities with clear and broad economic benefits. Critically, the funding for both higher education and paid parental leave provides support for a period of deferred or interrupted employment, and a key purpose of both loans is to aid in the development of human capital. While this is clearly the case for higher education, the same argument applies for paid parental leave, as the ability to take leave increases the likelihood of retention in the workforce. That these ICLs improve human capital is critical – by doing so this reduces the risk of debt default, and aids productivity and economic growth, thus helping to justify taxpayer subsidies that may remain. Indeed, an argument can be made for ICLs generally in the event that employment is interrupted or deferred for the purpose of human capital development.

An implication of the income contingent feature of these schemes is that repayments will generally only continue while employment continues. This restricts the policy instrument to persons with sufficiently long working lives, and raises questions about its viability for mature aged education, particularly if loan amounts are large. In the last part of Chapter 3, a novel ICL structure is proposed to address this issue.

Regardless of the area of application, the viability of ICL policy will depend in large part on the taxpayer costs. Assuming moral hazard and adverse selection are mitigated through scheme design, costs remain from interest rate differentials in the event that debt indexation differs from the government's cost of capital, or from

default as a consequence of a minimum repayment threshold.² The models in Chapters 2 and 3 assume simple static earnings assumptions, and do not allow for realistic mobility in labour force state, or mobility within full-time or part-time employment states. In Chapter 4 the implications of earnings model complexity to costing is explored through the construction of stochastic models that incorporate realistic mobility patterns. The models developed and conclusions reached have important implications to costing income contingent loans, and suggest that the estimates in Chapters 2 and 3, while they remain useful guides, are conservative.

1.2 Outline of the thesis

While the previous section provided an overview of the motivation and contents, a more thorough outline of the thesis contents is now given.

In Chapter 2, an income contingent loan is proposed as a policy instrument for extending paid parental leave. The arguments for government involvement in the provision of paid parental leave, and arguments for and against an ICL in this context, are summarised. Next, the design parameters for an ICL scheme as it could be applied as a supplement to a statutory paid parental leave scheme are outlined, where particular emphasis is given to mitigating adverse selection and moral hazard. A basic model for costing hypothetical scenarios is developed, and six design parameter cases are proposed for testing. The results of the modelling are presented and further observations are offered with respect to the financial attraction of the scheme to parents, alternative repayment schedule designs, and aggregate taxpayer costs.

In Chapter 3, it is argued that an ICL should be introduced for student living costs as a supplement to HECS. The benefits and deficiencies of existing income support arrangements are first summarised, and it is shown that a shortfall exists in required support despite recent improvements to policy. The case for an ICL is put forward and advantages and disadvantages are discussed, including observations from proponents and critics of ICL policy in this context, and domestic and international experience with similar instruments. The key features for consideration in policy

² While costs will also be present from establishment and ongoing administration, these are not considered in this thesis.

design are described, and a basic ICL is modelled with particular emphasis on different indexation arrangements. Finally, the specific case of mature-age training is raised, and a novel solution is briefly proposed that involves ICL loan financing from superannuation.

In Chapter 4, the extent to which earnings assumptions affect ICL debt, repayments and subsidies is investigated. First, a description of broad modelling structures for costing ICLs is given, followed by a detailed statistical empirical analysis of HILDA earnings data and labour force state transitions. Modelling dynamic earnings requires multiple components: a model of labour force transitions, and a model of earnings conditional on labour force state. Nested logistic labour force transition models are developed, followed by the development of a series of hourly wage models. These vary from a simple regression model with covariates and iid errors, to a model that accommodates unobserved variables through residual decomposition into serially dependent permanent and transient error components. A non-parametric model is proposed for the number of hours worked, and this is combined with the models for hourly wage to predict earnings. The models are combined and the implications of model complexity to ICL debt, repayments and taxpayer subsidies are examined through simulation.

The key conclusions from the thesis are summarised in Chapter 5, along with a description of limitations and directions for future research in this area. Two appendices are included. Appendix A1 provides a simple mathematical exposition of ICL debt, repayments and subsidy calculations. Appendix A2 provides a summary of earnings and labour force modules from the more well-known microsimulation models, and is referred in various parts of Chapter 4.

1.3 The development process for an ICL

The process used in motivating and developing the ICLs in this thesis is akin to that used in the development of traditional financial products.

A key feature of ICLs is the provision of finances in exchange for repayments at a later date, but where the repayments are contingent on income. An implication is that the product automatically includes an insurance component; namely repayments

are not required if income falls below a minimum threshold. Establishing the viability of the product to both consumer and provider involves, among other things, costing the product. As repayments are both uncertain in timing (due to the income contingent feature) and amount, the process required for quantification of net costs is akin to the process used in costing and profit testing traditional insurance products. While insurance calculations typically involve uncertain events such as mortality, disability, accident, loss, or similar incidents, here the uncertainty is associated with income. The steps in modelling are similar: future cash flows (income) are projected into the future, probabilities are associated with the future cash flows, the resulting claims (repayments) are discounted to a present value, and net income and outgo are compared. As with models for profit testing insurance policies, the models developed in this thesis facilitate the exploration of key parameter changes on financial outcomes.

As part of the insurance product design process, providers must be satisfied that the product features and the terms and conditions prevent, or limit, adverse selection and moral hazard. As with traditional insurance products, the ICLs proposed in Chapters 2 and 3 are subject to these risks, possibly even more so as a consequence of the taxpayer subsidies which may make the policy appear more attractive than otherwise to potential participants. Considerable space has been devoted to justifying and designing the product features for the policies in both Chapters 2 and 3, many of which are proposed to limit moral hazard and adverse selection.

In this sense, the processes taken in this thesis follow a first path through the control cycle associated with financial product design: establish the context and motivation for the product; choose product features so as to balance consumer needs and affordability with provider costs; develop a model and populate it with assumptions and parameters; use the model to undertake both risk assessment, costing and pricing³; and critique or revise the product design as a consequence of the modelling outputs.

³ Pricing in the context of an ICL involves selecting repayment thresholds and rates, and loan indexation parameters. When applied to assessable income, these determine the magnitude and timing of debtor repayment that reveal the profitability or costs to the provider.

2 Extending paid parental leave through income contingent loans⁴

2.1 Introduction

2.1.1 *Background and outline*

In May 2009 the federal government announced that a universal paid parental leave scheme would be introduced for working parents in 2011. The scheme will provide up to 18 weeks of paid leave at minimum wage to mothers with previous work attachment. This follows an enquiry launched in February 2008 by the Productivity Commission (PC) into paid parental leave (PPL) (Swan, 2008), and years of debate concerning the merits of a government provided scheme. In both their draft report (2008) and final report (2009), the PC called for a taxpayer-funded scheme of 18 weeks duration, despite Australian governments having previously resisted the introduction of a grants-based system, and their broad recommendation was taken up by the Rudd government. Despite the removal of the long existing policy impasse and approval from interest groups at the policy announcement, many advocates for leave and the PC itself, recognise that arguments remain for longer durations of leave and/or higher dollar amounts.

PPL as income replacement during leave from paid employment is an investment in human capital; it can improve maternal health and workforce attachment, as well as child health and development. A case for government subsidy of PPL can be made

⁴ The original loan structure and the preliminary modelling expanded on herein was presented at the Learned Academy ARC Grant Workshop, Income Contingent Loans for Social and Economic Policy, Canberra, August 2008. I would like to acknowledge the Academy of Social Sciences of Australia, and the Australian Research Council, for funding the Workshop and CEDA for supporting this research. I would also like to thank the Workshop participants, including Peter McDonald, for valuable comments. This chapter has benefited greatly from comments emerging from the Productivity Commission enquiry into paid parental leave and the resulting PC draft and final reports (PC, 2008, 2009). I would like to acknowledge the contribution of Lynnette Lin to early research, and the valuable comments of two anonymous referees for the 2009 AJLE paper co-authored with Professor Bruce Chapman. In particular, the series of submissions, reports and papers to which I contributed, and the consequent development of this chapter, would not have come to fruition without Professor Bruce Chapman's original conception and promotion of the idea of an ICL for PPL; promotion that ultimately led to endorsement by the Productivity Commission.

on the basis that the public benefits exceed the advantages accruing directly to families. However, as there are also private benefits for the families taking leave, there is a case for contributions from those receiving the benefits.

Liquidity constraints prevent many families from using their own funds to finance leave, and there exists a market failure in that commercial banks will not provide funds in the absence of collateral due to repayment uncertainty during periods of parental leave. To address the financial needs and market failure, in this chapter an income contingent loan is proposed as an extension to the statutory 18 week PPL scheme. An ICL as a way of extending the duration of available leave, or as an extension to the dollar amount available while on leave, was endorsed in the PC final report (2009) as a way of efficiently allowing parents to supplement the 18 week scheme should the government consider extending the scheme in duration and/or amount.

This chapter builds on an idea first proposed by Chapman (2002), preliminary modelling work undertaken by Lin (2007)⁵, and a research report by Chapman, Higgins and Lin (2008) commissioned by the Committee for Economic Development of Australia (CEDA). Included in the PC brief, and the final PC report, is identification and assessment of models for financing PPL. The CEDA report, which outlined the idea of using an ICL as a mechanism for supplementing a statutory paid parental leave, was presented by Chapman, Higgins and Lin as a submission to the PC enquiry into PPL.

To support their submission, Chapman and Higgins (2008a) participated in the PC hearings into parental leave in Canberra in May 2008. In their draft report the PC raised a number of criticisms of the use of the ICL as a supplement to a statutory grants-based scheme (PC, 2008, pp8.11-8.15). Chapman and Higgins addressed these criticisms in further PC hearings in November 2008 (PC, 2008b), and in their final report the PC acknowledged this. Coupled with support for ICL from interest groups (e.g., the Smith Family, see PC, 2008, p8.14) and recognition of 'likely future pressures that will bear on Government to extend the duration of the scheme beyond 18 weeks and to increase the payment rate' (PC, 2008, p8.18), the PC concluded as follows:

⁵ undertaken while an honours student under my supervision.

‘Against that background [of current and future pressure to increase the duration and payment rate], and in light of the persuasive supplementary input from the proponents of the income contingent loan scheme, the Commission has reconsidered its draft report conclusion...regarding the place for such loans as an optional top-up to a taxpayer-funded base scheme. Accordingly, should the Government consider extending scheme duration and/or the payment rate at some point in the future, the Commission now believes that income contingent loans could provide an appropriate low cost option (given the efficiency costs associated with taxpayer funding) for doing so.’ (PC, 2009, p8.18)

The PC made this conclusion subject to modifications to the scheme design put forward by Chapman, Higgins and Lin. These suggested modifications are described in appropriate sections of this chapter.

Following release of the 2009 PC report, Chapman and Higgins (2009) published a more considered and up-to-date proposal in light of PPL policy developments. Parts of the current chapter are a duplicate of the contributions of Higgins that appeared in Chapman and Higgins (2009), and as such these contributions are not specifically referenced beyond the present note. However, the present chapter expands on the topic considerably. In addition to the coverage in Chapman and Higgins (2009), this chapter provides expanded motivation for PPL and ICLs in this policy setting, and deeper coverage of all aspects of the scheme design, including the consideration and modelling of a variety of alternative design features. Additionally, consideration is given to the question of loan surcharge versus real debt indexation, and smoothed repayment schedules, topics that have not been addressed in publications to date.

Drawing heavily on the PC final report (2009), the recent and current situation for paid parental leave in Australia is discussed in Section 2.1.2. The arguments for government involvement in the provision of PPL, and arguments for and against an ICL in this context, are summarised in Section 2.2. In Section 2.3 the design parameters for an income contingent loan scheme as it could be applied as a supplement to a statutory PPL scheme are outlined. A basic model for costing hypothetical scenarios is developed in Section 2.4, and six design parameter cases are proposed for testing. The results of the modelling are presented in Section 2.5. In Section 2.6 further observations are offered with respect to the financial attraction of the scheme to parents, alternative repayment schedule designs, and aggregate

taxpayer costs. Section 2.7 summarises and discusses the key findings of the chapter.

Moral hazard and adverse selection are addressed in the scheme design through several means: restricting loan duration and size; restricting eligibility to parents with workforce attachment; reducing minimum repayment thresholds below those of HECS; and importantly, making the debt an obligation of both parents. Consideration is also given to the attractiveness of an ICL for families with different costs of capital, and the appropriateness of a loan surcharge versus real debt indexation, along with associated implications to adverse selection.

There is limited discussion herein on the economic rationale for how PPL costs should be partitioned between taxpayers, employers and individual families, though it is argued in Section 2.2 that there is a case for some private contributions in certain circumstances, and hence an ICL is worthy of consideration. This chapter shows that an ICL introduces both flexibility and choice, providing consumption-smoothing and lifetime income distribution advantages over traditional loans. The flexibility allows scheme parameters to be chosen so as to limit or eliminate contributions from taxpayers, thus reflecting government belief about the magnitude of public versus private benefits of PPL.

2.1.2 *The current situation*

Paid parental leave is ‘an income replacement to compensate for the leave from paid employment necessary around childbirth’ (HREOC, 2002, p. 13) and is a contemporary public policy issue of both social and economic importance, of scholarly debate⁶, and community and government interest as evidenced by the 2008 Productivity Commission enquiry into PPL, the media attention surrounding the enquiry, and most notably, the 2009 announcement of a statutory scheme to commence in 2011.

⁶ For example see Baird (2004). Also see Baird and Whitehouse (2007) and others in a special issue of the Australian Bulletin of Labour on work and family policy issues for Australia.

Until recently, Australia had not legislated for a minimum PPL system across the workforce despite recommendations in 2002 by HREOC for a national, government-funded scheme of 14 weeks PPL (HREOC, 2002), and despite Australia being one of only two developed countries (the United States being the other) in which there were no legislative requirement or taxpayer subsidy for PPL.⁷

Although statutory unpaid parental leave provisions of up to 52 weeks of unpaid leave exist for families with sufficient workplace attachment⁸, this does not address the financial needs of parents during periods of leave as daily expenses and debt servicing requirements continue. Furthermore, approximately 17 per cent of employee mothers do not meet the eligibility criteria for unpaid parental leave at the time of childbirth (PC, 2009, p3.16).

Despite the absence of a universal PPL scheme, individual workers in certain areas of employment have access to PPL through collective bargaining, public sector employment benefits, or by working for an employer who provides PPL as a key part of their human resources strategy (Baird and Litwin, 2005). However, only close to 50 per cent of employees had some form of PPL available in 2007 (PC, 2009, page 3.1), and arrangements are variable, depending critically on one's employer, duration of work, occupation and industry of employment. Additionally, the duration of leave that is available varies. Current provisions are given in the PC's report (PC, 2009, Chapter 3) but are summarised here for completion.

Inequities in the current system are apparent (e.g., see Baird, Brennan, and Cutcher, 2002). Access to existing paid parental leave is greater for certain groups, namely: full-time employees; employees on higher weekly earnings, reflecting that paid parental leave is more likely to be included as part of more generous remuneration packages; managers, professionals and clerical staff (whose positions generally attract higher wages); employees within public administration, utilities, education and training, and financial and insurance services (PC, 2009, p3.13-3.14).

⁷ However, the \$5,000 Baby Bonus provides a lump sum that is equivalent in dollar amounts to a parental leave scheme of 14 weeks at \$357 per week. Coupled with FTB A, B and Parenting Payment, '...family subsidies in Australia are generous by OECD standards' (PC, 2009, p1.2).

⁸ Workplace.gov.au (2008)

From analysis of the Longitudinal Survey of Australian Children (LSAC), the PC found that over 70 per cent of parents in paid work at the time of childbirth took leave, with the majority of those not taking leave resigning. Mothers take an average of 37 weeks of leave from paid work, with most of this (34 weeks on average) being unpaid (PC, 2009, ch.3). Despite this average being close to nine months, the PC notes that ‘Many parents return to work earlier than six months – often against their own preferences...’ (2009, p.xx).⁹

Against this background, one can put forward a case that demand exists for additional paid parental leave in Australia. The case as argued and summarised by the PC was successful, as evidenced by the creation of a statutory scheme to commence in 2011, however, limitations in duration and amount, largely due to cost constraints, open the door to extending the policy through alternative financing mechanisms such as income contingent loans. Arguments for PPL, for extending PPL beyond the parameters announced for the statutory scheme, and both for and against introducing an ICL for extending PPL, are given in the following section.

2.2 The case for intervention

2.2.1 The case for paid parental leave

A strong argument for PPL derives from observed labour force disparities between genders, which lead to lower retirement savings, skill development and financial independence of women. A barrier to greater participation is that women, due to the generally more flexible and casual nature of their employment, are particularly responsive to work disincentives that arise from the Australian welfare system (PC, 2009, p5.11).¹⁰ In the absence of welfare reform, policy such as PPL may help counter these distortions by encouraging workforce attachment.¹¹

⁹ 26 per cent return within six months, 57 per cent within 12 months, and 74 per cent within 18 months (PC, 2009, p3.1).

¹⁰ For example, Family Tax Benefit A and B, among other benefits, are contingent on income.

¹¹ As this may discourage employment, it is appropriate that eligibility for PPL is made conditional on prior employment. Although a prior employment condition may be seen to disadvantage non-working parents who care for their children full-time, the purpose of PPL is to encourage parental child care during the year after birth while also maintaining and promoting long term workforce attachment. While parents out of the workforce also have financial needs, the existing welfare system caters to these families.

The PC considered the evidence and theory for labour market impacts of paid parental leave (PC, 2009, ch.5), and concluded that PPL would likely promote employment prior to childbirth (if prior employment is a condition of eligibility for a statutory scheme), intentionally decrease employment following childbirth (thus improving health and developmental outcomes as discussed below), and improve attachment to the workforce and workplace. They contended that a consequence could be greater lifetime employment prospects for Australian women (PC, 2009, p5.1).

PPL may also lead to a more equitable distribution of formal and informal labour between men and women with young children, and allow low income workers the opportunity to care for their children (e.g., see Jongen *et al.*, 2001). Thus a benefit may be greater family equality and role sharing.

Advocates of PPL claim there are important physical and mental benefits of policy that encourages recent mothers not to resume paid employment too soon after the birth of their child (see, for example, HREOC, 2002; O'Neill, 2004). Evidence of the benefits of parental leave on the health and wellbeing of parents and children is considerable, and is summarised in Chapter 4 and Appendix D and H of the PC 2009 report. Benefits can be considered as two-fold: maternal health and wellbeing, and improved child health and development.

Early returns to work due to financial pressures can detract from both maternal mental and physical health, increasing the risk of depression and anxiety. Evidence points to a positive relationship between length of leave and maternal health and wellbeing. Quoting the PC: 'On health and wellbeing arguments alone, the optimal length of absence from work for a new mother should be longer than 12 weeks and potentially up to six months...' (PC, 2009, p4.15).

Despite the biases inherent in observational studies and the inconclusive nature of much of the biomedical literature on breastfeeding, as noted by the PC (2009), there nevertheless exist compelling studies and meta-analyses that consider the evidence of child health benefits of breastfeeding to be convincing. In addition to child health benefits, research suggests cognitive advantages from breastfeeding, as well as maternal health benefits (PC, 2009, p4.21). Recommendations from the World

Health Organisation, and the American Academy of Pediatrics, among others, are for six months of exclusive breastfeeding. The PC referred to both International and Australian evidence suggesting a correlation between leave from employment and the duration of breastfeeding, suggesting that PPL may lead to increased incidences of breastfeeding (2009, p4.26).

Apart from health benefits derived through breastfeeding, there is evidence of additional child health and developmental benefits facilitated through PPL. Lower post-neonatal mortality rates are associated with paid leave (attributed partly to more careful scrutiny of ongoing health through check-ups and immunisation). Moreover, parental care in early life (for at least the first six months¹²) is associated with a reduction in behavioural problems and cognitive delays, provided the care received at home is sensitive and responsive (PC, 2009, p4.45). Additionally, evidence suggests that child wellbeing is improved through increased family income.

Summarising the evidence, the PC concluded that six months of exclusive parental care, facilitated by paid parental leave, will generate health and welfare benefits, including reduction in the risks of maternal depression and anxiety, and health and developmental benefits from increased breastfeeding and parental care (PC, 2009, p4.53).

It is clear that improved physical and mental health of both parents and children directly benefit the family, as would workforce attachment through greater lifetime income, however, is it also the case that society benefits? Are there externalities?

2.2.2 Who should pay?

When considering whether government should create policy and commit funds to support PPL, one must ask whether the public benefits outweigh the costs. The identification of positive externalities would suggest a case for government intervention in PPL; if the benefits of PPL are returned to society then the costs should be borne by society. Equally, if a portion of the benefits are returned to the

¹² The PC noted that good quality care can be beneficial to cognitive development sometime after six months, however, the age at which these benefits manifest is not established and will depend on the quality of non-parental care versus parental care received at home (2009, p4.45).

individual, then the individual should finance a portion of the leave. The combination of both public and private benefits of PPL is an argument for the sharing of costs between government and recipients over broad taxes.

Nevertheless, the PC (2009) identified externalities that were used as the basis for an exclusively taxpayer funded scheme.

As summarised by the PC (2009) and discussed in the previous section, the evidence suggests that PPL can foster workforce attachment, thus leading to greater expected lifetime incomes. Using an analogy from higher education, if the private costs of education are reflected in the earnings of graduates, then it can be argued that there is a lack of rationale for subsidising students out of tax revenue.¹³ A paucity of empirical studies, and inconclusive theory on the relationship between PPL and earnings, makes determination of the relative magnitude of community versus private benefits impractical. Regardless, improved workplace attachment can lead to reduced staff turnover and associated reductions in recruitment and retraining costs for employers.

Moreover, the PC presented a strong case that positive externalities emerge from PPL in the form of reduced pressures on the health system due to enhanced maternal and child health and development, as well as broad social benefits from the promotion of gender equity and work/family balance.

As with income, however, it is not practical to separately identify and quantify the private and public benefits, hence the level of subsidisation is open to debate. The question of whether paid parental leave should be funded partially or exclusively by government is partly an ideological one, as it relates to one's belief about the purpose and use of tax revenue. It also is a question of equity. Subsidisation may result in income redistribution, as well as improved scheme participation, however this possibility does not imply that the taxpayer should necessarily pay.

As an 18-week statutory scheme funded by general revenue has been announced by government, arguments on the appropriateness of taxpayer funding for the statutory

¹³ It is noted that there is controversy in identifying the magnitude of the external benefit, though it is accepted that a positive externality exists (e.g. see Cigno and Luporini, 2009)

PPL scheme, and other funding alternatives, will not be covered in this chapter. For a discussion, see Chapter 8 of the PC 2009 report. Instead, the present focus is on funding an extension of the duration beyond 18 weeks, or extension of the payment beyond minimum wage.

2.2.3 The case for extending the statutory PPL scheme

It was intended by the PC that their recommendation of 18 weeks provide sufficient postnatal leave so when supplemented by people's private efforts, '...will allow almost all infants to be exclusively cared for by their parents for the first six months of life.' (PC, 2009, p4.1).

At the same time they acknowledged that there is a '...reasonable prospect that longer periods (of up to nine to 12 months) are beneficial' (PC, 2009, p4.53), and recognised that certain benefits may persist for substantially longer periods of leave: '...There appears to be a greater potential for positive effects [on a child's development] if a return to employment is made between 12 to 18 months.' (PC, 2009, p4.41)

The difficulty in selecting the duration for leave is acknowledged by the PC, '...there is no exact science about choosing the precise duration...' (PC, 2009, p.xxi), and there are conflicting pressures. While maternal and child health and welfare can benefit from a period of parental leave, excessive leave may jeopardise workforce attachment. There are also financial considerations when proposing taxpayer funding. Notably, 'The benefits to children and parents from incrementally longer periods of leave have to be weighed against their (appreciable) budgetary costs' (PC, 2009, p.xxi).

It is also the case that the most disadvantaged families, being those without access to existing paid parental leave schemes or other forms of accrued leave, would benefit most from a statutory PPL scheme, and yet it would be this group who is most liquidity constrained, unable to utilise private resources to supplement an 18-week statutory scheme.

Consequently, although it may be the case that a majority of parents are able to take 26 weeks of leave once the new scheme is introduced:

- the minority who do not have the available resources to stretch their leave to 26 weeks are those who may be most financially disadvantaged;
- the evidence presented by the PC suggests that longer periods of leave (beyond six months) are likely beneficial to child and parental health and wellbeing.

Additionally, there is the prospect that the amount provided through a statutory scheme (being minimum wage) is insufficient for many parents to meet their financial obligations, and will thus have limited behavioural effect in encouraging parents to remain at home and care for their infants during the critical first six months following birth.

These observations provide motivation for considering extensions of the statutory PPL scheme to allow for both greater durations of leave beyond 18 weeks, and greater amounts above minimum wage. In the next two sections the arguments for and against using an income contingent loan for these purposes are presented.

2.2.4 The case for an income contingent loan

In the previous section it was shown that externalities are likely to persist for longer durations of leave beyond the 18 week statutory scheme and beyond the six months of leave which a majority of eligible parents may afford, upon introduction of the statutory scheme. This supports the consideration of government subsidisation for periods of leave beyond 18 weeks. Equally, as the amount of PPL at minimum wage may be insufficient to encourage leave among those with large financial obligations, positive externalities may be present should increased amounts lead to higher take-up of PPL.

However, as the PC notes in their report (2009), the evidence for benefits of increased leave beyond six months is less decisive than for periods up to six months, and higher amounts or durations of government provided PPL will result in higher

budget costs. A related criticism is that financing an extension through general revenue would exacerbate inefficiencies in the taxation system, putting downward pressure on the labour supply of those not entitled to parental leave. The uncertainty surrounding the magnitude of the externalities for greater leave, coupled with budgetary restrictions, point to alternative financing instruments for additional leave durations or amounts.

While market priced loans provided through credit facilities may provide a source of financing for individuals with steady income streams, in periods of leave from employment, parents without collateral will find the market reluctant to lend. The market failure in this context is that of incomplete or asymmetric information. (e.g. see Hindricks and Myles, 2006). As with students borrowing to fund education, families taking parental leave undergo periods of reduced income. Although some private lending institutions may consider lending to parents with collateral, new parents generally haven't accumulated sufficient home equity or savings. Unlike borrowing based on home equity, insurance is not available against future earning risks due to the asymmetric information concerning future work intentions, hence the reluctance of the market to lend. Liquidity constraints coupled with this market failure, points to the need for government intervention.

Although separate instruments could be proposed - for example, explicit subsidies to address the positive externalities, and a separate loan to address the market failure - it is argued below that an income contingent loan can address the policy failures, while providing additional attractive features not available in traditional policy instruments.

That some type of intervention is required is clear, as without government intervention, liquidity constrained parents wishing to take leave beyond that offered through the statutory PPL face returning to work at a time that may be sooner than optimal from the perspective of maternal and child health and developmental benefits.

An ICL is a possible alternative to a traditional taxpayer funded grant and/or loan. It provides a source of funds for leave thus addressing liquidity constraints; it can be flexibly designed to allow sharing of costs between the recipients of the leave and

the broader community; the instrument enables consumption smoothing and is likely to be progressive in that proportionately greater costs are borne by those with higher incomes; and unlike a standard loan the contingent repayment feature encourages participation in the activity by offering insurance against default. These features are discussed in some detail below.

Flexibility in apportioning cost

Unlike a taxpayer funded grant which spreads costs among all taxpayers, for a risk sharing ICL, those whose incomes are above a minimum threshold repay the loan, and the balance of the debt is shared among all taxpayers (including the non-rePAYERS).

By varying the thresholds and rates of repayment, and the indexation rate applied to the debt, it is possible to alter the proportion of debtors repaying and the magnitude of loan recovered from the recipients. Thus, perceptions of the existence and magnitude of externalities and beliefs on how costs should be shared between recipients and all taxpayers can be accommodated by changing the loan parameters. At the extremes, setting repayment thresholds at zero dollars and loan indexation at the government's cost of capital would result in nil public outlays (with the exception of bankruptcy claims). Conversely, it is possible to set thresholds and indexation rates to a level at which the government subsidy is 100 per cent. This flexibility is discussed further in Section 2.2.5 as a way of countering adverse selection, and explored in the modelling described in Section 2.4.

Consumption smoothing

In the absence of an ICL for extending PPL, individuals would be faced with either forgoing the additional leave, or dramatically reducing their current consumption in order to allow for reduced income while on leave. An ICL provides the family with liquidity to supplement their reduced income while on leave. Repayments of the loan are made gradually in the future. This enables families to retain higher levels of consumption in the short-term than the levels they would otherwise have experienced had no funding been available, and future consumption is reduced as loan repayments are made.

This aspect of consumption smoothing is common to standard loans, however, a key attraction of ICLs that is not shared in the credit market is that repayments are a function of income; the higher the income, the greater the repayment, and vice versa. Thus income is smoothed over the term of the loan.

The income smoothing is intentional, as it ensures affordability of repayments, but also provides a hedge against the uncertainty of returns to the parental leave investment. Those who gain most economic benefit from the period of leave through workforce retention and improved lifetime income – i.e., those who derive most private benefit – repay the loan; whereas those who gain least make low or nil repayments, in which case the default insurance mechanism implicit in income contingent loans comes into play (described below). Thus, the loan reduces to a grant for those who derive the least economic benefit from the leave.

Insurance

A key argument for HECS is the uncertain returns from investments in human capital. When a student commits to the financial and opportunity costs of higher education, they hope the gamble pays off. Although success is determined by individual effort, it is also determined by factors beyond the student's control, such as ability and the demand for skilled employment in the student's chosen field of study. If the education leads to improved employment, the student benefits, as does society more generally.

As with higher education, a benefit (and for some, a motivation) for parents taking PPL is preservation of workplace attachment.¹⁴ In the case of higher education, the hope is that the extra years of study will increase their income beyond the private costs of their education plus what they would otherwise receive in the absence of higher education. For PPL, the hope is that by taking leave this will allow the parent to retain their human capital investment in previous employment, thus leading to greater lifetime income than if they were otherwise faced with having to quit work to raise their newborn child and seek new employment in the future.

¹⁴ For many the primary motivation would be to spend time with their infant following birth.

For higher education, there is a risk that the payoffs from undertaking further education will be lower than expected. ICLs applied to higher education mitigate this risk by providing insurance through the contingent feature of the instrument. For PPL, one could argue that there is similarly a risk that despite the leave, the parent's future income prospects may be damaged relative to their prospects had they not taken leave.¹⁵ This could arise, for example, due to the lost work experience and lack of involvement in the workplace during the period of leave. By this argument, the insurance feature of ICLs for both higher education and PPL has a similar purpose: namely to mitigate the risk associated with undertaking the activity, thus leading to increased participation in the activity.

This insurance mechanism not only provides short-term reassurance, but operates for the duration of the debtor's life, providing default insurance should the individual suffer long-term adverse economic hardship despite, or because of, the activity. This feature makes ICLs more attractive than standard loans, be they from government or the private sector (in the event that market failure was not present). Loans without the contingent feature would not offer default-protection, and would require regular repayments regardless of the hardships facing the debtor. In the event of default this would pose significant issues for the borrower's credit reputation.

Equity

The insurance mechanism and progressive repayment thresholds of income-contingent loans can be considered an implicit means-test. The purpose of means-testing is to target funds to those most in need, thus promoting equity. While significant government policy that involves the provision of funds to families is subject to income testing (e.g., Family Tax Benefit A and B), existing mechanisms are typically inefficient; over-charging of entitled families leads to debt retrieval, with associated administrative burden and family distress.¹⁶

¹⁵ Additionally, there is a risk that the investment in their child's development through PPL doesn't justify the outlay, however, this would be difficult (if not impossible) to ascertain.

¹⁶ In practice fortnightly FTB A and B amounts are estimated based on expected income for the year, and adjustments are made retrospectively once the exact income is known. This means that some parents wind up repaying their overpayments - in practice a portion of the FTB A and B (known as FTB supplement) is withheld until the end of the year to reduce this risk.

Under an income contingent loan those with low incomes will not meet the minimum repayment threshold and for these individuals the loan becomes a grant, akin to a non-repayable social benefit such as Family Tax Benefit. For those whose incomes exceed the minimum threshold (analogous to a social security income-test) repayments are required. The income-contingent feature thus ensures equity while avoiding the errors in misdirecting financial support and associated retrieval of debt that plague traditional means-testing policy.¹⁷ Equity is further discussed in Section 2.2.5.

2.2.5 *The case against an income contingent loan*

Adverse selection and moral hazard are two risks that can jeopardise the intentions and operations of policy (e.g., see Moss, 2002). Adverse selection in the context of an income contingent loan for PPL refers to the situation when individuals who choose to participate in the scheme are those who are most likely to require high government subsidisation. This is a particular risk in policy design where participation is voluntary, such as for the ICL proposed in this chapter. Adverse selection could occur if participation was favoured among debtors who expected not to re-enter the workforce following leave, who expected to work at low incomes part-time or casually in the future, or who emigrated or spent considerable time overseas. Scheme design is critical in order to mitigate adverse selection. For example, if repayment obligations were the responsibility only of the person taking out the loan and undertaking the leave, a mother could participate with the expectation that they may never earn above the minimum income threshold for repayment, or rarely earn above this level, leading to total or high subsidisation of their loan. Even if income was earned above the minimum threshold, the timing of when this income was earned may affect the subsidisation in the event that loan indexation and discount rates differed.

Moral hazard in this context refers to the situation when a debtor intentionally changes their behaviour in order to either avoid repayment, or prolong repayment in

¹⁷ Indeed it is conceivable that existing welfare policy that targets individuals through income-testing (such as the FTB A, B, etc.) could be made more efficient (and equitable) by replacement with appropriately structured income contingent loans. Means testing determines eligibility in the current time period, and eligibility is based solely on current circumstances with no consideration of future prosperity. If a family or individual requires welfare as a consequence of current hardship, but subsequently enters into propitious circumstances, they have no obligation to repay the state (and the taxpayer) for the previous financial support.

the event that the loan is subject to concessional indexation. As with adverse selection, this could occur if a debtor intentionally did not re-enter the workforce following leave, who worked at low incomes part-time or casually in the future so as to avoid repayment, or who intended to emigrate or spend considerable time overseas.

As these risks could jeopardise the workings and purpose of an ICL applied to PPL by dramatically increasing costs or by discouraging workforce participation, the ICL described in this chapter is developed with careful consideration of both adverse selection and moral hazard. Moss strongly advocates the need to include an in-built mechanism to limit moral hazard (2008). It is shown through the modelling in this chapter that incorporating appropriate scheme design features and parameters, can mitigate both adverse selection and moral hazard, and can reduce the public costs of the scheme while retaining desired features.

Even if such risks were minimised, an ICL may be subject to other criticisms. One possible criticism is that ICLs with taxpayer subsidisation may accentuate inequities in income distribution. For a traditional tax-subsidy system applied to higher education, the higher the subsidy, the greater the potential reverse redistribution of income, as funds are provided by the public to those with higher than average expected future income (e.g., see García-Peñalosa and Wälde, 2000; Cigno and Luporini, 2009). García-Peñalosa and Wälde (2000) argue that a risk pooling ICL (which they call a graduate tax) for higher education is more equitable. This involves all shortfalls in debt repayments being paid exclusively by those debtors with incomes above the minimum threshold, thereby excluding the general taxpayer from having to contribute. This increases equity; it reduces the differences in lifetime incomes between unsuccessful and successful students and those not participating in higher education, by spreading the costs of subsidisation among successful students only. When subsidies are included as part of public policy, however, this raises an unavoidable trade-off between efficiency and equity. García-Peñalosa and Wälde (2000) note that risk sharing ICLs tend to be more efficient than graduate taxes (i.e., they lead to greater likelihood of participation). In risk sharing the expected costs for students are reduced due to subsidisation from general taxpayers. Hence, it can be argued that in the event of positive externalities then a

risk sharing ICL is more appropriate as it contains an implicit subsidy, unlike a graduate tax.

Whether inequitable income redistribution is also a potential concern for an ICL for PPL depends on the returns to income from leave to debtors when compared with the broader taxpayer population. Indeed, the provision of an ICL may improve equity, as it can address existing income inequities between genders by promoting workforce attachment and family/work balance.¹⁸ As previously stated, the ICL can be tailored to allow greater or lesser levels of taxpayer subsidisation, hence resolving the question of equity need not precede further consideration and exploration of ICLs in this context.

A further possible criticism is that excessive leave, made possible through a poorly designed ICL, could hinder rather than improve workforce attachment, by leading to erosion of skills and confidence. Consequently, any additional loan amount or duration should be carefully considered in scheme design. Restricting the loan amount has the added effect of mitigating moral hazard and adverse selection.

Finally, there is an argument that an ICL may appear to be a more complex policy instrument than that required to address the apparent liquidity constraint and market failure. If a parent desires an amount in excess of the original 18 week grant, why not offer a repayable loan? Jongen, Kuipers and Westerhout (2001) note the borrowing constraints of young families, and hypothesise on the use of loans to parents in order to cover leave: 'In this way, the costs of the parental leave arrangements are borne by the beneficiaries, which may lead to a more efficient choice regarding labour supply and informal care.' (Jongen *et al.*, 2001:36) Indeed, government-provided loans may be seen as an appropriate instrument in the event that the benefits of leave are considered to be predominantly private. A response is that there is evidence that externalities may exist for leave durations in excess of those covered in the statutory scheme, and hence there may be an argument for partial subsidisation.

¹⁸ That said, it may be considered by some that there are inequities in the provision of the leave, as eligibility is confined to new parents with existing workforce attachment, but see Section 2.3.2.

However, in the event that no subsidisation is desired, it is conceivable that a risk sharing ICL scheme can be designed to have *zero net subsidisation*, while retaining the desirable features that encourage participation (and hence help foster positive health and development outcomes and workforce attachment), namely default protection and repayment relief during periods of financial hardship. The scheme and models developed in this chapter explore this possibility. Zero net subsidisation can potentially occur because of cross-subsidisation between scheme participants. A risk sharing ICL with zero net subsidisation mimics a risk pooling ICL. However, it is reasonable to expect that a risk sharing ICL would be seen as more attractive to participants due to the potential for taxpayer subsidisation, thus encouraging higher participation. Additionally, risk sharing allows for subsidisation of externalities.

Other possible criticisms of ICLs in this context, some of which are raised by the PC in their draft report (2008), are described and addressed in Section 2.3.

2.3 Designing an ICL for PPL

In this section the design parameters for an income contingent loan for PPL are proposed. For brevity, the ICL for PPL is referred to subsequently in this chapter as PPICL.

The parameters and loan features described below are incorporated into a simple model at the individual family level in Section 2.4 in order to illustrate how a scheme might work in practice, and the likely implications for both recipients (families) and the provider (the government) are explored.

Although many design parameters remain unchanged for the scenarios modelled, other parameters are varied to illustrate the flexibility of an ICL in this context, and for the purpose of considering plausible design options.

2.3.1 Employer participation

As employers benefit from the workplace attachment generated through PPL, rather than the debtor being solely responsible for repayments, employers could participate by negotiating arrangements to repay part, or all, of their employee's outstanding loan. Chapman (2002) suggests that these employer contributions should be made conditional on the parent returning to their original job since in this situation the employer gains. There are reasons in labour market theory for promoting such a possibility (e.g., see Becker, 1962), as in the event that the parent does not return to the original employer, the firm's specific training investments in the worker are lost. In administrative terms this would appear to be straightforward, but no modelling has been undertaken of this possibility herein.

As raised by Gans (2008), any scheme increasing the incentive for PPL could potentially also increase discrimination towards those most likely to take that leave due to the prospect of lost returns to training investments. By increasing the probability of the parent returning to their original job, shared loan arrangements could reduce the risk of discrimination. Shared loan arrangements would also mean that the relative contribution to loan payments would be higher for parents choosing not to return to the original job. Significantly, and in addition, having employers contribute to loan repayments would increase the proportion of debt recovered by government and decrease the implicit subsidies.

The simplest arrangement, however, would see the ICL provided by the government and to be repaid by the debtor and/or the family depending on the level of their future incomes. It is this simple government-provided loan scheme, excluding employer involvement, which is examined in detail and is the subject of modelling in this chapter.

2.3.2 Loan eligibility

Conditions on eligibility are essential in order to discourage adverse selection. Eligibility to participate in the loan scheme should ideally be restricted to parents in employment prior to paid maternity leave, as this would indicate stronger labour

force attachment and consequently higher chance of debt repayment. Importantly, eligibility criteria based on previous employment is not neutral, but will affect choices prospective parents make regarding labour force participation. Specifically, placing a prior employment condition on scheme eligibility may incentivise women intending to have children to engage in the labour force.

This condition is consistent with the 18-week government scheme which limits eligibility to parents who have ‘...been employed continuously (with one or more employers) for at least 10 of the 13 months prior to the expected birth of the child, and who undertook at least 330 hours of paid work in the 10 month period’ (PC, 2009, p2.1).¹⁹ The specific details of what constitutes prior employment can be complicated and are the subject of considerable discussion in the PC draft report (see, in particular, PC, 2008, p2.5). Eligibility conditions relating to past work patterns are not required for the scenarios generated in this chapter, but are critical in development of projections of aggregate take-up and costs.

As it is proposed below in Section 2.3.6 that the partner should also be responsible for the debt under the PPICL, it could be argued that the risk of adverse selection is sufficiently reduced and thus the prior employment condition could be relaxed. Although this may be true for couples it is not the case for singles, and although not making the loan facility available to non-working mothers may be seen as inequitable, the purpose of the proposed ICL is as a temporary income replacement while the parent is on leave from work, and not as a reward for unpaid care.²⁰ Both couples and single parents who satisfied the previous employment condition would be eligible for the ICL under the proposed scheme.

2.3.3 *Loan duration and amount*

As was shown in Section 2.2.3, there are sound arguments for leave durations in excess of 18 weeks and payment amounts in excess of minimum wage. Under the scheme design which is subjected to the majority of modelling in Section 2.4, the

¹⁹ The government scheme also limits participation to primary carers who have earned less than \$150,000 in the full financial year prior to the birth or adoption of a child (Commonwealth of Australia, 2009a, p236).

²⁰ Additionally, costs, including doubtful debt, could be considerable if the ICL was offered to all parents.

parent could take out a loan from the government to extend leave for ten weeks (after expiry of an 18 week entitlement paid for by taxpayers) for a first child (or twins). In the modelling a further ten weeks is allowed for a subsequent birth. An ICL duration of 26 weeks (6 months) is presented for comparison. Although Chapman, Higgins and Lin (2008) modelled a 26 week ICL duration exclusively, this was undertaken prior to adoption of the 18 week statutory scheme, and it is recognised that excessive paid leave options may adversely affect workforce attachment by eroding skills and reducing desire for re-employment. A review of empirical evidence by the PC found ‘...that the labour supply effects of paid leave peak at around 20 weeks’ (PC, 2009, p2.46), however, the evidence is far from conclusive. Regardless, this cannot be considered in isolation, as benefits of leave extend beyond those of workforce attachment to child health and development, which as stated earlier, evidence suggests may benefit by up to 12 months of exclusive parental care (PC, 2009, p2.44).

In the first instance it is assumed that the size of the loan per fortnight is the hourly federal minimum wage²¹ multiplied by 76 hours (38 hours per week). For ten weeks of leave the loan for one child would be \$5,438; or \$10,876 for two children. With the 26-week cap this comes to \$14,138; or \$28,277 for two children. Under one example explored in the modelling these amounts are modified by considering interactions with the existing government benefit system. This is explained in Section 2.3.4.

An alternative to fixed loan amounts is also considered, where individuals are able to borrow amounts up to the income they were receiving prior to commencing leave. In this case the borrowed amount will vary according to the income quartile of the debtor. It is assumed that the loan supplements the minimum wage provided for the duration of the 18 week scheme, and the full replacement income is further provided for 10 weeks beyond the 18 week scheme. By allowing individuals greater financial access while limiting leave duration, this may increase the effectiveness of tying the debtor to the workforce, while minimising possible skill erosion from prolonged

²¹ As at October 2008 the Federal Minimum Wage stood at \$543.78 per week (\$14.31 per hour). (Australian Fair Pay Commission, 2008). While this has since risen to \$15 per hour, the modelling in this chapter is based on the October 2008 level.

leave duration. The consequences to costs of debtors committing themselves up to their maximum earning potential are explored through modelling in Section 2.5.4.

2.3.4 Interactions with existing government benefits

There is a number of existing government benefit payments that parents of young children are able to access for the purpose of child rearing. These include the Family Tax Benefit A (FTB A), Family Tax Benefit B (FTB B), Parenting Payment (PP), and Baby Bonus (Centrelink, 2009). As the ICL for PPL is conceived as an optional loan, the policy should not affect eligibility for existing non-repayable government payments; to do so would potentially reduce the incentive to participate in the scheme.

As the purpose of intended intervention is to provide sufficient income to facilitate parental leave, it can be argued that determination of an appropriate ICL amount should take into account existing government income support.

Rather than attempting to model an optimal arrangement for how an ICL should interact with existing family benefits, one circumstance is offered to illustrate the potential interaction with the welfare system; an ICL is considered such that the loan plus FTB A, FTB B, and PP, is equal to the federal minimum wage of \$543.78 per week.²²

An implication is that eligible single parents on low wages who are already in receipt of high government benefit payments would be able to borrow relatively less than higher-earning parents who may have access to only partial payments. A further implication is that all eligible individuals, regardless of their marital and financial status, would be able to access an equal amount of government support, being equivalent to minimum wage. Indeed the support mechanisms in aggregate maintain progressivity; single low-income parents derive the majority of their income support during periods of parental leave through existing non-repayable benefits,

²² Importantly, it is assumed that the ICL is not taxable, and doesn't affect eligibility for benefits. It is also assumed that receipt of the Baby Bonus is unaffected by the availability of the ICL.

supplemented with the ICL, whereas eligible higher income couples derive the majority of support through the ICL itself.

At first glance, the administration of an ICL with variable payments may seem complex. In practice fortnightly FTB A, B and Parenting Payment amounts are estimated based on expected income for the year, and adjustments are made retrospectively once the exact income is known. This means that some parents repay their overpayments - in practice a portion of the FTB A and B (known as FTB supplement) is withheld until the end of the year to reduce this risk (Centrelink, 2009).

If an ICL amount was lent out based on receipt of FTB A, B and PP, which in turn was dependent on income throughout the year, then overestimating or underestimating income would have implications to both the government benefits received as well as the ICL. If income was overestimated, this would imply that lower government benefits should have been received, and a higher ICL offered. Similarly, if income was underestimated, this would imply higher government benefits and a lower ICL. Either way, incorrect estimation of income would not change the absolute level of income received, but instead would change the proportion received as a grant (FTB A, B and PP) and the proportion received as a loan (ICL). In the event that insufficient FTB was paid out to the debtor, part of the ICL already provided could be forgiven (i.e., part of the loan would become a grant, as this has the same net effect as increasing FTB). In the event that excessive FTB was paid out, the excess amount could simply be added to outstanding ICL balance. In this sense, the operations would be less financially disruptive to a recipient than if current administrative methods for FTB retrieval continued.

2.3.5 Debt indexation and surcharge

As with HECS, for most of the examples considered in this chapter it is assumed that the loans are indexed to inflation as reflected by changes in the CPI. Although this implies a zero real interest rate, a surcharge of 20 per cent on the borrowed amounts is proposed, so the outstanding debt, or amount to be repaid, is 20 per cent more in nominal terms than the amount borrowed (e.g., if someone borrowed \$100

they would have to repay \$120.) This is consistent with the FEE-HELP loan scheme (DEST, 2007), which is available to assist students pay tuition in all post-graduate courses, all private sector higher education institutions and a subset of vocational education and training courses. The 20 per cent surcharge acts as a blunt form of real interest rate.²³

In their final report the PC supported the use of ICLs for extending the duration of leave, subject to application of a current mortgage interest rate (PC, 2009, p8.20). In Section 2.5.5 a real indexation rate is used in place of the loan surcharge and the implications are discussed.

To encourage re-entry to the workforce following expiration of paid leave, thus mitigating moral hazard, incentives could be applied. One possibility is the freezing or capping of interest on the loan once income exceeds the minimum threshold, an event likely correlated with a return to employment²⁴, however this option is not explored in the modelling of this chapter.

2.3.6 *Repayment conditions*

Repayments are made when assessable income exceeds a specified minimum threshold.²⁵ The choice of minimum threshold, and the decision as to who repays, are important considerations in policy design as both can be critical in mitigating the risk of adverse selection.

Firstly, the repayments of the income contingent debt should be made the obligation of both parents (provided they are a couple at the time of the loan contract). Importantly, this would reduce the risk that a mother takes out the loan with the intention of never returning to work or intentionally keeping their income below the minimum threshold. In this situation, total repayments during each time period are the sum of the two repayment amounts, which are assessed based on each of the

²³ Lin (2007) also uses a 20 per cent surcharge.

²⁴ Alternatively, or in addition, interest could be frozen or capped while the child is younger than school age (e.g., for the first five years of life), recognising the increased caring obligations of parents during this time.

²⁵ A mathematical exposition of the income thresholds and repayment rates for an ICL is presented in Appendix A1 of this thesis.

parent's individual incomes. Basing repayments on both parents' incomes for couples is feasible logistically as the current tax collection mechanism in Australia allows for the collection of spouse details. Moreover, if both parents are treated individually by the ATO in calculation of the compulsory repayment, this removes a possible complication in the event the parents separate. In this circumstance, the outstanding balance would remain a liability of both parties irrespective of the status of their relationship.

A complication that could potentially arise is moral hazard manifesting from parents intentionally not declaring themselves as a couple in order to avoid the father's liability. To guard against this risk, discounts on the loan or freezing of interest on the debt could be considered for those declaring two persons as liable on the loan document.²⁶ Similarly, to further reduce taxpayer subsidies by increasing the chance of repayments, for single parents who wish to take advantage of discounts for multiple signatories, the loan rules could be expanded to allow other individuals (for example, a direct family member) to take liability by signing the loan document, though these considerations are not modelled here.

Secondly, to mitigate the possible costs due to non-retrieval of debt as a consequence of low future incomes a lower first income threshold of repayment for the scheme should be proposed.²⁷ This is likely to be particularly appropriate for the small minority of mothers living separately from the father of their child at the time of the parental leave. In order to avoid hardships associated with repayment in this circumstance there would be a commensurate reduction in the proportion of income required (from the four per cent with HECS, to, say, two per cent).

To achieve this, a minimum threshold of \$28,259 is applied, which is equivalent to the exempt income amount under the Australian Child Support System (CSS)²⁸ for a parent with a dependent child under the age of 13 in 2008. This threshold is

²⁶ This option was suggested by David Moss via personal correspondence following presentation of this draft research during the ARC ICL Workshop in August 2008.

²⁷ This approach is adopted by Lin (2007), and earlier by Chapman, Freiberg, Quiggin and Tait (2004) with respect to the modelling of an income contingent fine payment system for low level criminal offences.

²⁸ see http://www.csa.gov.au/guide/2_4_2.htm. This amount is higher than the exempt income level available for parents with no dependents due to the costs associated with raising a child.

considered as a suitable proxy for the lower limit of income affordability for individuals faced with child rearing responsibilities.²⁹

Thus, for the modelling in this chapter the 2008–09 HECS repayment rules³⁰ adjusted by imposing the additional requirement taken from the CSS rules, result in the annual payment thresholds and rates in Table 2.1.

TABLE 2.1 REPAYMENT THRESHOLDS AND RATES FOR PAID PARENTAL LEAVE SCHEME

Repayment threshold	Repayment rate (per cent)
Below \$28,259	Nil
\$28,260-\$34,926	2.0
\$34,927-\$41,594	3.0
\$41,595-\$46,333	4.0
\$46,334-\$51,070	4.5
\$51,071-\$53,754	5.0
\$53,755-\$57,782	5.5
\$57,783-\$62,579	6.0
\$62,580-\$65,873	6.5
\$65,874-\$72,492	7.0
\$72,493-\$77,247	7.5
\$77,248 and above	8.0

2.3.7 Additional parameters

Because the scheme involves repayments over time with differing indexation arrangements, some assumptions are required with respect to price and wage change: these are 2.5 per cent (the middle of the Reserve Bank of Australia’s acceptable band for price inflation) and 4 per cent per annum respectively, which are the approximate rates over the past decade in Australia (RBA, 2009a, 2009c). Consistent with the HECS-HELP and FEE-HELP arrangements, the income thresholds are adjusted with this assumed rate of growth in average weekly earnings.

As is the case with HECS-HELP and FEE-HELP, there is no liability for repayment of the debt from the debtor’s estate upon the death of the borrower. Furthermore, in

²⁹ Under the CSS the income used in the determination of support differs with the number of dependent children, but for the sake of simplicity this has been ignored here. The income threshold of \$34,926 per annum was selected because it is approximately mid-way between the new minimum threshold and the HECS minimum. Determination of rules for calculating repayments in practice can be particularly complex and so will not be explored further here. An appreciation of the complexity in such schemes can be gleaned from examination of the rules for the CSS.

³⁰ See <http://www.goingtouni.gov.au>

the modelling undertaken for this exercise a 1-year waiting period has been applied from the final loan payment before repayments are required.

2.3.8 Dealing with adverse selection and moral hazard

Many of the design features described above help control against adverse selection and moral hazard. First, eligibility is restricted to a parent or parents in employment prior to paid maternity leave. Second, both parents are responsible for the debt obligation provided both are present at the time of the leave. Third, either real indexation rates or a surcharge could be imposed on the loan, both of which may deter participation from borrowers who are tempted to take out the loan due to potential low cost. Fourth, a low first income threshold below that applying to HECS is applied to the loan. Other features, such as employer participation, offering incentives for multiple loan signatories or returns to employment (such as interest rate capping), could further help to reduce adverse selection and moral hazard.

In Australia there is an additional issue of PPL borrowers potentially having an existing HECS debt. The prospect of a similar debt for PPL might reduce the attractiveness of the scheme thus discouraging participation, it may encourage relatively high borrowings from former higher education students (adverse selection), and/or may act as a disincentive to earn above the minimum repayment threshold (moral hazard) given the magnitude of the debt.

To ascertain the prevalence and magnitude of HECS debts among young mothers, Wave 6 of the HILDA survey was analysed, revealing that approximately 15 per cent of young mothers potentially eligible for the ICL have a HECS debt.³¹ This proportion will understate the future as the population of tertiary graduates as an absolute number, and as a proportion of the population, is increasing (ABS, 2007b). Multiple income contingent loan debt obligations could conceivably become a financial strain should a new variant of the scheme be introduced. A simple way forward would be to group all such debts together, and have one compulsory repayment based on income which would go towards reducing the combined debt.

³¹ Women aged between 25 and 34 with at least one child aged less than 5 were extracted from HILDA. Of the 396 in the sample from Wave 6, 63 or 16% had an outstanding HECS debt. When the age range was extended to 20 to 39, the proportion with HECS dropped to 12%.

This would have the effect of extending the duration of the loan(s), thus increasing the net subsidy, but not the magnitude of the annual repayment obligation. This is illustrated in Section 2.5.2 when compulsory repayments of an ICL for PPL are considered in the presence of a HECS debt.

2.4 Modelling an ICL for PPL

A basic model is developed in this section to illustrate how the scheme might operate in practice under a range of design parameter options for four hypothetical scenarios. The model development of this chapter is similar in structure to Chapman, Higgins and Lin (2008) and Chapman and Higgins (2009).

The scenarios illustrate how such a scheme might work in practice by showing patterns of outstanding debt, repayments, and government subsidy for the design options given in Section 2.4.3. Modelling results are presented in Section 2.5.

The model used is deterministic in that the labour force states and projected incomes of the family units are pre-determined over the projection period. Income mobility is ignored (i.e., individuals are assumed to maintain a static income ranking relative to other individuals for the duration of the projections), however, individuals' static incomes in the scenarios considered cover a range of levels in order to illustrate the extremes in possible repayment outcomes. This is in contrast to Chapter 4 where labour force state and earnings are allowed to vary stochastically. In Chapter 4 the method of modelling of the current chapter is critiqued as a consequence of comparison with dynamic stochastic models. While the subsidies calculated in the remainder of this chapter are intended to be accurate under the specified pre-determined assumptions, they will differ in the presence of labour force or earnings mobility. Importantly, it is shown in Chapter 4 that by ignoring mobility, static models generally over-estimate costs. Consequently, the subsidy estimates below (for the most part) can be considered an upper-bound.

The modelling in the current chapter is predominantly based on four hypothetical families³²; the purpose being to show the type of variation in repayment patterns and subsidies for typical family structures.

2.4.1 Scenarios - constructing a basic model

Four scenarios have been chosen to reflect family units which might be expected to utilise the income contingent loan scheme (see Table 2.2).

TABLE 2.2 THE SCENARIOS UNDER ANALYSIS

<p>1 Couple with two children</p> <p>Mother: 18 week statutory scheme + ICL Part-time employment for 1 yr after ICL 18 week statutory scheme + ICL Part-time employment for 2 yrs after ICL Full-time employment thereafter</p> <p>Father: Full-time employment</p>	<p>2 Couple with two children</p> <p>Mother: 18 week statutory scheme + ICL Part-time employment for 1 yr after ICL 18 week statutory scheme + ICL Part-time employment thereafter</p> <p>Father: Full-time employment</p>
<p>3 Single mother with one child</p> <p>18 week statutory scheme + ICL Part-time employment for 2 yrs after ICL Full-time employment thereafter</p>	<p>4 Single mother with one child</p> <p>18 week statutory scheme + ICL Part-time employment thereafter</p>

Notes: During the years in which the mother takes PPL, it is assumed that she works part-time for those weeks of the year in which leave is not taken.

Scenarios one and two are two-parent households with two children, while scenarios three and four are single-parent households with one child. For the couple scenarios the father is assumed to be working full-time, and the mother works full-time under scenario one after returning from leave with the second child, whereas she works part-time under scenario two and doesn't return to full-time employment. Under scenarios three and four the mother is a single parent with one child. Under scenario three she takes PPL, after which time she engages in part-time paid work for two years before returning to full-time paid work. Under scenario four she remains in part-time paid work following expiration of the leave. While the empirical exercises include single mothers, rather than single fathers, this keeps the analysis straightforward.

³² This follows the approach of Lin (2007).

Justification for selecting these family compositions comes from ABS statistics (for example, Australian Social Trends (ABS, 2007b); 2006 Census (ABS, 2006b); Parenting and Employment transitions (ABS, 2006d)). Among other things, the data reveal that 75 per cent of partnered fathers with dependent children work full-time, and close to 70 per cent of both single and partnered mothers engage in full-time or part-time paid work by the time their children have reached their teenage years.³³ These statistics would no doubt be greater if we only include parents who engaged in paid work prior to having children.

In all scenarios the father is assumed to be aged 33 and the mother aged 31 at the time of birth of the first child. These ages are consistent with the 2006 Australian median ages of 33.1 and 30.8 respectively (ABS, 2006a), and follow the assumptions of Lin (2007). It is assumed that assessable income is below the minimum threshold once parents retire. Retirement is assumed to occur at ages 62 for men and 58 for women (ABS, 2007a).

2.4.2 *Income assumptions*

As loan repayments are contingent on income, projected future debtor income is a critical assumption for the scenarios. Specifically, the measure of income that is assumed for calculation of loan repayment obligations, known henceforth as assessable income, is equal to taxable income, plus any reduction in taxable income due to rental loss, plus fringe benefits and exempt foreign employment income. This is the same definition as applies under the HECS-HELP scheme.³⁴

Assessable incomes were approximated by extracting relevant components of income from the ABS 2003-04 and 2005-06 surveys of Income and Housing Confidentialised Unit Record File (CURF) (ABS, 2004; ABS, 2006c). In addition to the specific components of income, age group, sex, employment status (full-time and part-time), and relationship status (single or partnered) were extracted for all

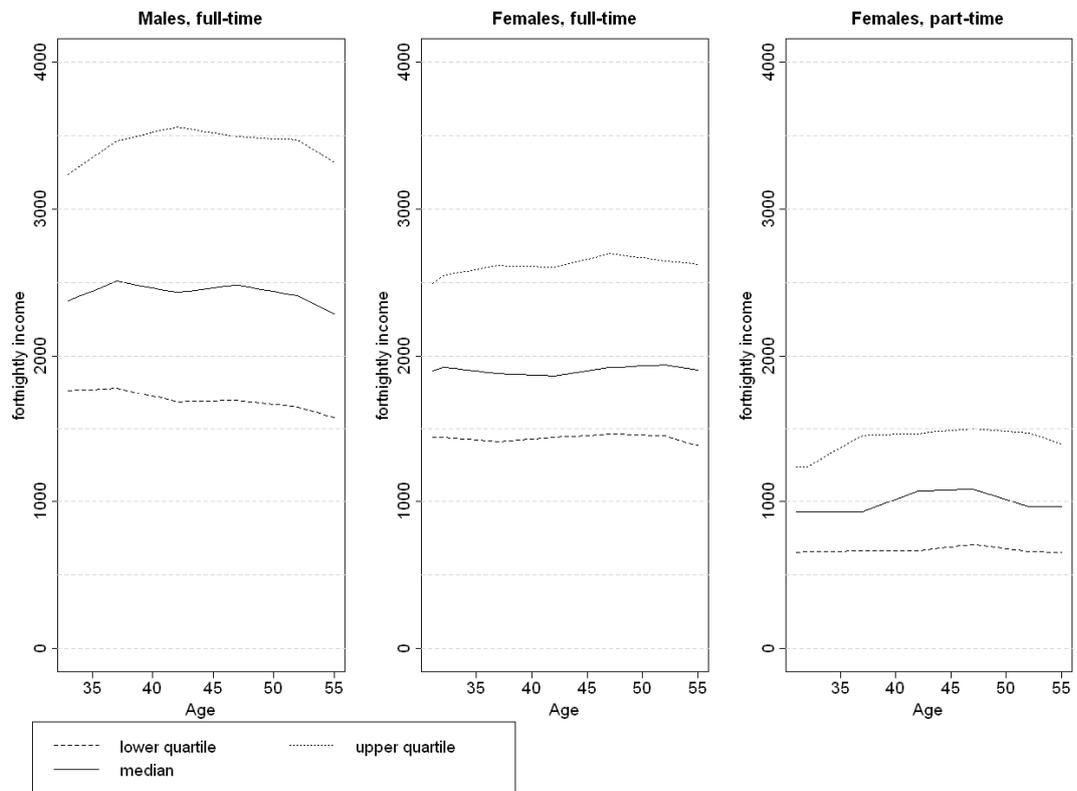
³³ Although only 20 per cent of mothers in one parent families are employed while their child is aged less than two years old (ABS,2006d), this number increases to close to 70 per cent once the children have grown. That the majority of mothers either return to paid work part-time or full-time following leave to have children is supported by research from other sources including: Australian Institute of Family Studies (2007); Whitehouse, Baird, Diamond and Hosking (2006); and Social Policy Research Centre (2006).

³⁴ See <http://www.goingtouni.gov.au>

individuals in the surveys. The data from both surveys were adjusted with AWOTE growth to the present (ABS, 2008) and 25th, 50th and 75th percentiles (lower, median and upper quartiles) were calculated from the adjusted data across the two surveys.³⁵

Although Parenting Payments are taxable and are a component of assessable income, Parenting Payments were not included in the incomes extracted. Eligibility for Parenting Payments was separately determined and the eligible payment amounts were added to the assessable income amounts used in the modelling. Plots of the income assumptions (excluding Parenting Payment) are given in Figure 2.1.

FIGURE 2.1 NOMINAL FORTNIGHTLY ASSESSABLE INCOME QUARTILES AS EXTRACTED FROM ABS CURFs (EXCLUDING PARENTING PAYMENT)



As the CURF data is cross-sectional rather than longitudinal, adjustments are made to the data for projection purposes. Projections of assessable income in subsequent years allow for increases due to gains in productivity, inflation and returns to experience or promotion. For an individual aged g at time t , the projected quartile of income for the same individual aged $g+1$ at time $t+1$ was approximated by taking the income quartile at age $g+1$ and time t , and inflating this by projected growth in

³⁵ This follows the approach of Lin (2007).

average weekly earnings to time $t+1$. This was repeated for future years and for median-, lower- and upper- income quartiles. Development and implications of incorporating a dynamic model for income are raised in Chapter 4.

2.4.3 *The scheme design parameters tested*

Six design parameter cases are modelled for the four hypothetical scenarios. For all cases the assumptions governing income, eligibility, and repayment thresholds and rates, are kept unchanged and are as described above. It is also assumed that the income contingent loan assistance begins immediately after the 18-week period of grants-based assistance for all cases, with the exception of Case 5 which also allows for an increase in amount above minimum wage during the 18-week statutory scheme period. A surcharge of 20% is assumed for all cases with the exception of Case 6 where the loan surcharge is set at zero and a real indexation rate is applied.

The design cases considered are summarised below:

- 1 – Duration: 26 weeks; Loan amount: Min Wage.
- 2 – Duration: 10 weeks; Loan amount: Min Wage.
- 3 – Duration: 10 weeks; Loan amount: Min Wage; HECS debt
- 4 – Duration: 10 weeks; Loan amount: interacting with Government Benefits
- 5 – Duration: statutory scheme + 10 weeks; Loan amount: replacement income
- 6 – Duration: 10 weeks; Loan amount: Min Wage; Real indexation = mortgage rates, no surcharge

An exploration of the advantages and disadvantages of using a loan surcharge rather than a real indexation rate is covered in the discussion of the results of modelling Case 6 in Section 2.5.5.

2.4.4 *Subsidy calculations*

An income contingent loan for PPL does not strictly imply a ‘user-pays’ scheme. There is a cost to the government and taxpayer if debtors fail to reach the repayment thresholds and never repay the debt. There can also be a cost to government even in

the event that the loan is repaid provided the rate of indexation applied on the loan is less than the government's opportunity cost. The costs to the government are subsidies, and the subsidy proportions can be expressed as the present value of the difference between how much is provided by the government and how much is repaid by the borrower, as a proportion of the amount provided using an appropriate discount rate.³⁶

If a borrower repays none of the debt, this is equivalent to a 100 per cent subsidy to the borrower. If, as with FEE-HELP, borrowers are liable for a 20 per cent surcharge, the present value of repayments can exceed the amount outlaid, and consequently a profit, or negative subsidy, can result. A profit to government can also arise if a real indexation rate that exceeds the government's cost of capital is imposed in place of a surcharge.

The scenarios examined reveal the circumstances under which positive or negative subsidies can arise. For the scenarios explored herein, the discount rate chosen to calculate the present value of the repayments and new debt is 5.5 per cent nominal, or 3 per cent real, being the approximate average real 10-year government bond rate over the last decade (RBA, 2009b).

The recommended approach for determining discount rates for policy decisions advocated by the Commonwealth Department of Finance and Deregulation is to recognise that capital required for a project must be sourced from displaced investment, newly stimulated savings (decreased consumption), and/or foreign capital inflow. They note that an appropriate discount rate should reflect the costs associated with these sources, and be weighted based on the proportion drawn from each source (DoFD, 2007). The Office of Best Practice Regulation (within DoFD) suggests a real market weighted average of 7 per cent real, however, they note that this is appropriate when the proposal has a similar amount of risk as the market, and that lower rates should be used for projects with lower sensitivity to market returns. They advocate a rate of 3 per cent real as the weighted average riskless discount rate (DofD, 2007, p132).

³⁶ A mathematical exposition of subsidy calculations is presented in Appendix A1 of this thesis.

When modelling the ICL in this chapter, allowance has been made for non-repayment of debt by incorporating realistic incomes. As the likelihood of repayment is explicitly accounted for in the model developed, it is appropriate to use a riskless discount rate when determining subsidies. Use of a higher discount rate would effectively double-count the risks associated with non-repayment.

One might argue that a higher discount rate could be warranted as the incomes used in the model, while being based on quartiles, may nevertheless overestimate expected earnings at an aggregate level due to the prospect of adverse selection or moral hazard. Rather than altering the discount rate assumption, the prospect of adverse selection is explicitly allowed for in Section 2.6.3 where aggregate costs are estimated assuming that a high proportion of low-income earners participate in the scheme.

After accounting for variability in income, risks may nevertheless remain with recovery of debt, due to administrative shortcomings, and unforeseen complications. Although 3 per cent real is used as a best estimate, as the choice of discount rate has a significant bearing on costs when dealing with long-term future cash flows, for comparison subsidies are produced under 6 and 10 per cent discount rates in Section 2.6.1.

2.5 Results

Results for the four scenarios described above are presented for the six cases. Three income levels: low (25th percentile), medium (50th percentile), and high (75th percentile), are given for each scenario and each case.³⁷ For scenarios one and two, the parents are assumed to have two children and hence the amount borrowed is twice the single amount.

2.5.1 Design Cases 1 and 2

Figure 2.2 and Figure 2.3 illustrate the time stream of repayments of the debts and outstanding debt respectively for Case 1, where the debt is constrained to 26 weeks.

³⁷ For the couple scenarios, 1 and 2, the 25th and 75th percentile cases mean that both male and female income profiles are the 25th and 75th percentile levels respectively.

The following points are noteworthy from the figures:

1. The accumulation of debt early in the life of the loan takes a stepped appearance in scenarios one and two due to the loan amount increasing when leave is taken for the second child.
2. There are large differences in time to repayment in all scenarios depending on income, ranging from about seven years to 20 years for two-parent families with two children.
3. For single mothers on median part-time incomes long term, repayments are only partial; repayments are made when the parent is eligible for Parenting Payment, which has the effect of temporarily boosting their income above the minimum threshold.
4. For single mothers who earn at the lower quartile of part-time income, their income is below the lowest repayment threshold for the entire duration and as a consequence no debt is repaid at any stage.

FIGURE 2.2 TIME STREAM OF REPAYMENTS FOR CASE 1: 26 WEEK LOAN.

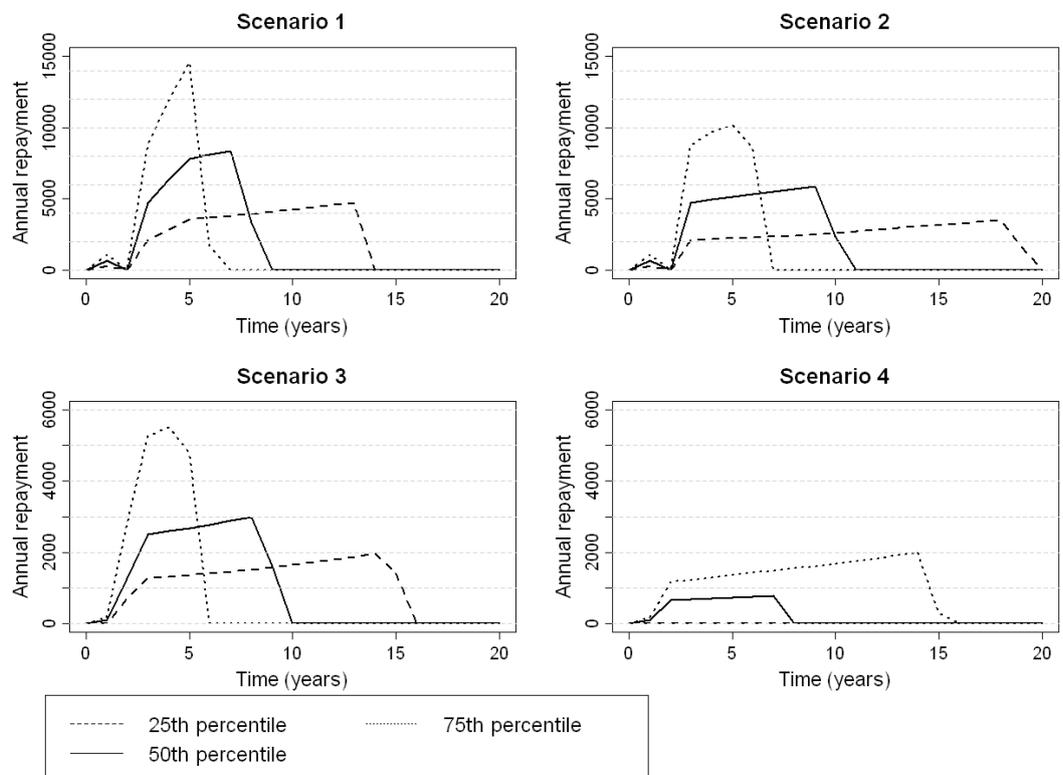
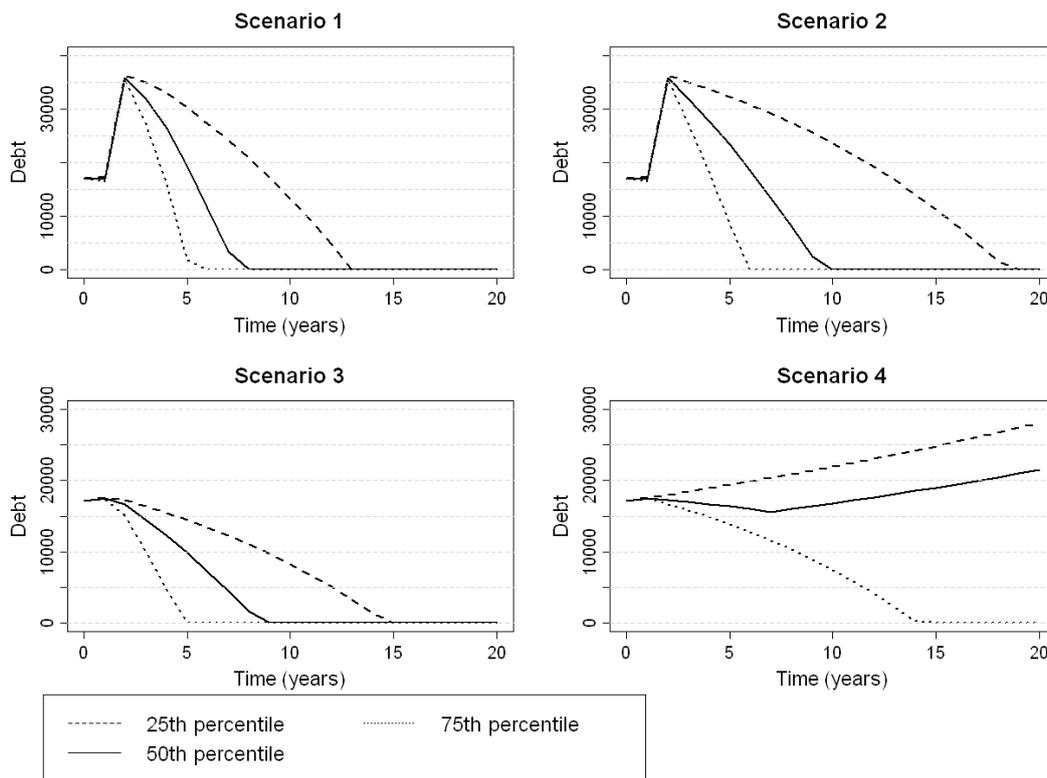


FIGURE 2.3 TIME STREAM OF OUTSTANDING DEBT FOR CASE 1: 26 WEEK LOAN.



For Case 2, with loan duration of 10 weeks, the patterns of repayments and outstanding debt appear similar to Figure 2.2 and Figure 2.3. Duration of debt has no effect on income or repayment thresholds, and therefore, debt remains unpaid for part-time single parents on median income or below, however, as the outstanding debt starts from a lower base, a greater proportion is repaid when loan duration (and hence amount) is lower.

Table 2.3 presents the subsidy proportions for each income band within each scenario for Cases 1 and 2, along with the present value of both the amounts outlaid by the government and the amounts repaid by the borrower. The subsidy proportions differ according to the interest rate differential (being the difference between the indexation rate of CPI applied to the loan and the discount rate of 5.5 per cent per annum), the 20 per cent surcharge, and the unique future income circumstances of the specific borrowers (which affects the time until repayment of the loan).

TABLE 2.3 GOVERNMENT SUBSIDIES AND REPAYMENT TIMES FOR CASES 1 AND 2

Scenario	Present value of amount outlaid (\$)	Present value of the repayments (\$)			Subsidy proportion (per cent)			Time to repayment (years)		
		25%	50%	75%	25%	50%	75%	25%	50%	75%
Income percentile		25%	50%	75%	25%	50%	75%	25%	50%	75%
Case 1: 26 week loan										
1	27,002	26,435	28,679	29,686	2	-6	-10	14	9	7
2	27,002	24,672	28,049	29,686	9	-4	-9	20	11	7
3	13,694	12,876	14,078	14,850	6	-3	-8	16	10	6
4	13,694	-	3,400	13,055	100	75	5	NA	NA	16
Case 2: 10 week loan										
1	10,471	11,276	11,735	11,937	-8	-12	-14	8	6	5
2	10,471	11,069	11,688	11,937	-6	-12	-14	10	6	5
3	5,311	5,626	5,844	5,955	-6	-10	-12	8	5	4
4	5,311	-	3,581	5,689	100	33	-7	NA	NA	8

Notes: For scenarios 1 and 2 the loan received for the second child is assumed to be indexed at AWE to reflect growth in minimum wage.

Of note in Table 2.3 is the sensitivity of the subsidies to the amount of debt accrued. Reducing the amount of leave from 26 to ten weeks, and thereby the amount of debt accrued, significantly reduces the time to repayment and the subsidy in all cases with the exception of the lowest income quartile for scenario four where the mother's income is such that no debt is repaid.

Repaying the loan quickly provides negative taxpayer subsidies (as the benefits to the government from the loan surcharge more than offset the opportunity cost of the zero real indexation rate), and those repaying slowly or incompletely will generate positive – and in some cases, potentially large – subsidies (as the costs of zero real indexation rates outweigh the benefits to the government of the surcharge).

Part-time median income earners (Scenario 4) are particularly close to the minimum repayment threshold; only one or two thousand dollars of additional assessable income per annum would result in greater repayments and a considerable reduction in the subsidy associated with this group. A consequence is that as small changes to income can have a considerable effect on repayment obligations, it is the category of debtor with incomes close to the minimum threshold that are most likely to be at risk of moral hazard.

The dramatic impact on subsidies of minor income changes to repayments can be appreciated by considering the case where an individual moves from non-repayment to repayment. For a 26-week loan, in the event that an individual's income transitions from below the minimum threshold to the minimum, the subsidy would drop from 100% to 19% while for a 10-week loan the subsidy would drop from 100% to 1%. A subsidy persists in both of these cases due to a long duration for loan repayment coupled with concessional indexation (as the revenue to the government from the surcharge is more than offset by the nil real indexation rates). The relationship between the surcharge and real indexation rates is explored through modelling in Section 2.5.5.

The operations of a 10-week PPICL scheme and the magnitude of loan and repayments relative to other sources of income are further illustrated in Figure 2.4 to Figure 2.7. Figure 2.4 decomposes income for a single mother with full-time income at the 25th percentile from time three, including welfare payments (FTB A, B³⁸ and Parenting Payment), payments received through the 18-week statutory PPL scheme, the 10-week ICL, tax and ICL repayments. In Figure 2.5, income sources are grouped together and net income is displayed including the PPICL and corresponding PPICL compulsory repayments, and for comparison, net income in the absence of the ICL is presented.

In the year in which parental leave is taken, given by year 1 in the figures, the increase in income due to the PPICL is noticeable. Although income from employment is higher in year 2 than year 1, it is assumed that the parent is working only part-time while the child is a young infant in this scenario, returning to full-time work in year 3. For the first six years of full-time work following the birth of the child, the parent makes repayments of the ICL, an occurrence which is demonstrated by the reductions in income for times 3 to 8 in Figure 2.5.

³⁸ FTB B is received during those weeks of the year in which the government PPL scheme is not received.

FIGURE 2.4 INCOME DECOMPOSITION
CASE 2: 10 WEEK LOAN.
SCENARIO 3: SINGLE MOTHER, FULL-TIME INCOME AT 25TH PERCENTILE.

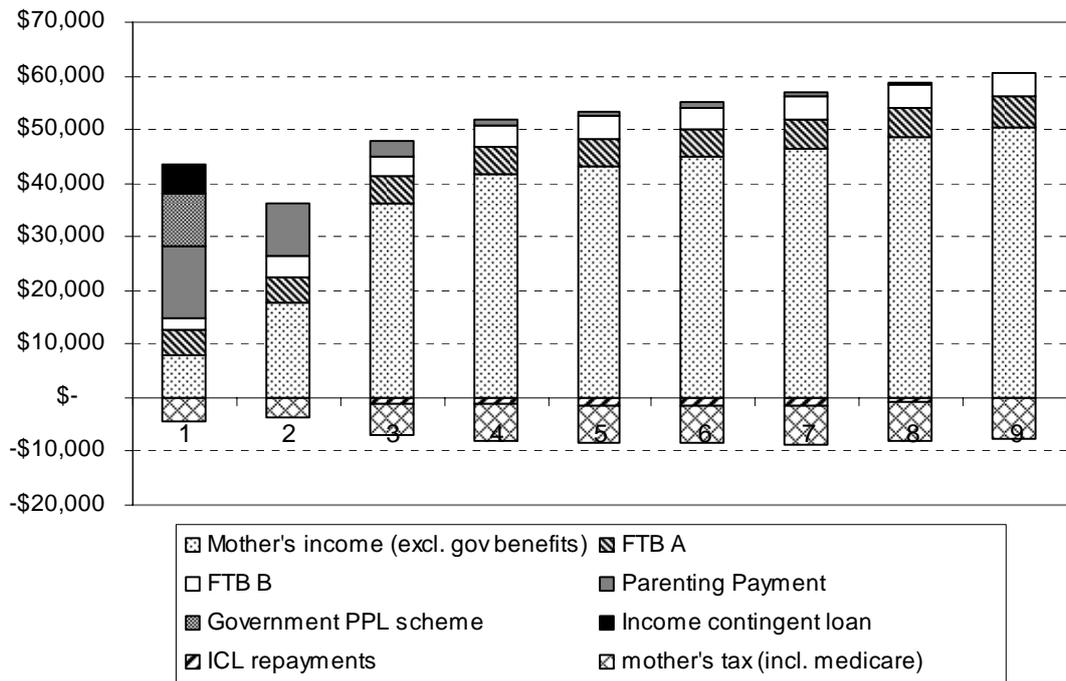


FIGURE 2.5 NET INCOME WITH AND WITHOUT ICL
CASE 2: 10 WEEK LOAN.
SCENARIO 3: SINGLE MOTHER, FULL-TIME INCOME AT 25TH PERCENTILE.

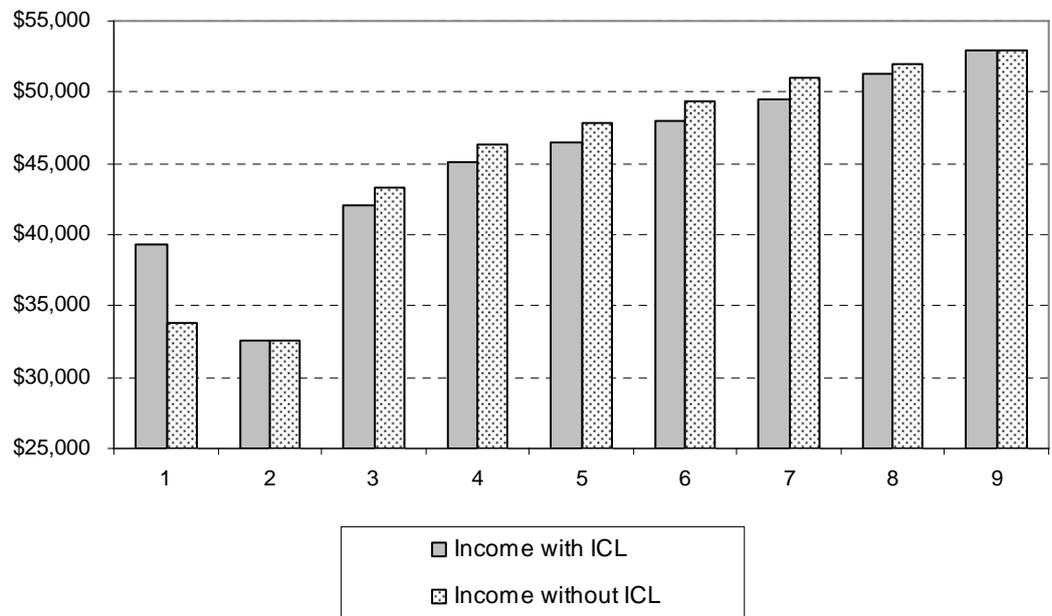


Figure 2.6 and Figure 2.7 are analogous to those above, with the exception that they illustrate median income earners from Scenario 2, with the mother on part-time income. A noticeable feature is that the magnitude of the ICL repayments is

relatively large and the loan is repaid quickly as a consequence of the father's full-time earnings. Consumption smoothing is more apparent for the single parent than the couple, however, the attractiveness of an ICL will depend on financial needs, affordability and the costs of capital, or opportunity costs, facing individual families. Some of these considerations are explored in Section 2.6.

FIGURE 2.6 INCOME DECOMPOSITION
CASE 2: 10 WEEK LOAN.
SCENARIO 2: COUPLE, MOTHER WITH MEDIAN PART-TIME INCOME

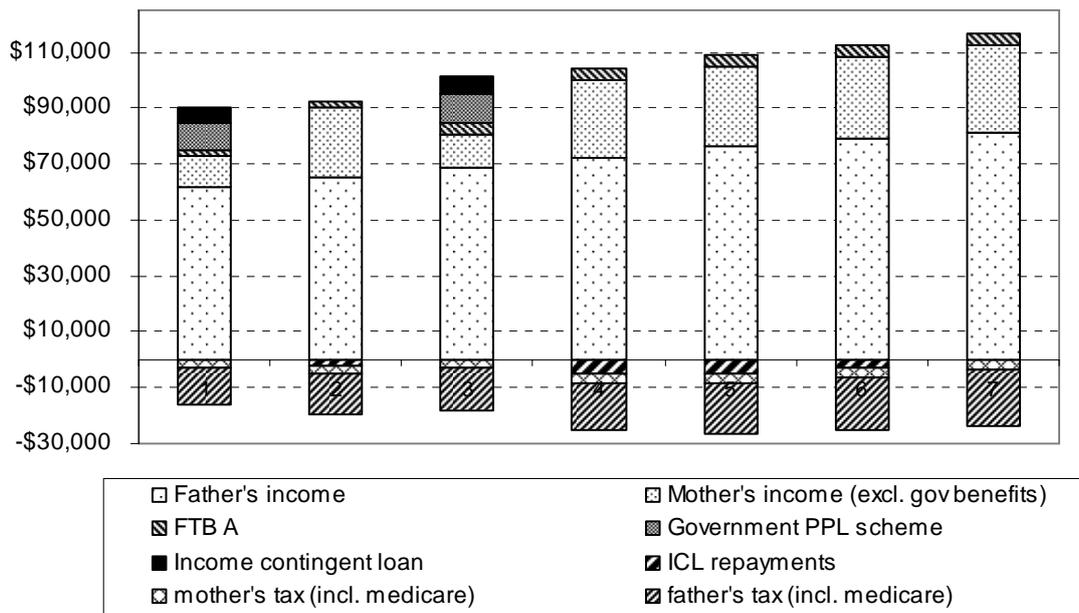
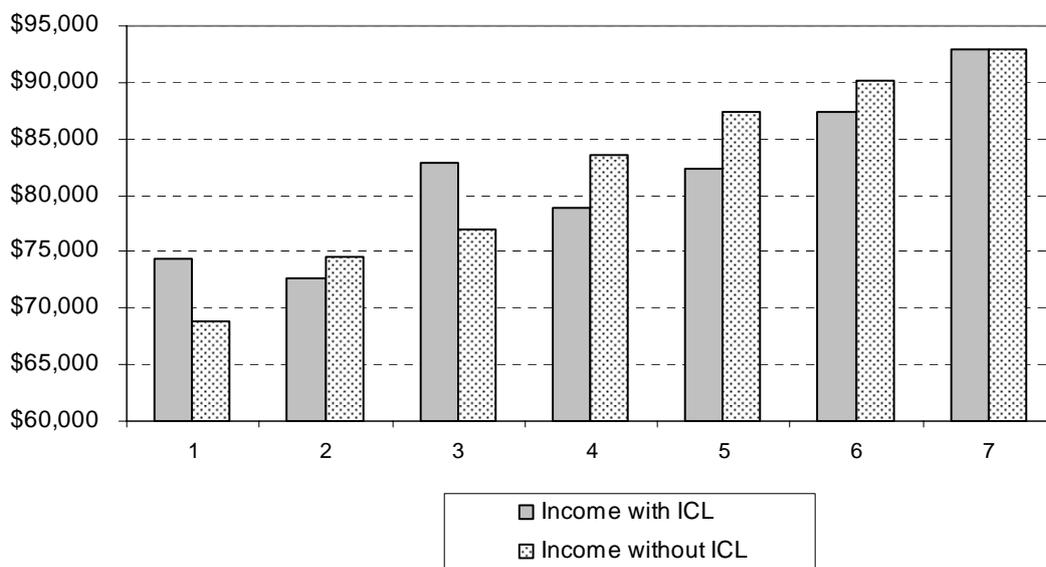


FIGURE 2.7 TOTAL NET INCOME WITH AND WITHOUT ICL.
CASE 2: 10 WEEK LOAN.
SCENARIO 2: COUPLE, MOTHER WITH MEDIAN PART-TIME INCOME



2.5.2 Design Case 3: adding a HECS debt

For Case 3 and 4 it is assumed that the debtor has a HECS debt in addition to the income contingent loan for PPL. As described in Section 2.3.8, a sensible way of treating this situation is to group both income contingent loans together, and have one compulsory repayment based on income, a strategy that would go towards reducing the combined debt.

For illustration, it is assumed that each parent has an outstanding HECS debt of \$10,000.

A complication arises due to a higher minimum repayment threshold applying for HECS than that assumed for the PPICL. A flexible model was developed that allows for variable levels of HECS debt and PPICL. In the cases when income exceeds the minimum income threshold for PPICL, but is lower than the minimum HECS threshold for either or both parents, the calculated repayment reduces the PPICL balance and the HECS balance remains untouched. This results in no change in net repayments or implicit interest rate subsidies for these debtors. In the cases when income exceeds the minimum threshold for HECS, it is assumed that the repayment reduces both the PPICL and HECS debts simultaneously, with the reduction being proportional to the outstanding balances.

For example, for a single parent if income exceeds the minimum HECS threshold, the outstanding PPICL debt is \$1000 and the outstanding HECS debt is \$2000, then 1/3 of any compulsory repayment would go towards reducing the PPICL debt with the remaining 2/3 reducing the HECS debt. An implication is that, for singles, in the event that incomes exceed the minimum HECS threshold, both the PPICL and HECS debts are paid off at the same time.

Results for all four scenarios, based on a HECS loan amount of \$10,000 per parent and 10 weeks of PPICL are given in Table 2.4. For ease of comparison, the results are presented alongside Case 2, where zero HECS debts are assumed.

TABLE 2.4 GOVERNMENT SUBSIDIES AND REPAYMENT TIME FOR CASE 3 (WITH CASE 2 FOR COMPARISON)

Scenario	Present value of the amount outlaid (\$)	Subsidy proportion (per cent)			Time until repayment of PPICL		
		25%	50%	75%	25%	50%	75%
Income percentile							
Case 3: 10 week loan with HECS							
1	10,471	-6	-12	-14	9	6	5
2	10,471	-2	-12	-14	12	6	5
3	5,311	-6	-4	-9	8	10	6
4	5,311	100	33	-7	NA	NA	8
Case 2: 10 week loan							
1	10,471	-8	-12	-14	8	6	5
2	10,471	-6	-12	-14	10	6	5
3	5,311	-6	-10	-12	8	5	4
4	5,311	100	33	-7	NA	NA	8

For those cases when income exceeds the minimum HECS threshold, the existence of HECS debts may result in a longer time to repayment for the PPICL and consequently higher subsidies, however the magnitude varies according to the income earned.

For Scenario 1, where both the father and mother are on full-time income, time to repayment of the PPICL increases by at most only one year. For the lowest income quartile the father's income exceeds both the minimum PPICL and HECS thresholds. Hence, his compulsory contribution is partitioned across both debt obligations. The implication is a reduced PPICL contribution from the father compared with his contribution in the absence of HECS. The mother's income remains below the minimum HECS repayment threshold yet above the minimum PPICL threshold, and consequently her contribution to the PPICL remains unchanged. The net effect is an extension of one year to repay, and a modest reduction in the size of the negative subsidy. For the median and upper quartile incomes, both parents' incomes exceed the minimum HECS threshold and thus the contributions to the PPICL are reduced. Despite the reductions, the magnitudes of HECS repayments for the father are high and his HECS debt is repaid quickly. The mother's income is partitioned between her HECS debt and PPL debt, however in aggregate the existence of HECS has negligible effect on time to repayment and subsidies.

For Scenario 2, the mother's income falls below the minimum HECS threshold for all three considered income quartiles. In contrast the father's income is above the minimum threshold for the three quartiles. For median and upper quartile incomes the father's HECS debt is paid very quickly, and there is no noticeable impact on PPICL subsidies. For the lowest income quartile, however, approximately 30 per cent³⁹ of repayments are allocated towards the father's HECS debt. This has the effect of extending the time to repayment of the PPICL by two years, and increasing the subsidy to -2 per cent.

Scenario 3 captures the potential complexity of the repayment arrangements. For the lower income quartile the mother's income is below the HECS minimum threshold and hence the PPICL subsidy is unchanged at -6 per cent. For the median income case the mother's income exceeds the HECS minimum threshold. This extends the time to repayment of the PPICL considerably from five to ten years, resulting in a lower present value of repayments and a much greater subsidy (-3 per cent as compared with -10 per cent for the case without a HECS debt). Although one would expect that higher income would lead to greater repayments and a lower subsidy, the opposite has occurred in this example as a consequence of the repayment arrangements. For the upper income quartile, the presence of HECS prolongs the PPICL repayments. Although the subsidy increases (six versus four without HECS), as income is relatively high, so too are the repayments, and the debt is repaid quickly.

For Scenario 4, the mother's income is consistently below the HECS minimum threshold; thus the presence of HECS has no affect on the PPICL subsidies.

Measuring the effective cost of a PPICL scheme due to the inclusion of HECS debts is only half the picture, as HECS subsidies are themselves affected by the existence of a PPICL. Further modelling was performed to quantify this effect. HECS subsidies for fathers and mothers under Scenarios 1 and 2 were calculated separately, and the impact on these subsidies from 10 weeks of a PPICL scheme was modelled. Results were produced for mothers under Scenarios 3 and 4. These are tabulated in Table 2.5.

³⁹ The PPL balance is approximately 70 per cent of the value of the PPL loan plus the father's HECS loan. Under the assumptions used for this example, repayment allocations are made according to the proportions of PPL and HECS debt.

TABLE 2.5 HECS SUBSIDIES WITH AND WITHOUT 10 WEEK PPICL SCHEME

Scenario	HECS subsidy proportion (per cent)			Time until repayment of HECS debt		
	25%	50%	75%	25%	50%	75%
HECS and no PPICL						
1 (father)	7	3	2	6	3	2
1 (mother)	100	17	14	NA	9	7
2 (father)	7	3	2	6	3	2
2 (mother)	100	100	100	NA	NA	NA
3	100	12	9	NA	7	5
4	100	100	100	NA	NA	NA
HECS plus PPICL						
1 (father)	11	4	2	10	3	2
1 (mother)	100	18	14	NA	9	7
2 (father)	12	4	2	12	3	2
2 (mother)	100	100	100	NA	NA	NA
3	100	15	11	NA	10	6
4	100	100	100	NA	NA	NA

In the event that the mother’s income is below the HECS minimum thresholds, the existence of the PPICL scheme will have no impact on HECS subsidies which remain at 100 per cent. This is the case for Scenario 4, and also the mother’s HECS debt for Scenario 2.

The HECS minimum threshold is exceeded for the father’s income levels, and for the mother’s median and upper quartile full-time income. For these cases the presence of PPICL generally increases the duration until HECS repayment, pushing up the implicit HECS subsidy. The exception is where the father is earning high incomes, as in these cases the magnitude of the repayments are such that HECS is paid quickly and is unaffected by the presence of PPICL.

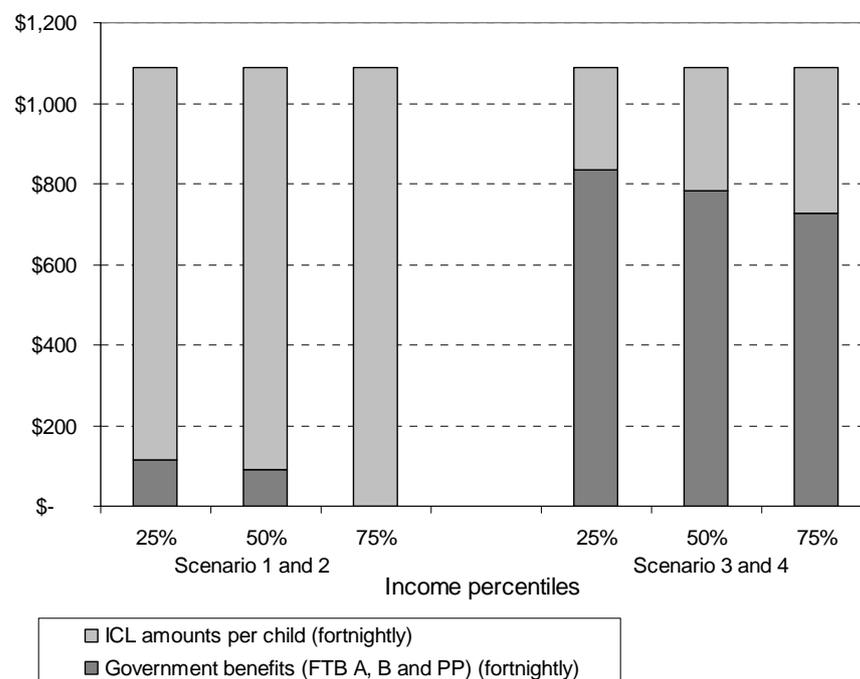
Key conclusions of these examples are as follows: the costs of an ICL for PPL, and indeed any potential ICL scheme that might be taken up by existing HECS debtors, should be modelled allowing for the existence of HECS; implicit subsidies for *both* a new ICL and HECS will potentially be affected by the introduction of the new ICL; and the implications of existing debt are not always clear, with some results potentially being counter-intuitive as a consequence of the repayment arrangements.

2.5.3 Design Case 4: interactions with existing benefits

As described in Section 2.3.4, a possible alternative to fixed ICL amounts is to vary the loan based on the receipt of existing parental government income support

payments. Assuming 10 weeks of parental leave (over the 18 weeks provided through a statutory scheme), Figure 2.8 gives the maximum possible ICL received for each scenario such that the ICL plus FTB A, FTB B, and Parenting Payment, is equal to minimum wage. Additionally, the figure shows the value of the existing non-repayable government benefits provided during the period when the ICL is available (NB: the sum of the ICL and existing benefits is equal to minimum wage in each case). Table 2.6 gives the resulting government subsidies.⁴⁰

FIGURE 2.8 CASE 4: ICL AMOUNTS AND GOVERNMENT BENEFITS (FTB A, FTB B, AND PARENTING PAYMENT).



The differences in loan amount and government benefit for the singles and couples are notable. Single parents in Scenarios 3 and 4 are eligible for the maximum FTB

⁴⁰ Rules for determination of amounts payable for FTB A, B and Parenting Payment were obtained from the Centrelink website: www.centrelink.gov.au. Additional assumptions follow. The mother receives 18 weeks of PPL via the government scheme, the ICL for 10 weeks thereafter, and part-time income (at 25th, 50th or 75th PT income percentiles) for the remaining weeks of the year in which parental leave is taken. As announced in the 2009-10 budget, the statutory 18 week PPL scheme payments are taxable and count as assessable income when determining eligibility for FTB A and B, however, the payments do not affect entitlements to Parenting Payments. For Scenarios 1 and 2 the amount of FTB A will differ for the second year of parental leave due to the additional child. However, the differences have relatively little impact on subsidies for couples and for simplicity it is assumed that the government benefit provided for the second child is identical to that available for the first. Household assets are assumed to be below the assets test limit for Parenting Payment eligibility. While quarantining rules apply to FTB B in practice (e.g., see PC, 2008, Appendix F), implying that some parents taking non-paid parental leave who would otherwise not be eligible for FTB B due to high income may be eligible for the maximum rate, this feature has not been incorporated into the modelling in this chapter.

benefit A and B during the year in which they take parental leave. All single parents considered are also eligible for Parenting Payment. In contrast, mothers in Scenario 1 and 2 are not eligible for any Parenting Payment, and are eligible for only partial or nil FTB A and B as a consequence of the inclusion of the father's income.

TABLE 2.6 CASE 4: GOVERNMENT SUBSIDIES ALLOWING FOR INTERACTIONS WITH FTB A, FTB B, AND PARENTING PAYMENT.

Scenario	Subsidy proportion (per cent)			
	Income percentile	25%	50%	75%
1		-9	-12	-14
2		-7	-12	-14
3		-12	-13	-14
4		100	-11	-13

For the subsidy calculations in Table 2.6 it is assumed that the loan is received for 10 weeks for each child. This implies a total loan amount (excluding the 20 per cent surcharge) of approximately \$4,900, \$5,000 and \$5,400 per child for the three income percentiles in Scenarios 1 and 2, and \$1,300, \$1,500, and \$1,800 for Scenarios 3 and 4. The subsidy proportions assume that the 20 per cent surcharge has been applied to the loans. As expected, since the government benefits provided are relatively low under the first two scenarios, the reduction in subsidies relative to the 10 week loan results from Table 2.3 are modest. In contrast, for Scenarios 3 and 4 the reduction in subsidy is greater due to considerably shorter repayment periods. The exception remains the lowest part-time earners who fail to reach the minimum income threshold.

For the median income earner in Scenario 4 the subsidy is negative in contrast to 33% in Table 2.3. The difference arises due to the smaller ICL outstanding loan which is repaid in total while the parent is eligible for Parenting Payment.

2.5.4 Design Case 5: Replacement income

For Case 5 it is assumed that the parent is able to take out an ICL so the fortnightly amount received during the 18-week period of statutory PPL is equivalent to the parent's net income prior to taking leave.

The motivation for this exercise is based on the premise that the minimum wage, as offered through the statutory scheme, may provide insufficient incentive to take leave for many parents with financial obligations such as mortgages. ABS statistics (2007) show that housing costs for couples and singles with dependent children are substantial, with median fortnightly levels of \$500 for couples and \$330 for one-parent households. These amounts are higher for homeowners with mortgages, being \$660 and \$460 per fortnight respectively. There is substantial variation around these median levels, so that persons with higher incomes tend to have greater financial obligations, and would be less likely to take up loans with minimum wage limits. By allowing individuals greater financial access while limiting leave duration, this would increase the likelihood of parents taking the necessary leave to benefit their child's health and development, while reducing possible skill erosion by limiting leave duration.

ICL amounts are estimated for the four scenarios such that the fortnightly ICL, plus the minimum wage level through the statutory PPL, is equal in magnitude to the net fortnightly income prior to taking leave. Although FTB A, FTB B and Parenting Payment will supplement the statutory PPL minimum wage payments while the parent is on leave, these welfare benefits (which are not specifically intended as income replacement) are omitted from consideration. An alternative scheme structure could incorporate the magnitude of welfare benefits when determining replacement income (broadly following the approach taken in Section 2.5.3), such that pre- and post-natal disposable income were identical, however, this has not been undertaken as part of this chapter.

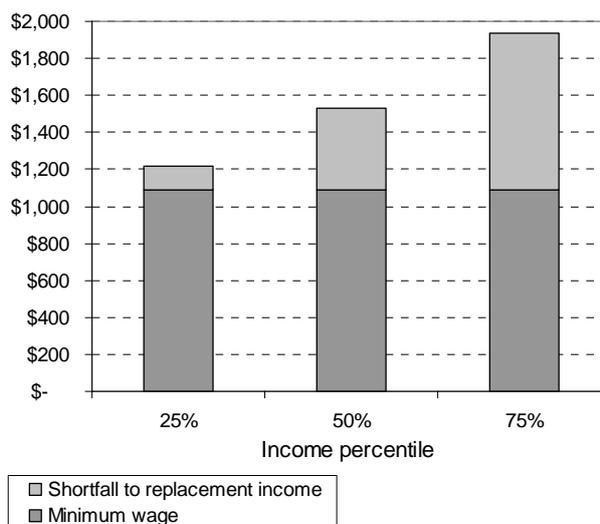
For all scenarios it is assumed that prior to taking leave, the prospective mother earned full-time income at the 25th, 50th or 75th income percentiles. The net of tax amounts were then calculated based on these incomes, and the net fortnightly amount was compared with the minimum wage amount received via the statutory 18-week PPL scheme. The difference between these amounts was assumed to be taken as an ICL for the 18-week period. Following the 18-week period it was assumed that the total net fortnightly amounts was then provided as an additional 10-week ICL. In Table 2.7 the required net annual and fortnightly incomes, the income shortfalls for replacement income, and the corresponding total ICLs required

are given for the three full-time female income percentiles. The required fortnightly net incomes are also displayed in Figure 2.9.

TABLE 2.7 CASE 5: LOAN AMOUNTS FOR THE FIRST YEAR OF LEAVE

Income percentile	25%	50%	75%
Required annual net income	\$ 31,605	\$ 39,847	\$ 50,426
Required fortnightly net income	\$ 1,216	\$ 1,533	\$ 1,939
Shortfall required over min wage	\$ 128	\$ 445	\$ 852
ICL	\$ 7,230	\$ 11,668	\$ 17,364

FIGURE 2.9 CASE 5: REQUIRED FORTNIGHTLY NET INCOME



For example, for a woman on median full-time income, the net prenatal income is \$39,847, or \$1,533 fortnightly (equivalent to \$1,900 pre-tax; or \$49,412 gross per annum). There is a shortfall of \$445 between this fortnightly amount and the minimum wage of \$1,088. Hence, an ICL of \$445 is assumed to be taken for the first 18 weeks of leave, and an amount of \$1,533 per fortnight is taken for the 10 weeks thereafter. In total this implies an ICL of \$11,668 for the first year in which leave is taken. The ICL amounts are approximately double these values for Scenarios 1 and 2 due to leave being taken for two children.

Government subsidies are presented based on these assumptions in Table 2.8.

TABLE 2.8 CASE 5: GOVERNMENT SUBSIDIES

Scenario	Subsidy proportion (per cent)		
	25%	50%	75%
Income percentile			
1	-6	-8	-9
2	-3	-6	-8
3	-3	-5	-8
4	100	69	8

As expected, since the loan amounts for Case 5 exceed those for Case 2, the subsidies are greater, but nevertheless still remain negative for Scenarios 1, 2 and 3.

It is plausible that a debtor with relatively high pre-natal income may return to work at a lower income level, and this contingency is captured by Scenarios 2 and 4, as the loan amounts are based on full-time circumstances yet the mother never returns to full-time employment. The inclusion of the father's income for Scenarios 1 and 2 guarantee fast repayment even in the presence of substantial loan amounts and low maternal earnings.

The PC noted (2009, Appendix I) that earnings-related payment systems (i.e., systems that provide replacement income) are '...the dominant model for maternity payments around the world' (2009, pI.3). Their main reservation in recommending a system for Australia is the large fiscal costs if funded by the taxpayers. A key conclusion of the modelling above is that providing access to an ICL that covers replacement income may be affordable if structured sensibly.

However, as in previous examples considered above, single parents with low incomes prove to be the 'fly in the ointment'. A positive subsidy arises for single parents in the top quartile of part-time income due to the long time to repayment as a consequence of the size of the loan (17 years). In practice, if an ICL was structured as a means of replacing prenatal income, a cap would need to be imposed in order to limit adverse selection, moral hazard and potential scheme costs.

2.5.5 Design Case 6: Real indexation

Case 6 explores the effect of a real indexation rate by considering the consequence to implicit subsidies of replacing a loan surcharge with a real rate of 3.5 per cent (a nominal rate of six per cent⁴¹). Results are given in Table 2.9.

⁴¹ Six per cent is approximately consistent with default variable home loan rates from major financial institutions during 2009 (<http://www.yourmortgage.com.au>; 8 August 2009). The PC suggested that mortgage interest rates should be imposed on any PPICL loan rather than a surcharge (PC, 2009, p8.20).

TABLE 2.9 CASE 6: GOVERNMENT SUBSIDIES UNDER REAL INDEXATION OF SIX PER CENT NOMINAL

Scenario	Subsidy proportion (per cent)		
	25%	50%	75%
Income percentile			
1	-2	-1	-1
2	-2	-1	-1
3	-2	-1	-1
4	100	33	-2

The subsidies in Table 2.9 are expected. In the event that the loan indexation rate was equivalent to the discount rate (in the absence of a loan surcharge), the subsidies would be zero for all cases when the loan was entirely repaid. For median part-time income earners in Scenario 4 repayments are only made for a short duration⁴², and changes to indexation or overall loan amount have no effect on the subsidy.

An attraction to government of real indexation rates is they provide greater cost certainty. While a surcharge implies a fixed real cost to individuals, the benefits to government vary depending on the cost of capital and time to loan repayment. By applying real rates equivalent to the government discount rate, potential interest rate loss is removed (however, default insurance continues to apply and remains a cost to the loan provider). A consequence is that the attraction to the scheme for low-income families might be compromised. This is discussed further below.

The implications of a surcharge versus a real indexation rate are now explained and explored further. If an individual is faced with a 20 per cent surcharge and pays off their loan, their real cost remains at 20 per cent regardless of time to repayment (however, the relative cost to individuals will depend on their individual opportunity costs. This is explored in Section 2.6.1). As seen in earlier examples, the time to recovery of the debt by the government is critical in determining cost. The implications of the fixed surcharge can best be illustrated through a simple example. Consider an individual with a \$10,000 loan and 20 per cent loan surcharge. If the individual repays the entire loan at the end of the first year this implies that \$2,000 is returned to government on top of the original loan amount. If, in contrast to a surcharge, a real indexation rate was applied to the loan, then if all individuals repaid at the end of the first year, the government would have required a real rate of

⁴² This duration corresponds with receipt of Parenting Payment, which is received while the child is aged under 8 years (for eligible singles). The effect of Parenting Payment is that assessable income is temporarily boosted above the PPICL minimum repayment threshold.

20 per cent in order to achieve the same cost outcome as the surcharge. Similarly, if the individual instead repaid the entire amount in two years, this is equivalent to an annualised effective rate of 9.54 per cent.⁴³ For a total repayment in ten years, the 20 per cent surcharge is equivalent to 1.84 per cent per annum.

Continuing from the example above, if an individual expected to repay the entire loan as a lump sum in two years, and had to choose between a 20 per cent surcharge and an annual indexation rate of 9 per cent, they should favour the indexation rate as this compounds to 18.8 per cent, less than 20 per cent.

More generally, if an individual was faced with choosing between a 20 per cent surcharge or a specific real interest rate, then the relative attractiveness of the options would depend on the magnitude of the real indexation rate and on the expected timing of the repayments. For the purpose of comparing the loan surcharge with indexation rates, a real indexation rate for each income quartile and scenario is determined by solving for the rate that would generate an equivalent implicit subsidy as that produced by the 20 per cent surcharge plus zero real indexation. These rates are given for Cases 1 and 2 in Table 2.10 (these rates are independent of the discount rate).

For example, for a full-time median income earning single mother (Scenario 3), a real indexation rate of 6.2 per cent has an equivalent impact on net cost to government as a 20 per cent surcharge for a 10 week PPICL. If faced with a choice of a 20 per cent surcharge or a real indexation rate, an individual in this category of debtor should choose the real indexation only if it was less than 6.2 per cent per annum.

TABLE 2.10 EQUIVALENT REAL LOAN INDEXATION RATE CORRESPONDING TO A 20 PER CENT SURCHARGE FOR CASES 1 AND 2.

Income percentile/ Scenario	Case 1: 26 week loan			Case 2: 10 week loan		
	25%	50%	75%	25%	50%	75%
1	2.7	4.5	6.3	5.1	8.2	11.0
2	2.0	3.8	5.9	4.4	7.7	11.0
3	2.2	3.5	5.5	4.4	6.2	8.3
4	NA	NA	2.4	NA	NA	4.9

⁴³ 9.54 per cent compounded for two years is equal to 20 per cent.

Table 2.10 shows that for those debtors who repay the PPICL quickly (namely, higher income earners), the government would require relatively high real indexation rates in order to achieve a similar return as that achieved through the loan surcharge. As a consequence of the short time to repayment these families would generally favour a real indexation rate over the surcharge. Conversely, low income earners with a longer time to repayment would only benefit financially from low indexation rates, and should tend to favour the surcharge.

The fact that the attractiveness of the choice of real indexation rate versus surcharge will depend on time to repayment has potential consequences to participation in voluntary ICL schemes. A surcharge in place of modest real indexation may encourage greater participation from those with greater financial need. These families are also those most likely to have no means of self-financing extended periods of leave. Although a purpose of a proposed PPICL scheme is to enable these families to have the option to extend their parental leave, greater participation of these groups by design is adverse selection. As detailed elsewhere in this chapter, there is a trade-off between targeting these groups for participation while maintaining manageable costs, and numerous design features have been suggested in the chapter to minimise the potential cost impacts.

In contrast to those expecting low incomes, for higher income earners a surcharge may appear unattractive relative to modest real indexation rates, and may discourage participation. While this may reduce the risk of abuse of the scheme from those with alternative financial means to provide for their own leave, reduced participation from higher income earners will increase adverse selection.

There is also the possibility that many would have a preference for a surcharge over a real indexation rate due to the recognition that a surcharge implies a known fixed cost, while a real indexation rate set by government may appear more prone to future change, and therefore, cost uncertainty.

The implications of a surcharge versus real indexation are further discussed in Section 2.7.

2.6 Further observations

2.6.1 Individual opportunity costs

The subsidies reported in Section 2.5 indicate the net position for the government, and not explicitly the attractiveness to the parent who may have a different cost of capital.

Instead, to determine whether a parent would benefit financially, the repayments under this scheme should be compared with those a parent would otherwise face through the private sector in the event that private sector loans were available.

The results for Case 1 and 2 are presented in Table 2.11 where both discount rates of six per cent and ten per cent are assumed.⁴⁴ A positive subsidy under these conditions indicates that the repayments of the PPICL would be less than those the debtor would face under a loan available at these rates of interest.

TABLE 2.11 SUBSIDIES FROM PERSPECTIVE OF DEBTORS FOR CASE 1 AND 2 AT SIX AND TEN PER CENT DISCOUNT RATES.

Income percentile/ Scenario	25%	50%	75%	25%	50%	75%
Case 1: 26 wk loan	6 per cent			10 per cent		
1	5	-4	-8	26	11	3
2	12	-1	-8	36	15	5
3	10	0	-7	32	18	6
4	100	76	8	100	79	30
Case 2: 10 wk loan	6 per cent			10 per cent		
1	-6	-11	-13	8	-2	-6
2	-4	-10	-13	12	-1	-6
3	-4	-8	-11	11	4	-2
4	100	34	-5	100	43	9

The large variability in the subsidies under the two discount rates in Table 2.11 additionally provides insight into the importance of the choice of discount rate when valuing cash flows over long durations.

Another way of exploring the issue of scheme costs from the perspective of the individual is to find the discount rate that would set the subsidy to zero per cent for each income quartile within each scenario. If a parent could borrow funds privately

⁴⁴ Six per cent is approximately consistent with default variable home loan rates as reported in the previous section. Rates for unsecured or secured personal loans can range between 10 per cent and 16 per cent (<http://www.moneybuddy.com.au>; 8 August, 2009), with credit card rates being higher.

below these equivalent discount rates, their costs of servicing the private loan would be less than the costs they would otherwise face through an ICL. Equivalent discount rates are presented in Table 2.12 for Cases 1 and 2.

For example, for a single parent on the lowest quartile of full-time income, they would have to borrow at a rate below 6.9 per cent *pa* for the repayments to be less costly in aggregate than those available through a 10 week PPICL as structured here.

TABLE 2.12 EQUIVALENT DISCOUNT RATE CORRESPONDING TO ZERO PER CENT SUBSIDY FOR CASE 1 AND 2.

Income percentile/ Scenario	Case 1: 26 week loan	25%	50%	75%	Case 2: 10 week loan	25%	50%	75%
1		5.2	7.0	8.8		7.6	10.7	13.5
2		4.5	6.3	8.4		6.9	10.2	13.5
3		4.7	6.0	8.0		6.9	8.7	10.8
4		NA	NA	4.9		NA	NA	7.4

Following from Section 2.5.5, an alternative to a loan surcharge is a real indexation rate applied to outstanding debt. In this case determination of an equivalent discount rate is immediate; provided the loan is repaid the nominal discount rate is equal to the nominal indexation rate. For example, if an indexation rate of 6 per cent nominal is applied to the loan, the equivalent discount rate corresponding to zero subsidy would also be 6 per cent, and the PPICL would appear financially attractive to a parent seeking additional leave who could only raise funds elsewhere at a higher rate. This comparison between an ICL and private loans is not as simple as it appears however, as the default protection implicit in the contingent nature of the ICL is an added attraction that isn't replicated in the credit markets.

An implication of different opportunity costs for government and for families is that an appropriately designed scheme could conceivably be attractive financially to both loan provider and loan recipient.

2.6.2 Smoothed repayment schedules

In their draft report the PC raised the possible disincentive to exceed the income threshold as a criticism of income contingent loans applied to PPL, thus 'reducing their incentives to work at the margin...' (2008, p8.14). A consequence of the repayment schedule applied to HECS (and that adopted for PPICL) is that the

effective marginal tax rates (EMTR) at the transition points between income thresholds are substantial. Chapman and Leigh (2009) noted that earning \$1 over the minimum HECS threshold in 2003-04 reduced post-tax income by \$760, equivalent to a 76,000 per cent tax rate. Despite the possible perverse incentives that could result, they found little evidence of bunching below the threshold, indicating only modest intentional repayment avoidance. For PPICL, so as to not burden debtors on low incomes, the first rate of repayment for a parent is intentionally set at the low level in which only two per cent of income (\$539.06 per annum, or less than \$11 per week for an income of \$28,260) would be required to pay off the debt. It is unlikely that parents would value this repayment obligation more highly than the benefits of earning in excess of the minimum threshold.

Although there is little evidence of bunching for HECS, if an individual incurs both a PPICL and HECS debt, the added obligation may increase incentive for moral hazard at the margins. A repayment schedule that maintains progressivity but removes discontinuities and high EMTRs may alleviate risk of bunching.

One option would be to develop a schedule of rates that apply to additional income as opposed to total income. This is akin to the income taxation schedule in Australia, where the rates applied to additional income are EMTRs. For illustration, a hypothetical alternative repayment schedule is derived by first charting the annual repayments under the PPICL schedule as given in Table 2.1, and then manually selecting marginal rates and income bands so as to produce a series of linear segments that approximately follow the PPICL repayment pattern. A plausible schedule is given in Table 2.13, and Figure 2.10 and Figure 2.11 display the repayments and effective repayment rates under the schedule as compared with the original PPICL schedule of Table 2.1.

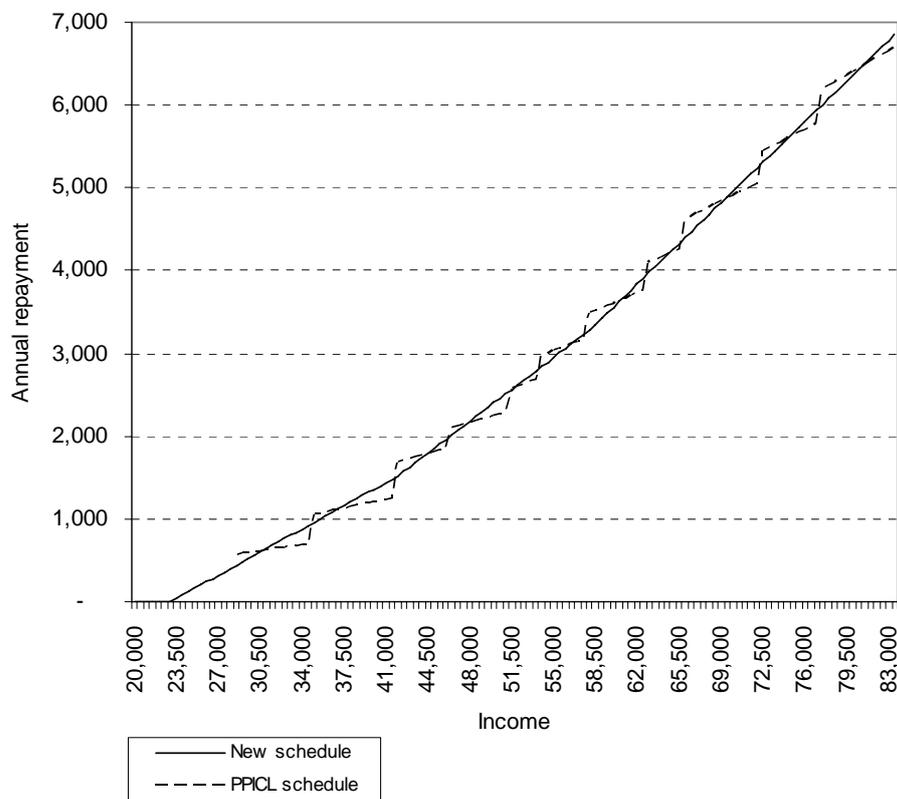
TABLE 2.13 ALTERNATIVE (SMOOTHED) REPAYMENT SCHEDULE FOR PPICL.

Assessable income	Repayment
\$0 – \$23,000	Nil
\$23,001 – \$42,000	8c for each \$1 over \$23,000
\$42,001 – \$58,000	\$1,520 plus 11c for each \$1 over \$42,000
\$58,001 and over	\$3,280 plus 14c for each \$1 over \$58,000

Having a higher minimum income cut-off than with the income tax schedule (which currently uses a \$6,000 cut-off) maintains the default insurance feature of ICLs. However, rather than implementing a cut-off at \$28,259, as in Table 2.1, the

minimum is chosen as \$23,000. The operations of the alternative schedule mean that repayments near this income are minimal, but the magnitude of repayments at \$28,259 is similar under both schedules. By phasing in repayments gradually the alternative schedule removes the high initial EMTR once a debtor exceeds the minimum threshold, replacing this by 8%. In addition to a reduction in the likelihood of bunching at moderate and higher incomes, the alternative schedule would reduce the potential costs of adverse selection by recovering debt from those on lower repayments than under the originally proposed schedule. This is quantified by applying the alternative repayment schedule of Table 2.13 to design Cases 1 and 2.

FIGURE 2.10 ANNUAL REPAYMENTS UNDER STEPPED REPAYMENT SCHEDULE (TABLE 2.1) AND ALTERNATIVE SCHEDULE (TABLE 2.13)



Minor differences arise for a number of the subsidies for Scenarios 1, 2 and 3 due to the altered repayment rates, however there are marked changes for low-income earners under Scenario 4. In this case, those who previously paid nothing, or very little, repay a greater amount as a consequence of phased-in repayments from a lower income level. In particular, for single median part-time income earners the lower income cut-off means that the 10-week loan will be entirely repaid, in contrast to only partial repayment under the repayment schedule from Table 2.1.

FIGURE 2.11 EFFECTIVE REPAYMENT RATES UNDER STEPPED REPAYMENT SCHEDULE AND ALTERNATIVE SCHEDULE.

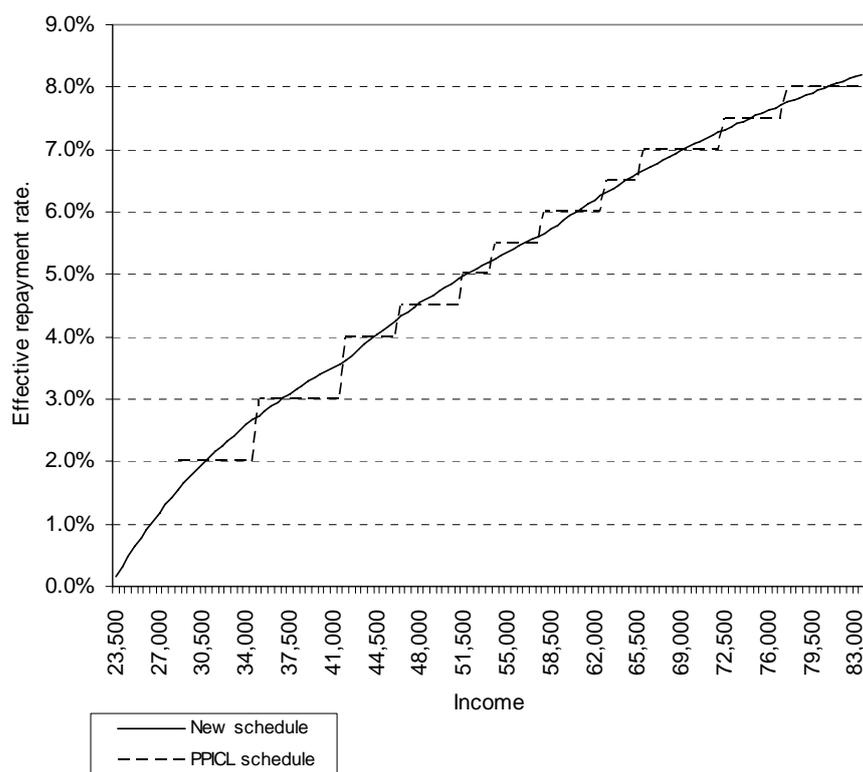


TABLE 2.14 GOVERNMENT SUBSIDIES UNDER ALTERNATIVE REPAYMENT SCHEDULE (COMPARED WITH ORIGINAL SCHEDULE) FOR CASES 1 AND 2.

Scenario	Subsidy proportion (per cent)			Subsidy proportion (per cent)		
	Alternative repayment schedule (Table 2.13)			Original repayment schedule (Table 2.1)		
Income percentile	25%	50%	75%	25%	50%	75%
Case 1: 26 week loan						
1	2	-6	-10	2	-6	-10
2	8	-4	-9	9	-4	-9
3	5	-3	-8	6	-3	-8
4	90	45	4	100	75	5
Case 2: 10 week loan						
1	-8	-12	-14	-8	-12	-14
2	-6	-12	-12	-6	-12	-14
3	-6	-10	-12	-6	-10	-12
4	73	1	-7	100	33	-7

Smooth repayment schedules such as those proposed here can be designed to maintain equity and affordability, yet can improve efficiency over stepped ICL schedules, and could be considered for HECS, let alone a yet to be introduced ICL. A caveat is that the administrative complexity and cost in replacing existing repayment arrangements with a new schedule would be nontrivial. Additionally,

there are political implications, as debtors who would face higher repayments under a new schedule are unlikely to be supportive.

2.6.3 *Aggregate costs*

It is apparent from the results in Section 2.5 that, regardless of whether or not the scheme design imposes a loan surcharge or real indexation, and irrespective of whether the loan amount is for 10 weeks or a longer duration, fixed in amount or variable, or based on a stepped or smooth repayment schedule, a large taxpayer cost could arise from single parents with permanent low incomes.

Although an ICL scheme's viability would be questionable if this demographic was the primary group in the population, nationally lone parents make up fewer than 15 per cent of families with young dependants.⁴⁵ In fact, only a proportion of these parents would contribute solely to the costs of their loan, since in some cases both parents would have existed as a couple at the time the loan was agreed. In these circumstances the father would be expected to contribute following divorce or separation under the scheme design parameters.

One way to assess possible aggregate costs for an ICL for PPL is to extract from the population of eligible parents those whose assessable incomes are below the minimum threshold. While ABS survey data includes information on the proportion of singles and couples with young dependants, and includes income data, the data does not enable one to distinguish between eligible and ineligible persons; information is not available on their employment status prior to having children. Notwithstanding this limitation, using the 2005/06 Income and Housing ABS survey, data was extracted for singles and couples with dependants, where the youngest dependant is aged five or above. This age was chosen as children are generally in kindergarten by age five, and many mothers who intended to return to work either part-time or full-time are likely to have returned by this time (e.g., see Baxter, 2008). Weighted estimates of the single and couple populations with incomes below and above the minimum income thresholds were produced. It was

⁴⁵ This statistic was obtained from the ABS 2005-06 Income and Housing Confidential Unit Record File based on families with dependants aged zero to two (ABS, 2006c).

found that approximately 30 per cent of single families with dependants, and 10 per cent of couples with dependants, have income levels below the lowest threshold. Using this population, however, would provide an overestimate of the true proportion, as critically, eligible parents are required to have had previous labour force participation and this is not able to be ascertained in the data.

A data source that addresses this limitation is the Longitudinal Study of Australian Children survey (LSAC), which includes the Parental Leave in Australia survey, a nested study within the LSAC (AIFS, 2007). Baxter reports that ‘those who had not been employed during their pregnancy experienced the lowest rates of return to work. Just 13% in this group had returned by 18 months after the birth’ (2008,p.x) Conditional on pre-birth employment, the proportions employed after 18 months for self-employed, permanent, contract and casual employees, are 84%, 76%, 64% and 58% respectively (Baxter, 2008). These statistics suggest a very high correlation between pre-birth and post-birth employment status. A consequence is that a large proportion of the 30 per cent of single families with dependants who have incomes below the minimum repayment threshold, reported above, are likely to have not been eligible for participation in the PPICL scheme.

Although a detailed analysis of the LSAC data would allow a more considered assessment of potential aggregate cost, a rudimentary analysis suggests that scheme costs would be modest, if not negligible. This is achieved by applying the subsidies for the hypothetical scenarios to the probability of representation in the ICL scheme for each of the family types (and income groups). Under assumptions of no adverse selection (i.e., 85 per cent of participants are couples, 15 per cent are singles, and each income quartile is equally represented), the aggregate subsidy based on values for the ten week loan from Table 2.3 would be *minus* six per cent (or positive three per cent for a 26 week loan). Even in the presence of substantial adverse selection, manifested by the dominance of single parent families in the scheme, a simple simulation shows that aggregate costs would be small. To illustrate the case of adverse selection, it is assumed that 50 per cent of take-up is by single parents, compared with an actual population proportion of 15 per cent, and that of the single

parents, 50 per cent of those participating are in the lowest income quartile.⁴⁶ The aggregate government subsidy under these quite extreme circumstances is just seven per cent when based on ten weeks of leave.

To appreciate the potential cost in dollar terms, assumptions need to be made for take-up. Not all women with new babies are eligible for the PPICL, as many will not have been employed prior to taking parental leave. According to ABS statistics, in 2005 only 64 per cent of women with children aged less than 2 years were employed while pregnant (ABS, 2006d), and of these, 84 per cent will have had sufficient workplace attachment to be considered for the statutory PPL scheme (PC, 2009). Following these considerations, the PC estimates 125,000 as the potential take-up of the statutory scheme for mothers (PC, 2009). As the eligibility conditions for the statutory scheme match those proposed here for the ICL, the same potential take-up is assumed for the purpose of calculating aggregate costs. However, in practice, as the ICL is an optional loan rather than a grant, the take-up would be expected to be smaller. Given that 15 per cent of families with young dependants are single parent families, the maximum take-up possible by single parent families would be 18,750. Under assumptions of substantial adverse selection, whereby it is assumed that 50 per cent of take-up is by single parents, this implies a maximum total take-up of the loan of 37,500.⁴⁷ Under these extreme assumptions the loan outlay in year one is roughly \$200 million, but the cost (due to the subsidy) would be only \$14 million. These calculations suggest that, even in conditions of severe adverse selection, the policy would not be costly.⁴⁸ A further caveat is that these calculations are based on subsidy estimates that assume static income profiles. Evidence will be presented in Chapter 4 that aggregate subsidies are likely to be over-estimated under static assumptions. The implication is that aggregate costs under extreme adverse selection are likely to be lower than those estimated here.

⁴⁶ It is assumed that 25 per cent have the median income and 25 per cent have the upper quartile of income. Further we assume that 50 per cent of single families are full-time and 50 per cent are part-time.

⁴⁷ That is, 18,750 are single parent families, and 18,750 are couple families.

⁴⁸ To put the dollar amounts of subsidy in context, the annual outlay for FTB A and B for this same group of 37,500 parents during the first year of parental leave is estimated at approximately \$200 million, with over an additional \$250 million for Parenting Payment.

2.7 Discussion

In this chapter it has been argued that the developmental and health benefits to parents and children of paid parental leave may not be maximised through the recently announced government PPL scheme. Social spill-overs from additional leave may also arise through improved workforce attachment and a reduction in labour force gender disparities. Despite the potential benefits, a lack of liquidity and a market failure due to the absence of collateral and unknown default risk prevents families from financing an extension of leave. This sets the scene for government intervention. An income contingent loan for PPL was proposed to provide a source of funds for parents to extend their leave beyond the 18-week statutory scheme.

An ICL in this context provides a source of funds for leave; it can be flexibly designed to allow sharing of costs between the recipients of the leave and taxpayers; it enables consumption smoothing and is likely to be progressive within categories of debtors; and the contingent repayment feature encourages participation through the provision of default insurance. Two risks that jeopardise the operations of an ICL scheme are adverse selection and moral hazard. Key design features for the PPICL were proposed, many of which help mitigate these risks.

Eligibility is confined to persons with previous workforce attachment (consistent with conditions for participation in the 18-week government scheme). This is in keeping with the purpose of the ICL as a temporary income replacement while the parent is on leave from paid employment, and importantly reduces the prospect of adverse selection from parents with no workforce attachment. The HECS repayment schedule is broadly applied, albeit with a reduction in the minimum income threshold to guard against non-retrieval of debt from low income earners in the scheme, noting that scheme participants have, on average, lower income earning potential than HECS debtors. Additionally, to counter adverse selection, the scheme is designed such that repayments are the obligations of both parents. Loan durations of 26 weeks and 10 weeks in excess of the 18-week statutory scheme are modelled, as are various loan amounts, including minimum wage, reduced amounts to reflect interactions with existing family benefits, and replacement wages. For the majority of cases modelled it is assumed that the loan is subject to a 20 per cent surcharge (consistent with FEE-HELP). This acts as a real interest rate, however its impact

varies according to the time until loan repayment for the debtors. For comparison, for one of the cases the surcharge is replaced with mortgage interest rates.

Four scenarios were selected as being representative of the family units who might participate in a PPICL scheme, and six cases representing combinations of scheme design parameters were tested against the scenarios. The chief output of these examples were implicit subsidies, as these provide insight into the potential costs faced by taxpayers due to non-recovery of debt (as a consequence of the ICL default insurance) and debt indexation at levels below the government's opportunity cost. The results of the cases explored in Section 2.5 highlight key features of the PPICL scheme. Design Cases 1 and 2 illustrate a 26-week and 10-week scheme respectively, both providing a loan of minimum wage operating with a 20 per cent surcharge. The results in Table 2.3 show that the scheme is progressive with these parameters. Debtors with low future incomes and in particular low-income single mothers, take the longest time to repay or do not repay the loan (due to the built-in default protection), benefiting most from the fixed surcharge and nil real indexation. This group is a cost to the taxpayer, whereas those with higher incomes repay more quickly generating negative subsidies.

This cross-subsidisation may be seen as an equitable outcome as the high subsidies are provided to those groups most in need, namely low income mothers who are unlikely to be able to finance a period of extended maternity leave by other means. Equally, the negative subsidies experienced by higher income earners may add to adverse selection by deterring participation from those most likely to repay quickly.

Negative subsidies, however, do not necessarily imply that the scheme would be unattractive. First, the scheme offers a source of financing that might otherwise be unavailable. Second, it provides default protection, which risk adverse individuals may value highly. Third, the subsidies in Table 2.3 are calculated from the perspective of the government, whereas the debtor may have a different opportunity cost. Section 2.6.1 explores this last point by reporting subsidies for Cases 1 and 2 at six and ten per cent discount rates. It is shown that the scheme as structured under these cases might indeed be attractive to median and higher income earners if they were faced with moderate borrowing costs. A key conclusion is that an appropriately designed scheme could be attractive financially to both government and parents.

Maintaining attraction to the scheme from all eligible persons is important for two reasons. First, as a motivation for the ICL is to promote take-up of sufficient parental leave in order to maximise maternal health and child health and developmental outcomes, while encouraging workforce attachment, it is all families with children, and not specifically the most financially constrained, who the ICL is attempting to target. Second, taxpayer costs are reduced if some level of cross-subsidisation occurs among the participating families, particularly in the presence of a loan surcharge.

Although adverse selection is reduced through eligibility conditions, low repayment thresholds, and shared parental repayment obligations, the prospect remains, hence consideration is given to alternative scheme designs.

The prospect of cross-subsidisation that may both encourage participation from low income earners while discouraging higher earners from participating, is to a large degree a consequence of the loan surcharge. The effect of a real indexation rate as opposed to a fixed surcharge is explored in Section 2.5.5, where a real rate of 3.5 per cent is applied. This removes the prospect of interest rate loss for the government, thus providing greater cost certainty. While it also makes the scheme more attractive to those who repay quickly, the scheme attraction would be compromised for low income earners who repay slowly. While equity is an inherent feature of an ICL due to default insurance, a surcharge arguably adds to the equity by increasing the level of cross-subsidisation. A real indexation rate, while reducing the equity features of the ICL, may reduce adverse selection by both encouraging greater participation from higher earning families, while dampening the attraction to families with lower income earning potential.

In addition to the perceived scheme costs relative to other financing arrangements for potential participants, attractiveness of a PPICL scheme will depend on affordability. Affordability in the presence of HECS is dealt with by treating all ICL debts as one debt and requiring one, rather than multiple, compulsory repayments based on existing income thresholds. In this sense affordability for PPICL would not be any more onerous than the financial obligations facing existing HECS debtors. In Section 2.5.2 the addition of a HECS debt is shown to have a relatively minor affect on costs, however, the results can be mixed and counter-intuitive. Where a

difference exists between HECS and a PPICL scheme is among low- income earners who may face repayments under a PPICL scheme, but who are not required to make repayments under HECS due to the different minimum threshold assumptions. For lowest income earners repayment obligations under a PPICL scheme are unlikely to be onerous, as payments start at less than \$11 per week.

As raised in Section 2.6.2, concerns of high marginal repayment obligations, or high EMTRs and associated moral hazard could be addressed by introducing a repayment schedule where rates are applied to additional income, as opposed to total income (though the administrative complexity and cost in replacing the existing HECS arrangements with a new schedule would be nontrivial). A smooth repayment schedule such as that suggested in Section 2.6.2 has the added advantage of collecting additional repayments from lower income earners, thus reducing adverse selection.

Flexibility in design is further illustrated in Sections 2.5.3 and 2.5.4, where variable loan amounts are considered, first through interactions with existing family benefits, and second through the consideration of loan amounts equal to replacement income instead of minimum wage. Finally, although this chapter has included detailed conceptualising and modelling of design features that might mitigate adverse selection in a PPICL scheme, a simple costing exercise suggests that under even extreme adverse selection the aggregate subsidy would be small and overall costs manageable.

In Chapter 4, the implications of earnings model complexity to ICL costs are examined, and the results include discussion of the implications of alternative earnings models on PPICL costs. A key conclusion of Chapter 4 is that static earnings assumptions overestimate aggregate costs, suggesting that the tentative aggregate estimates provided in Chapter 2, while low, may in fact be an upper bound on costs, giving further support to the financial viability of a PPICL scheme.

Prior to the earnings modelling of Chapter 4, tertiary education, the original application area of ICLs, is returned to, and it is argued for an extension of HECS beyond tuition fees to student living costs.

3 Income support for higher education through income contingent loans⁴⁹

3.1 Introduction

3.1.1 *Background and outline*

In Chapter 2, an income contingent loan was introduced for paid parental leave, a policy area removed from the one setting where ICLs have to the present been successfully applied - higher education - yet sharing many features with that area; intended participants of each have liquidity constraints yet face potentially high costs that may prevent participation; each is subject to a market failure; and, participation yields personal benefits, as well as societal benefits in the form of greater workforce participation (among other things). In the current chapter, higher education is considered and an area of financial deficiency, namely student income support, is identified.

There are a range of potential benefits to society of investments in education, and higher education in particular. Externalities may include:

- advances to knowledge for the benefit of health, innovation for advancement or preservation of lifestyle, improvements in infrastructure and technology, security and risk mitigation, environmental management, economic efficiency, and social justice and equity;
- higher labour force productivity, participation, employment, and reduced welfare dependency⁵⁰;

⁴⁹ The proposal for an income support ICL designed specifically for mature aged students with dependants and previous higher education was the topic of a 2009 AJLE paper co-authored with Bruce Chapman and Dehne Taylor. While Section 3.5 of the current chapter describes the specific example of income contingent loans for mature aged training, the ICL suggested in that section differs substantially from Chapman, Higgins and Taylor (2009). Moreover, the vast majority of the current chapter describes and models an ICL for income support for all university students, the majority of whom are aged less than 25, and thus differs in motivation and contents from Chapman, Higgins and Taylor (2009).

⁵⁰ Greater skills lead to an ability to command greater salaries, which in turn leads to greater incentive to participate in the labour force (e.g., see Access Economics, 2005).

- other benefits, such as a reduction in criminal behaviour, improved physical and mental health⁵¹, and considerable domestic employment and economic activity generally (Universities Australia, 2008).

Education has a positive effect on economic growth. Universities Australia (2008) reports high rates of return on investment in university education - an investment of \$420 per tertiary student returns \$595 in public revenue and \$821 in private disposable income. However, as noted by Chapman (2006, p.13)⁵², 'measuring the impact of higher education on economic growth is not straightforward'. Nevertheless, in aggregate, there is strong empirical evidence of a high correlation between GDP and expenditure on higher education (OECD, 2007).

That benefits exist for the individual is also clear. Earnings increase markedly with education as workers with greater skills can command higher salaries. According to studies of earnings in developed countries, each extra year of education raises earnings by five to ten percent (Dowrick, 2003). More recently, the private return for investment in higher education in Australia has been estimated at close to 15 per cent per year of a bachelor degree (Leigh, 2008).

Regardless of the specific magnitude of the public returns to education, it is clear that by improving access to student finances, society will benefit. As raised in numerous submissions and summarised by the Bradley Review (Commonwealth of Australia, 2008b), insufficient student finances are a significant barrier to participation, achievement and course completion.

In this chapter it is argued that an appropriately structured ICL could reduce the deficiency in student finances. Much of the current chapter sets out the argument for greater financial support beyond that available through current government assistance, and describes a structure for an ICL to provide this support. Some simple modelling is undertaken to illustrate potential taxpayer costs under different interest rate regimes. The specific case of income support for mature aged students is described as a final topic.

⁵¹ correlated with education (OECD, 2006).

⁵² See Chapman (2006) for a discussion of higher education externalities and a summary of empirical studies into the relationship between higher education and GDP.

An outline of the chapter contents is as follows. In Section 3.2, the benefits available to students through Youth Allowance and Austudy are summarised, followed by the noted deficiencies and inefficiencies in operations of existing policy. Conclusions and recommendations on income support policy by the Bradley Review are summarised, as are changes announced in the 2009 Budget. In Section 3.3 a case is made for further student income support above existing levels. First, it is shown that there is a shortfall in required support. It is argued that market failure opens the door to government intervention, and the case for an income contingent loan is put forward. Advantages and disadvantages are discussed, including observations from proponents and critics of ICL policy in this context.

In Section 3.4, the key features for consideration in ICL policy design are described, including debt indexation, repayment conditions, and eligibility criteria as a means of reducing adverse selection. There is a lack of consensus on the appropriate interest rate regime that should apply to ICLs in the context of education financing. In the countries in which an ICL for education has been adopted (whether just tuition, or tuition plus other expenses), indexation of student debt varies from the extremes of zero nominal to a rate that incorporates all potential scheme costs, thus ensuring nil subsidy. A number of indexation options are considered, and it is shown through some simple modelling that the impact on subsidies can vary considerably depending on the option selected. While it is shown that subsidies can be kept low under different arrangements, there are implications to equity, cost uncertainty, and debt accumulation under each arrangement.

In Section 3.5, the specific case of mature aged training is raised. As prospective tertiary education students with dependants face financial responsibilities and barriers to participation not faced by typical university students, there is a case for considering the financial needs of this group separately. While there are strong arguments for increasing participation and educational outcomes among mature aged students entering university for the first time, a case can also be made for facilitating the retraining of workers with existing educational qualifications in order to address skill shortages. As the financial costs for mature aged students are typically higher than for younger students, the income support required is greater. While an ICL in this context was proposed by Chapman, Higgins and Taylor (2009), moral hazard and adverse selection are particularly problematic in the event of large loan amounts

and reduced potential repayment duration. In Section 3.5.3, a novel solution is briefly proposed that involves ICL loan financing from superannuation.

3.2 The current situation

As at the date of submission of this thesis, students in TAFE and undergraduate (and some postgraduate) tertiary education were entitled to income support through Youth Allowance, Austudy and Abstudy (for Aboriginal and Torres Strait Islanders).⁵³ The details of eligibility and benefit payment conditions and amounts for Youth Allowance and Austudy are summarised in this section.⁵⁴ Following this summary, the deficiencies and inefficiencies in current income support arrangements are covered. The principal source in this instance is the Bradley Review into Higher Education and associated submissions. The conclusions of the Bradley Review pertaining to student income support are summarised, and lastly, the recent changes to student income support as announced in the 2009 Budget are given.

3.2.1 *Financial support for students*

Youth Allowance

Youth Allowance provides income for eligible persons while studying, looking or preparing for paid employment. The discussion in this chapter is confined to the component of financial support provided to students. Eligibility for Youth Allowance is for full-time students aged 16 to 24 years old, and 16 to 21 years old for part-time students. Students who received the benefit prior to turning 25 can continue to receive it beyond age 25 until their course of study is completed. Besides age and proof of activity (study or seeking employment), eligibility is constrained by

⁵³ Approved courses include: secondary education courses, undergraduate courses, associate diplomas and some other diplomas, TAFE courses and some post-graduate courses. Certain Masters courses that are required for professional entry are also approved (since 1 Jan 2008), and students of all coursework masters courses will be eligible from July 2012 (DEEWR, 2010).

⁵⁴ As welfare payments can arise as a consequence of interrupted employment, a brief discussion of the structure and benefits of Family Tax Benefit is presented when mature aged students with dependants are discussed in Section 3.5.1.

parental, personal and partner's (if married) income and assets. Conditions and amounts of allowance payable depend on whether the student is classified as dependent or independent, and whether the student is living at or away from home, has dependants of their own, and is single or partnered. Maximum fortnightly rates and approximate annualised amounts are given in Table 3.1.

TABLE 3.1 MAXIMUM AMOUNTS (\$) PAYABLE UNDER YOUTH ALLOWANCE

Category	Fortnightly	~Annual
single with no children, under 18 years and living at home	206.30	5,360
single with no children, 18 years and over and living at home	248.10	6,450
single with no children, and not living at home	377	9,800
single with children	493.90	12,840
partnered with no children	377	9,800
partnered with children	413.90	10,760

(Source: Centrelink, 2009)

Independence is granted if an individual can show proof of recent and substantial workforce participation, or if they can satisfy specific non-work related conditions.⁵⁵ Workforce participation criteria include that they have worked full-time for 18 months in the last two years, or part-time for at least two years since completing school. All full-time students aged 24 or over are automatically classified as independent. Under recently announced policy changes, the age of independence will be gradually reduced to age 22, and the workforce participation constraints for eligibility for persons under the age of independence will be tightened (Gillard, 2009).

For a student classified as independent, parental income and assets are not included when determining the benefit amount.⁵⁶ For a dependent student, the level of parental income and assets may limit the benefit payable. The maximum Youth Allowance is paid if combined parental income is below \$44,165 (Gillard, 2009).⁵⁷ If the individual is classified as dependent or independent, a family assets test or personal asset test apply respectively.

Regardless of whether an individual is classified as independent or dependent, they are subject to both a personal and partner income test. Under the personal income

⁵⁵ Non-work conditions include that they have been married (or in a marriage-like relationship) for at least one year, they have a dependent child, their parents are incapable of providing care and support, among others.

⁵⁶ Additionally, an individual is entitled to the independent rate if the parent is not self-employed and is receiving a pension or benefit, or under certain under exceptional circumstances.

⁵⁷ This recently increased from a parental limit of \$32,800 in the previous 2008/09 financial year. Beyond the threshold of \$44,165, payments are reduced by 20 cents in the dollar.

test full-time students can earn up to \$236 per fortnight (\$6,136 per annum) or \$62 per fortnight for part-time students, before payments are reduced. This limit will increase to \$400 per fortnight from July 2012 (Gillard, 2009).⁵⁸

Austudy

Austudy is available to students over the age of 25 who are studying full-time at an approved education institution (or an Australian Apprenticeship).⁵⁹ Eligible students are considered independent, so no parental means tests apply for Austudy.

TABLE 3.2 MAXIMUM AMOUNTS (\$) PAYABLE UNDER AUSTUDY

Category	Fortnightly	~Annual
single	377	9,800
single, with children	493.90	12,840
partnered, no children	377	9,800
partnered, with children	413.90	10,760

(Source: Centrelink, 2009)

A personal income test applies, the conditions of which are identical to those applying to Youth Allowance. As at September 2010, for persons with no dependants, payment of Austudy ceases when private income reaches \$878 per fortnight (\$22,820 pa). For a single with dependants the payments cut out if income reaches \$1,072 pf (\$27,885 pa). These amounts are set to change as a consequence of the new personal income thresholds announced in the 2009 Budget (Gillard, 2009). Partner's income is also taken into account in determining eligibility and Youth Allowance or Austudy benefit amount (Commonwealth of Australia, 2009b). An assets test also applies, where the permitted assets depend on whether the applicant is single or partnered, and a homeowner or non-homeowner.

A feature of both Youth Allowance and Austudy arrangements is the 'Income Bank'. This allows students to earn income during short periods (such as summer break between academic years) while not jeopardising income support payment amounts. The implication is students have flexibility to earn over the personal income threshold for short periods, provided they have previously earned below the threshold and saved up credit in the income bank. The income bank balance is limited to \$6,000 (Centrelink, 2009).

⁵⁸ The level of reduction of payments depends on the extent to which income exceeds these amounts. For married students, a partner income test also applies.

⁵⁹ Full-time secondary education courses, graduate courses, undergraduate courses, and some Masters, diplomas, and TAFE courses are approved for Austudy.

Other benefits

Students who receive Youth Allowance are also entitled to Pharmaceutical Allowance and may be entitled to Fares Allowance. Rent assistance is also available for students eligible for Youth Allowance who are permanently living away from their parents, and for Austudy recipients, where the payment levels depend on single or couple status and dependants.

A range of scholarships was announced in the 2009 Budget for eligible students (Gillard, 2009; Centrelink, 2009), the details of which are discussed in Section 3.2.3. These replace the Commonwealth Scholarships Program that was introduced in 2004 to assist low SES domestic students (Commonwealth of Australia, 2008b).

3.2.2 Deficiencies and inefficiencies

Following extensive consultation with the public, the Senate Employment, Workplace Relations and Education References Committee released a report into student income support in 2005 (Commonwealth of Australia, 2005a). They noted the ‘...Government’s preoccupation with program efficiency over policy effectiveness’ (ibid., p.xv), and reported that income support was insufficient to cover student needs. They observed failings with the parental income test threshold, the eligibility criteria relating to the age of independence, and a variety of other aspects of income support policy. Government senators disagreed with the majority of the Committee’s recommendations, and few changes to income support policy were subsequently passed into law and implemented.

The criticisms raised in the 2005 Senate report were reiterated in the Bradley Review of Australian Higher Education (Commonwealth of Australia, 2008b). The Bradley Review issued a discussion paper in June 2008 (Commonwealth of Australia, 2008a) that, among other things, called for submissions into how the inadequacy of current student income support adversely affects individuals or groups. This was accompanied by a more general question into how to increase participation among low SES students. Close to 300 submissions were received, many of which provided evidence of the need for student income support reform.

A frequent criticism was the poor targeting of Youth Allowance towards students who are genuinely independent.⁶⁰ Under existing arrangements, an individual may leave home and work temporarily, thereby becoming classified as independent, yet return home while a student and claim the independent rate, regardless of actual dependence on their parents. A consequence is that many students claim the maximum rate of Youth Allowance while living in households with substantial incomes. The poor targeting of independence was supported empirically in a study of HILDA data by Chapman and Lounkaew (2009).

There was also a call for a reduction in the age of independence⁶¹ - the desire to demonstrate independence is having a significant impact on deferral rates, particularly among non-metropolitan students (e.g., see Deakin University, 2008; Charles Sturt University, 2008). Arguments for a lower age of independence have persisted for some time. Chapman (1992) noted that parents and students may place different value on higher education, and thereby some parents may be unwilling to assist when in a financial position to do so, while the 2005 Senate Report into student income support recommended costing of the implications of reducing the age of independence (Commonwealth of Australia, 2005a). In their submission to Bradley, the National Union of Students (NUS) argued for an age of independence of 18 noting that this is the socially accepted age of adulthood, being the age at which an individual can ‘...legally marry, drive, vote and serve in the armed forces and on juries’ (NUS, 2008, p25).

A common criticism was that existing arrangements have been inadequately indexed and provide insufficient benefits.⁶² QUT (2008) reported many of their students as financially deprived despite being in receipt of student income support benefits. Additionally, the relative level of support for different groups of students was subject to criticism.

Perhaps the most frequent policy criticism was that both the personal and parental income means tests are too low, unfairly excluding many students who come from

⁶⁰ e.g., Simpson, 2008; Deakin University, 2008; Go8, 2008; ANUSA, 2008

⁶¹ e.g., AFUW, 2008; Skinner, 2008; UWA, 2008; Universities Australia, 2008; Murdoch University, 2008; NTEU, 2008; NUS, 2008

⁶² e.g., AFUW, 2008; Professions Australia, 2008; Monash University, 2008; QUT, 2008; UWS, 2008; ANUSA, 2008; NTEU, 2008

low- and middle-income families.⁶³ A consequence is that many students are ineligible for Youth Allowance despite their parents having insufficient income to provide financial support. The NUS commented that ‘...the parental income threshold is set so low that it impacts even on low/middle SES blue-collar families with a sole person in stable employment’ (NUS, 2008, p24). This has manifested through poor policy design; indexation has been absent since 1993, eroding the real value of both the parental and personal income thresholds. Indexation of the personal income threshold would lead to the amount of \$236 increasing to almost \$470 per fortnight (Australian Law Students’ Association, 2008).

Inadequate indexation of the income bank also did not escaped criticism. While the income bank is seen as an excellent policy initiative as it provides some flexibility in earnings, there are calls by many of the student unions, including the NUS (2008), to increase the income bank beyond the \$6,000 at which it has been fixed since 1993.

A consequence of the low benefit levels and means tests is that many students turn to paid employment at levels which compromise their ability to successfully study full-time.⁶⁴ Evidence of an increasing proportion of students engaging in long hours of paid employment was a major concern expressed by the 2005 Senate Committee report into student income support (Commonwealth of Australia, 2005a). Those who attempt to work while studying full-time tend to have poorer academic performance, higher withdrawal and failure rates (with consequent higher HECS debts), and associated medical and psychological conditions such as stress, anxiety and depression (e.g., ANUSA, 2008).

A large number of tertiary institutions report an increasing number of students who are forced to juggle part-time work commitments with full-time study, and the adverse consequences of employment on study.⁶⁵ The University of Southern Queensland (2008) has noted a significant decline in student load despite increases in enrolments due to the pressure to work while studying, while La Trobe University reports that 25 per cent of students undertook paid work *while* their classes were in session (BSA, 2008, p11), and a survey of Melbourne University students found that

⁶³ e.g., AFUW, 2008; Professions Australia, 2008; QUT, 2008; SFAN, 2008; UWA, 2008; UniSA, 2008; UWS, 2008; UNSW, 2008; UoQ, 2008; Charles Sturt, 2008; USQ, 2008; NTEU, 2008; University of Melbourne, 2008; NUS, 2008

⁶⁴ e.g., UNSW, 2008; USQ, 2008; EDU, 2008; ANUSA, 2008

⁶⁵ e.g., University of Adelaide, 2008; Murdoch University, 2008; Monash Student Association, 2008a; Deakin University Student Association, 2008

37.5 per cent believed that work adversely affected their study (Bexley, 2007). While there is ample anecdotal evidence of the link between employment and poor performance, using UK data Callender (2008) confirms that employment during semester has a detrimental effect on marks obtained.

Another unpleasant implication of rising living costs and insufficient finances is that many students are in effect homeless, having to stay temporarily with friends or relatives (Tomazin, 2008). Others have turned to drastic measures to make ends meet; reports include students giving blood to afford lunch, donating bone marrow, volunteering as subjects in medical studies, undertaking informal 'cash-in-hand' work, and engaging in illegal endeavours such as drug-dealing and shoplifting, as well as taking employment in the sex industry (NUS, 2008; Lantz, 2005).

That financial hardship compromises attendance and completion of university studies is clear. In a 2007 survey of 2,500 students conducted by the University of Newcastle, 46 per cent of respondents had given at least some consideration to dropping out, with 38 per cent citing time problems and 30 per cent citing financial problems as a reason (University of Newcastle, 2008). A Monash University survey reported that 80 per cent of students had difficulty affording necessary study materials, and high proportions had difficulty with transport, food, accommodation and medical costs (Monash Student Association, 2008b). This is exacerbated by rental prices and property shortages in many metropolitan areas (e.g., Tomazin, 2008; SFAN, 2008).

Numerous universities and student unions provided anecdotal evidence of increased hardship through increasing demand on internal financial assistance programs and the negative effect of financial hardship and paid work on academic performance.⁶⁶ Some argue that financial hardship is further aggravated by a reduction in welfare services due to the introduction of Voluntary Student Unionism (NUS, 2008; Universities Australia, 2008).

The state of affairs nationally with regards to student finances was captured in a survey of undergraduate students in 2000 commissioned by the Australian Vice-

⁶⁶ e.g., ACU, 2008; University of Sydney, 2008; UniSA, 2008; USQ, 2008; EDU, 2008; ANUSA, 2008; UNSW SRC, 2008.

Chancellors' Committee (Long and Hayden, 2001). This was followed by a survey in 2006 commissioned by the renamed AVCC, Universities Australia (James *et al.*, 2007). The surveys identified student poverty as a constraint on participation and achievement in higher education. Some of the notable statistics and findings from the 2006 survey are as follows:

- full-time undergraduate and postgraduate students undertook considerable paid work in order to supplement their other sources of income. 70.6 per cent of undergraduate students worked during the semester, at an average of 14.8 hours per week, while an even greater proportion of full-time postgraduate students worked. These proportions represent a greater reliance on paid work in 2006 relative to 2000. Meanwhile, 65.9 per cent of total income was derived from paid employment in 2006 as compared to 50.7 per cent in 2000;
- many students indicated that substantial work was necessary to afford basic necessities and study material, and over 40 per cent of full-time undergraduates (and 50 per cent of part-time undergraduates) reported a significant negative effect on their academic studies as a consequence;
- one in eight students regularly went without food or other necessities due to insufficient finances, and nearly 60 per cent of full-time and 55 per cent of part-time undergraduate students reported that their financial situation is a regular source of worry. Similarly large proportions of postgraduates shared this concern.

While students from all groups appear to be subject to financial hardship to a greater or lesser degree, indigenous higher education students are more prone to hardship as they are more likely than other students to have a disability, be a sole parent, have children, be over age 30, or are less likely to be able to rely on relatives for financial students (Indigenous Higher Education Advisory Council, 2008). As a consequence of the particular circumstances facing indigenous students, the Indigenous Higher Education Advisory Council recommended specific measures to fix what they see as deficient policy (2008). Similar measures were advocated by other groups including the University of Western Sydney (2008) and NTEU (2005), who called for a significant increase in Abstudy payment levels, among other measures.

In light of the compelling evidence the Bradley Review concluded that current financial support arrangements ‘...are complex and poorly targeted. The entire framework for provision of financial support for students needs urgent reform’ (Commonwealth of Australia, 2008b, p47). The Bradley recommendations included: extending eligibility for income support to all masters coursework programs; lowering the age of independence and better targeting benefits through reforms to the workforce participation criteria for independence; updating benefit payments through application of indexation adjustments; increasing parental and personal income test thresholds; and improving the provision of Commonwealth Scholarships. Specific comments from the Bradley Review pertaining to income contingent loans are discussed in Sections 3.3.3 and 3.3.4 of this chapter.

3.2.3 *Budget changes*

The Labor party has argued for sometime that financial hardship is a barrier to university education that needs to be overcome (ALP, 2006), and have recently delivered to an extent on a promise to address this issue by announcing changes to income support policy. Following the recommendations put forward by the Bradley Review, the Federal Government announced changes in the 2009 Budget (Gillard, 2009) which included:

- increases in the parental income test for dependants under Youth Allowance and Abstudy (from \$32,800 to \$44,165);
- a gradual reduction in the age of independence from 25 years to 22 years by 2012 (currently at 24);
- an increase in the personal income limit from \$236 to \$400 per fortnight (and indexing this to CPI) for Youth Allowance, Austudy and Abstudy.
- tightening of the workforce criteria for independence under Youth Allowance and Abstudy⁶⁷;

⁶⁷ specifically, so that part-time work, or a wage of \$19,532 in itself, is no longer sufficient. Instead, only full-time work for at least 18 months in the previous two years will be sufficient for students to

- a new Student Start-up Scholarship of \$2,254 (indexed with CPI) per year of study for all higher education students receiving full or partial Youth Allowance, Austudy and Abstudy (DEEWR, 2010);
- a Relocation Scholarship of \$4,000 in their first year and \$1,000 in subsequent years for Youth Allowance and Abstudy recipients (DEEWR, 2010);
- extension of income support to all masters by coursework programs from 2012; and
- relaxing means testing of scholarships provided by universities and philanthropic organisations.

While these changes will have a substantial effect on reducing the financial hardship facing university students, deficiencies remain. Notably, Youth Allowance rates have not been directly increased:

‘The decision not to increase the rate of Youth Allowance as a part of the Budget means that many students will be obliged to continue to balance work with study in order to make ends meet. Given that the highest rate of payment that can be attained by singles on Youth Allowance currently falls well short of Newstart Allowance for singles, it may be argued that this discrepancy provides a disincentive for young people (and especially disadvantaged people) to participate in higher education rather than seeking full-time employment.’ (Klapdor and Thomas, 2009).

Youth Allowance and Austudy have increased, albeit not directly, through the inclusion of the Start-up Scholarships. This is equivalent to an extra \$87 per fortnight. Combined with the Relocation Scholarship this implies an equivalent fortnightly amount of \$240 for the first year of study and an extra \$125 thereafter for those eligible.

Some of the Budget measures have attracted criticism. Specifically, the changes to workforce participation criteria for independence, while ensuring better targeting of allowances to those genuinely in need, will disrupt the plans of many students who

satisfy workforce participation criterion for Youth Allowance eligibility. This final change ‘...will ensure that only students who are genuinely independent can receive student income support.’ (Gillard, 2009)

were already taking a 'gap'-year in 2010 to qualify for independence. The detrimental effect of the new independence criteria on prospective students currently taking a 'gap' year has led to the government delaying the introduction of new policy, thereby allowing existing 'gap' students access to Youth Allowance under existing arrangements. The cost associated with this measure is to be recovered by delaying the commencement of the increased personal income test thresholds to July 2012 (Centrelink, 2009).

3.3 The case for further intervention

As will be shown in this section, despite recent budget measures, levels of income support in Australia remain insufficient to allow many students to concentrate on full-time study without the need to supplement their income through other means. It is argued that the level of paid employment required to obtain sufficient supplementary income would be detrimental to academic performance.

Financing arrangements, such as bank loans, are either unavailable or require evidence of credit-worthiness, through either collateral or the involvement of guarantors, both of which are unavailable for many students. This raises a case for further government intervention. The prospect of an income contingent loan for income support is raised, and the cases for and against are summarised.

3.3.1 *How much is needed?*

To answer the question of how much additional income support (if any) is required, one must first establish the financial position of existing students given the various sources of income available. For a person on the independent rate of Youth Allowance, disposable income in year one of study (assuming receipt of the Start-up Scholarship and \$4,000 Relocation Scholarship) would be approximately \$15,400 after tax, or \$17,300 if the maximum single shared rate of rent assistance is also received. For subsequent years of study disposable income would be approximately \$12,400 (assuming \$1,000 Relocation Scholarship) without rent assistance, and \$14,300 with rent assistance.

University timetables include periods of non-contact during which students can undertake paid employment, thereby supplementing existing student income support. This raises the question as to what constitutes a reasonable amount of paid employment so that a full-time student's academic performance is not compromised. While in full-time study, students are expected to engage in approximately 40 hours weekly of university related work.⁶⁸ So as to not jeopardise academic performance, it is reasonable to assume that paid employment should be confined to academic breaks. In the typical academic year there are about 15 weeks outside of the standard teaching and exam periods; this is taken as the upper limit for employment at a full-time level.⁶⁹ At minimum wage of approximately \$15 per hour⁷⁰, this equates to just over \$8,500 of earnings.

Regardless of what might constitute the maximum duration of employment so that performance is not compromised, some students, be it through lack of opportunity due to geographical location, or lack of time due to course requirements, may be unable to participate in paid employment. For example, there is evidence that part-time employment opportunities are limited for rural and regional students relative to opportunities in metropolitan areas.⁷¹ Employment over the summer break may also limit a student's ability to undertake internships or may not be possible due to course structure. For example, at the University of Melbourne and University of South Australia certain schools have placement components preventing employment.⁷²

One way to interpret sufficiency of income support is by comparison with poverty lines, based on the benchmark established in 1973 by the Henderson poverty inquiry. These represent the amount of disposable income required for a range of family types. The Melbourne Institute of Applied Economic and Social Research produces poverty lines quarterly, the latest of which is for the 2010 June quarter (Melbourne Institute, 2010). For a single person not in the workforce the weekly

⁶⁸ For some courses the requirement may be even greater. For example, according to Professions Australia, the average engineering student needs approximately 50 hours per week to attend lectures, tutorial and laboratories and to complete sufficient independent study (Professions Australia, 2008).

⁶⁹ While employment over the long summer break is realistic, it may be impractical to find employment during short teaching breaks during the year. Hence, 15 weeks is as upper limit, and 12 weeks may be more realistic.

⁷⁰ \$569.90 per week for full-time employment (Australian Fair Pay Commission, 2010)

⁷¹ e.g., see University of New England, 2008; USQ, 2008; ANZSSA, 2008

⁷² SFAN, 2008; UniSA, 2008

Henderson poverty amount is \$326, or approximately \$17,000 per annum. Assuming that course requirements or labour market conditions are not an impediment to employment during university breaks, then income from paid employment may supplement existing student income support and push students above the poverty line.

However, a more appropriate measure for the sufficiency of overall finances is the total living cost associated with attending university, excluding tuition. University attendance requires additional costs above those faced by a typical single person not in the workforce. These include text books, equipment and supplies, and computing and internet costs. Students also may be required to stay either on campus incurring rental costs, or if living away from campus, they face daily transport costs in order to attend class.

The cost of living, particularly in metropolitan areas, provides a basis for determining the shortfall. The Student Financial Advisers Network reports that income between \$19,000 and \$26,800 is required for the costs of living within a 6-kilometre radius of the Melbourne university campus (SFAN, 2008). In a separate study costs for regional young persons studying away from home were estimated at between \$18,000 and \$26,000 (including relocation and start-up costs) (Godden, 2007).

For the purpose of estimating student financial needs in this chapter, dollar amounts tabulated via an online calculator developed by the Australian Scholarships Group (ASG) were sourced. The calculator provides information on costs of a university education by state and living options. Table 3.3 reports national average costs (excluding tuition fees/HECS) assuming study in 2010 for students living at home with their parents, living in halls of residence, and shared independent living (ASG, 2010).⁷³

⁷³ The ASG notes that the figures from the calculator for utilities, food, entertainment and transport etc., are average costs and may vary considerably depending on individual preferences and consumption needs. Additionally, certain courses have specific and significant equipment costs and accommodation can vary both within and between states and territories.

TABLE 3.3 ANNUAL NATIONAL AVERAGE LIVING COSTS ASSOCIATED WITH UNIVERSITY STUDY (\$)

	At home	Hall of residence	Shared independent living
Text books, equipment & supplies	1,018	1,018	1,018
Computer & Internet	740	-	740
Establishment Costs	-	1,000	1,311
Accommodation	-	13,325	7,025
Groceries & Food	1,820	1,820	5,460
Utilities	-	-	1,300
Public Transport	1,924	1,040	1,924
Entertainment/Other	1,820	1,820	1,820
Ancillary	2,600	2,600	2,600
Total per annum	9,922	22,623	23,198

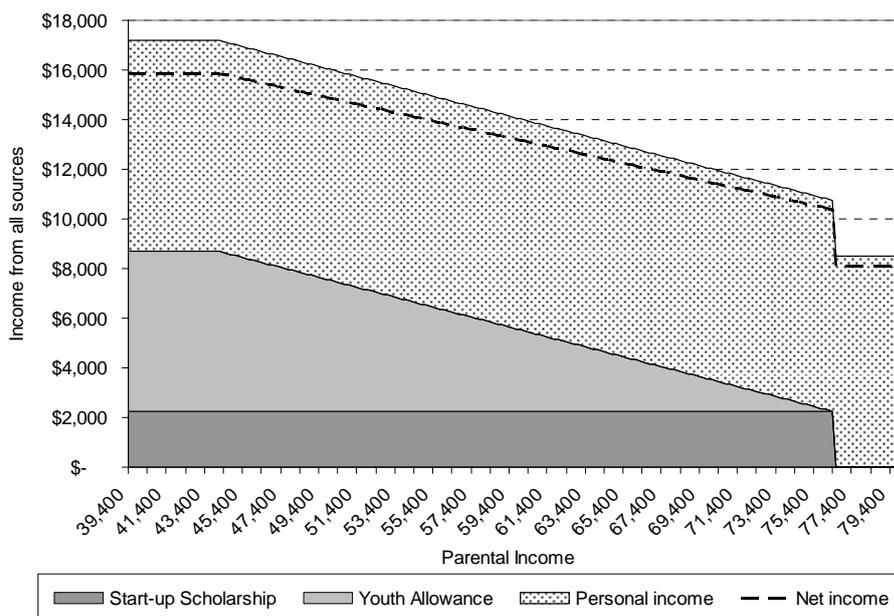
Notes: Ancillary includes medical expenses, mobile phone costs, clothes, etc.

Source: ASG, 2010

To ascertain whether the new income support arrangements, in aggregate, provide sufficient financial support, a series of graphs are produced that present the income to which students may be eligible, including Youth Allowance, Austudy, Start-up and Relocation Scholarships, and Rent Assistance. The graphs present this information alongside parental income and/or personal income levels, so that the effect of these income sources on income support can be observed, and so as to produce aggregate income estimates. In concert with the required amounts in Table 3.3, the information is used to argue that Australian student income support arrangements remain deficient despite the recently announced policy changes.

For dependent students eligible for Youth Allowance, the amount received will depend on parental income. While dependent students are assumed to rely on financial support including accommodation from their parents, many nevertheless undertake paid part-time employment to supplement their income. Figure 3.1 assumes personal income of \$8,500 per annum, being the limit of earnings estimated above so as to not compromise academic performance. The bold dashed line indicates income net of tax.

FIGURE 3.1 STUDENT INCOME SUPPORT AND PARENTAL INCOME. DEPENDENT STUDENT (>18) LIVING AT HOME, \$8,500 PERSONAL INCOME.



For genuinely dependent students who are able to rely on their parents for accommodation, utilities, and food while at home, average cost of university study as given by the ASG in Table 3.3 is approximately \$10,000 per annum (excluding tuition). From Figure 3.1 it is clear that this is achievable with personal earnings of less than \$8,500, provided parental income is below the maximum threshold at which Youth Allowance payments cease. According to the Universities Australia 2006 survey, approximately 60 per cent of full-time undergraduate university students (and 24 per cent of part-time) benefit from free accommodation and meals (James *et al.*, 2007, p18).

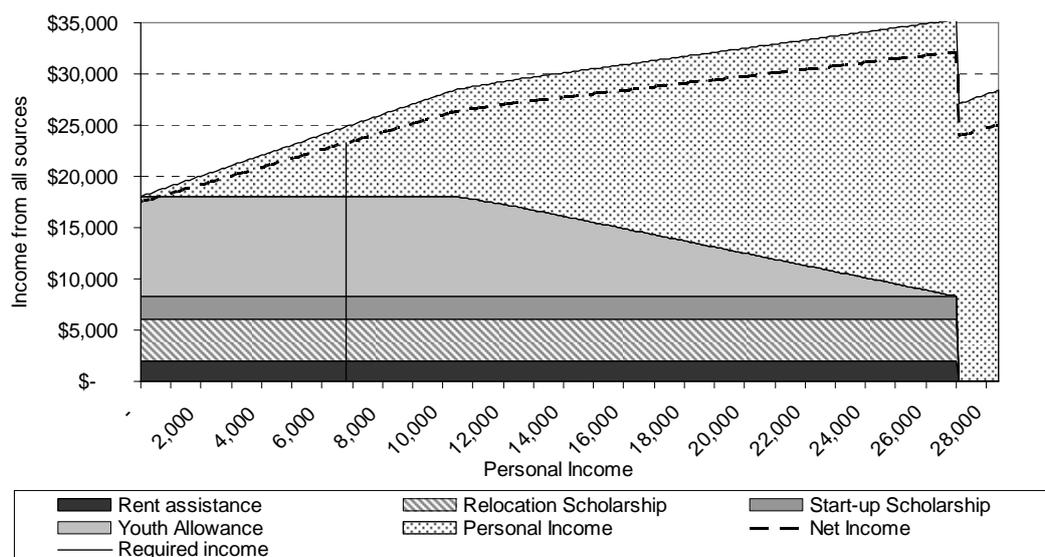
As noted by the Bradley Review, prior to the 2009 Budget some parents would not have been in a financial position to provide adequate support to their student children due to deficient parental income limits. While the adjusted parental income limits go some way to address this, and while age of independence is being phased down to age 22, it is possible that some dependent students will be required to be more self-sufficient than intended by government income support policy, and will require greater funds than the \$10,000 per annum reported by the ASG. If we assume that some dependent students are provided with accommodation and utilities by their parents, but are required to be self-sufficient for other costs, then a reasonable estimate of annual expenses is \$15,000 (being equal to the average costs of ‘shared independent living’ minus costs of accommodation and utilities). Many students in this position would be hard pressed to avoid financial hardship without

increasing their hours of employment (thus potentially compromising academic performance).

Students eligible for independent status are more likely to be genuinely financially independent of their parents, so it is this group of students who are of most interest when scrutinising the relationship between income support and financial needs. Approximately 38 per cent of all full-time undergraduate students (and 66 per cent of part-time) described themselves as financially independent in 2006 (James *et al.*, 2007, p18).

Figure 3.2 displays the circumstances for an independent student on Youth Allowance in first-year university, where it is assumed that they are eligible for the Relocation Scholarship of \$4,000 and also Rent Assistance.⁷⁴ Personal income from employment and net income are included in the figure. A vertical line is superimposed to indicate the amount of personal income (employment earnings) required so that net income from all sources is approximately \$23,000, being the average costs required for a student in independent shared living arrangements according to the ASG. This corresponds with a personal income of approximately \$7,000 per annum, which is potentially achievable for a student without its acquisition being detrimental to academic performance.

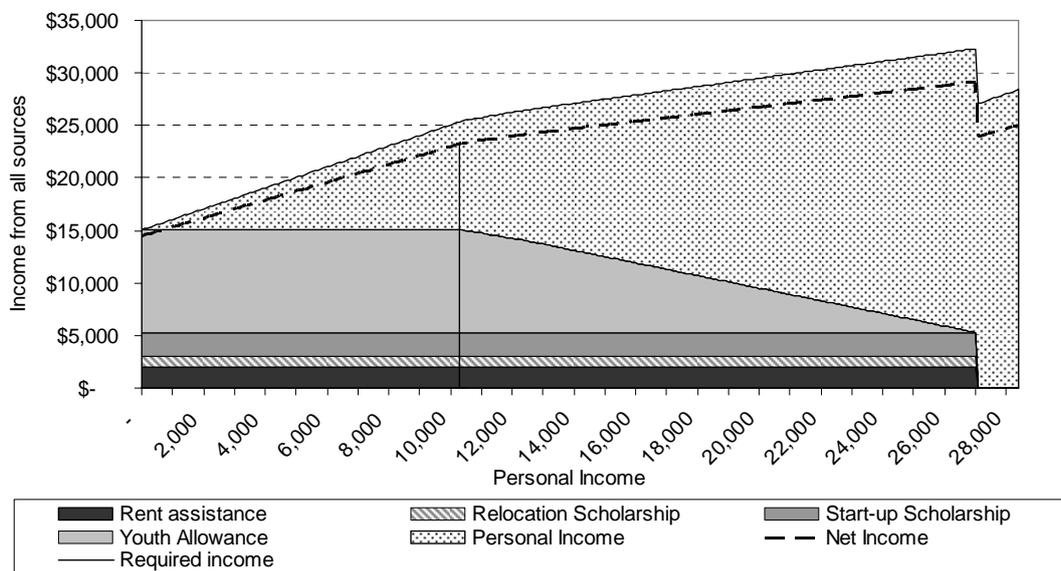
FIGURE 3.2 STUDENT INCOME SUPPORT AND PERSONAL INCOME. INDEPENDENT STUDENT. AGE 18-24, NO DEPENDANTS. YEAR ONE OF STUDY.



⁷⁴ It is assumed that Rent Assistance is received at the maximum single, shared rate of \$76.80 per fortnight.

Figure 3.3 displays the same information for a student in subsequent years of study. A distinction has been made here as the Relocation Scholarship in later years is limited to \$1,000 (Gillard, 2009). The implication is that employment earnings of over \$10,000 would be needed to achieve \$23,000, corresponding to 18 weeks of full-time work at minimum wage. While some students would earn over minimum wage, and thus may be able to achieve required earnings within study breaks, others may have difficulty securing sufficient employment. Additionally, \$23,000 is an average cost, and as noted earlier there will be variation in the costs of textbook, supplies and accommodation across course type and university location.

FIGURE 3.3 STUDENT INCOME SUPPORT AND PERSONAL INCOME. INDEPENDENT STUDENT. AGE 18-24, NO DEPENDANTS. FURTHER YEARS OF STUDY.



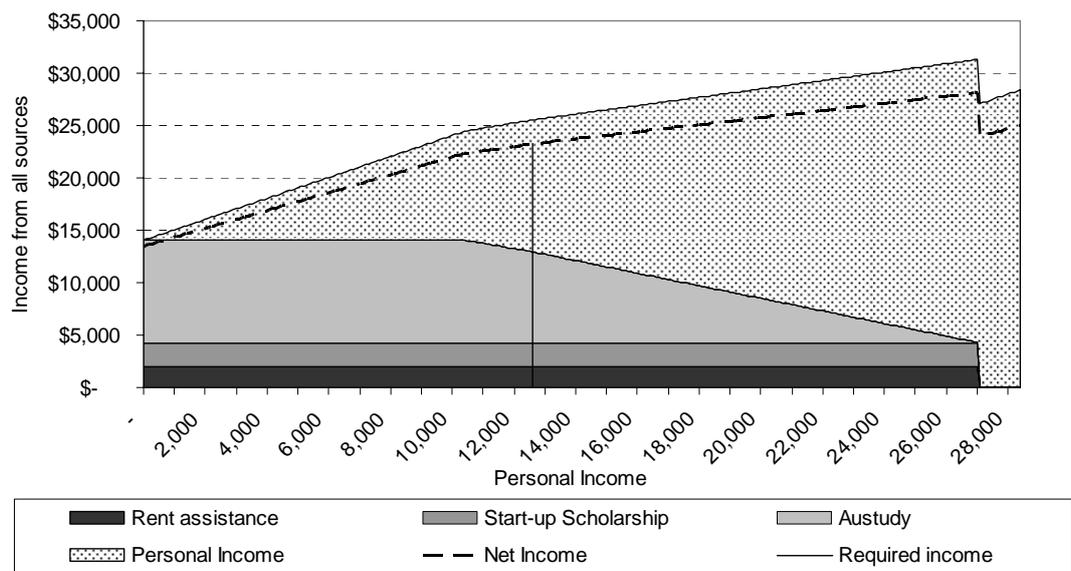
The rates of Youth Allowance that are used in Figure 3.3 are identical to those received through Austudy for a full-time student over age 25. However, as the newly designed Relocation Scholarship is not available to Austudy recipients, there is a greater need for employment for single Austudy students (without dependants) than for students on Youth Allowance. This is shown in Figure 3.4, where employment earnings of over \$12,500 per annum would be required to achieve sufficient total income to meet average living costs. In this instance, earnings exceed the personal income threshold, and thus the rate of Austudy is reduced, further increasing the earnings required to achieve an adequate net income.

In summary, despite recent improvements in income support, financially independent students (whether under independent or dependent Youth Allowance

status) will be unable to meet the average cost of living without supplementing their income with substantial employment earnings. Critically, the duration of paid work required to reach average living costs for many would necessitate employment during study periods, to the detriment of academic performance and completion rates.

If we assume that \$8,500 of employment earnings (or personal income) is appropriate and achievable, then an estimate of the shortfall can be established by comparing the net income under the assumption of \$8,500 of earnings with the assumed average cost of \$23,000. In Figure 3.3, employment income of \$8,500 corresponds to a net position of \$21,700, indicating a shortfall of approx \$2,000. Similarly, for students eligible for Austudy, the shortfall amounts to approximately \$3,000 per annum.

FIGURE 3.4 STUDENT INCOME SUPPORT AND PERSONAL INCOME. AGE 25+, NO DEPENDANTS.



For students with dependants, rates of Youth Allowance and Austudy differ, and Family Tax Benefit may be receivable. As the majority of students with dependants are mature-aged, these cases are explored in Section 3.5.1, when the specific case of mature-aged students with dependants is covered.

3.3.2 *Who should pay?*

As an income shortfall will exist for many students unless excessive paid employment is undertaken, to the detriment of academic performance, completion rates and participation, there is an argument for further student income support. Government recognises the benefits of encouraging higher education – if they did not, current taxpayer subsidised student income support measures would not be policy. However, reservations exist for financing additional income support via the taxpayer exclusively.

First, an additional \$2,000 or \$3,000 per annum for students eligible for income support potentially implies substantial taxpayer outlays. While increasing participation yields spillovers to society, uncertainty in the magnitude of these spillovers means ‘selling’ the idea to government of further taxpayer-funded student income support is problematic. This is particularly so in the current climate of budgetary pressure brought on by the Global Financial Crisis. Additionally, budgetary pressure is unlikely to abate, with projected rises in expenditure (particularly on health services) and falls in taxation revenue as a consequence of the ageing demographics of the Australian population (e.g., see the 2010 Intergenerational Report, Commonwealth of Australia, 2010a).

Second, while the analysis above suggests that an average level of shortfall may be \$2,000 or \$3,000, some students will not require additional funds, others may need slightly less, while others might require amounts near the top of this range. Providing a fixed amount to all income support students regardless of their specific needs would reflect an inefficient use of capital.

Third, as discussed in the introduction, while it is difficult to measure the relative public versus private benefits, there are clearly private benefits from increasing income support. It is, therefore, reasonable that the direct beneficiary of the income support should themselves be liable for at least part of this support.

3.3.3 *The case for an income contingent loan*

As noted by Barr (2001) and Friedman (1955), and summarised by Chapman (2006), investment in education is risky and efficient outcomes cannot be left to the market. Approximately a quarter of students who commence university do not complete⁷⁵, a student's relative success depends on both individual abilities and those of others, and opportunities in the labour market for the specific skills learned during university will not be known in advance (Chapman, 2006). Together, these uncertainties imply that a student's capacity to repay a loan is in doubt, and commercial financial institutions are unwilling to lend without a guarantee of repayment, be it in the form of collateral to draw on or a credit-worthy guarantor in the event of default. The capital market failure in this instance is identical to the market failure identified for student tuition costs, and has been the subject of considerable academic discussion in the context of motivating HECS (e.g., Chapman, 2006).

While financial products tailored to students are available, the terms and conditions would make such products unsuitable to a large number of students in need of financial assistance. As an example, the National Australia Bank offers a Tertiary Student Package Deferred Repayment Loan that allows borrowing of between \$500 and \$20,000 (NAB, 2010). The main attraction of this product is that repayments can be deferred for up to five years, however only three years is given to repay the loan following the deferral period. Critically, as with personal and home loans, collateral in the form of accumulated assets or evidence of current employment must be provided. In the absence of collateral, the loan application requires a guarantor. While some parents or guardians may be willing to take on the financial risk and act as guarantor, this will generally not be the case for financially independent students.

In the absence of a market response, Government involvement is required to enable the shortfall identified in the previous section to be financed without disrupting academic performance.

⁷⁵ this is supported by Marks (2007) who presents evidence that completion rates for the first course of study is in the range of 71 to 74 per cent.

A way to address the default-risk that prevents commercial lenders from participating is to offer Government guaranteed bank loans. This is the approach adopted in the USA and Canada, among others. Chapman (2006) summarises the arguments for and against this option in the context of HECS. As a government guarantee removes the risk of default for the loan provider, this also removes the need for collateral and thus addresses the market failure. While these arrangements benefit the commercial lender, the terms and conditions of a government guaranteed loan still pose credit risks for students. Bank loans require regular, level repayments irrespective of the student's capacity to repay, thus there remains a chance of default, with associated damage to credit reputation (Chapman, 1997).⁷⁶ Even if default is avoided, constant repayments can result in consumption hardships in instances when income falls due to unforeseen circumstances.

The risks, financial costs, and opportunity cost of higher education are not lost on students. Uncertainty of completion, competition for employability and labour force opportunities, the time taken, and the costs and finances required for a qualification, all act as barriers to university participation. While finances may be available through a government guaranteed loan, if regular and constant loan repayments are required, then the risk of default and potential consumption hardships due to uncertainty in future income may reduce participation below the levels it might otherwise reach under more flexible repayment conditions.

Finally, as noted by Chapman (2006), where government guaranteed loans exist, loan provisions are usually means tested on family income. This lack of universality is to the detriment of students who are financially independent, despite parental income being at a level that prevents them from eligibility for support.

An income contingent loan avoids the limitations of a government guaranteed loan in this context. The general features and benefits of income contingent loans have been covered in Chapter 2. Summarising, a risk sharing ICL is flexible in that it can be designed to apportion costs between taxpayers and student beneficiaries of the loan; repayment levels are a function of income and thus the instrument offers consumption smoothing ensuring affordability; and the ICL provides default

⁷⁶ However, Chapman (2006, p.30) notes that terms and conditions of some loans are such that repayments can be deferred if financial hardship is demonstrated.

insurance, since if income falls below the minimum repayment threshold repayments are not required, yet credit reputation remains intact.

It is the features of consumption smoothing and default protection that distinguish the ICL from typical bank loans or government guaranteed loans. Critically, these features mitigate risk for the debtor, and lead to an increased likelihood of participation in higher education. Additionally, they imply equity if loan indexation is below market rates. Greater subsidies are returned to those earning lower incomes, while high-income earners benefit less. In other words, more costs are borne by those to whom the human capital investment has been most successful, while those who have benefited least repay less (if at all).

Arguments for ICLs for higher education financing, including potential extensions beyond tuition to student living costs, are raised by Chapman (2006). Debate need not remain in the theoretical domain, however, as policy that involves ICLs in the context of student living costs has been enacted in both Australia and internationally. Discussion of an ICL for the costs of living for university students needs to consider that a type of ICL scheme operated in Australia between 1993 and 2003, albeit as a benefit-for-loan-trade-in. The scheme, called the Austudy Loans Supplement and later renamed the Student Financial Supplement Scheme (SFSS), allowed students to trade in one dollar of their Centrelink benefits⁷⁷ in exchange for two dollars of an ICL loan, where the maximum additional income available through the exchange was \$3,500 per annum (Commonwealth of Australia, 2005a). Although students were able to increase their income through this mechanism, the total income provided was to be repaid through HECS-style arrangements.

Those most vulnerable to financial hardship, such as low SES and indigenous students, were most likely to take out SFSS loans due to greater financial need (Commonwealth of Australia, 2005a). The majority of recipients were mature age (over 50 per cent were aged 25 and over) (NUS, 2008), and 15 per cent of the 40,000 who took out loans in the final year of operation of the scheme were indigenous (NTEU, 2008). A consequence of the adverse selection is that the expected debt recovery was very low relative to HECS (SFAN, 2008, p6) with over 50 per cent of loans estimated as doubtful (Commonwealth of Australia, 2005a).

⁷⁷ this included Youth Allowance, Pension Education Supplement, Austudy and Abstudy.

Additionally, the scheme acted like a debt trap - the effective interest rate charged on the loans was higher than market rates - thus burdening students prone to financial hardship with excessive debt (albeit income contingent). An additional criticism is that repayments were made in addition to HECS, so that rates of repayment exceeded those of HECS. On the back of many of these criticisms the scheme was closed in April 2003.

Since the closure of the SFSS there has been discussion among interest groups about the possible application of ICLs to student living costs. While the National Union of Students (NUS) cautions against the extension of HECS for living costs (NUS, 2008), they do so in the context of adverse experiences from the SFSS scheme. The major concerns being: it is the most disadvantaged groups that will incur debts; it is such groups who are most debt averse and therefore participation would be adversely affected; and, any new scheme should not repeat the excessive effective interest rates of the SFSS. Similar concerns are shared by SFAN (2008) and NTEU (2008).

When the SFSS was abolished, the NUS was contacted by students who indicated that they would not be able to complete their studies as a consequence of the removal of the loan (NUS, 2008), and many of the 4,000 indigenous students who had accessed the loan were suddenly put in difficult financial positions (Commonwealth of Australia, 2005a). Despite the deficiencies the SFSS scheme served a purpose in enabling participation in higher education, and the sudden closure of the scheme may have led to students having to withdraw from university (Commonwealth of Australia, 2005a).

Consequently, the NUS have recognised that there may be a place for an ICL for study-related costs (for items such as textbooks, computers and compulsory equipment) provided that existing gaps in income support are first filled as per their recommendations. In their submission to the Bradley review, they recommended that students be given the option of adding upfront study-related costs (as opposed to living costs) to their HECS liabilities to a level of \$1,000 per annum (NUS, 2008), cautioning against adding excessive amounts to student debt.

While the University of Sydney Students' Representative Council (2008) stops short of explicitly recommending an ICL for living costs, they noted that if the SFSS was to be reintroduced it should not be a trade-in of existing payments, interest should be at CPI only, and repayments should be made after HECS debt is first repaid in full. A number of other submissions to the Bradley Review suggested that consideration should be given to extending HECS to cover living costs.⁷⁸ Calls to extend HECS to student expenses pre-date the Bradley Review. Professor Roger Dean suggested extending HECS to specific expenses such as university contracted accommodation and book purchases (Commonwealth of Australia, 2005b, p2). While the 2005 Senate Committee recommended that DEST examine a new income loan scheme to replace the SFSS (Commonwealth of Australia, 2005a, p63), Government senators disagreed with this recommendation.

In a private submission to the Bradley Committee, the Vice Chancellor of Macquarie University supported the extension of HECS for living costs (Schwartz, 2008). He argued that costs associated with attending university, such as accommodation, travel, food, and textbooks, are a deterrent from participation among low SES students. Further he argued that the ability to borrow would provide students opportunity to move from home and afford accommodation, thus enabling travel to the location of educational opportunities. Edith Cowen University likewise supported the provision of living costs loans (they called this "COSTS-HELP") though they noted this would increase the debt burden on students (EDU, 2008, p3). The Group of Eight (Go8, 2008), supported the consideration of an ICL for accommodation rental costs, however, they stopped short of supporting extensions for other discretionary purposes.

The Bradley Review recognised that there are certain groups of students who incur additional costs because of their specific circumstances. These include: students who require practical training as part of their courses which can involve stays in locations away from home; students who face moving costs due to relocation for university; and mature aged workers with dependants who wish to retrain (Commonwealth of Australia, 2008b).⁷⁹ They reported on two options to address these issues. First, they summarised an idea put forward by Chapman and Lounkaew which is essentially the

⁷⁸ e.g., Schwartz, 2008; Monash University, 2008; Universities Australia, 2008; EDU, 2008.

⁷⁹ The specific case of mature aged workers with dependants is discussed in Section 3.5 of this chapter.

old SFSS scheme, but with modified parameters including a 1:3 trade-in ratio, debt to be paid off after HECS rather than in parallel, and a cap to limit potential costs. While the Bradley Review recognised the merits, they stopped short of recommending this option. Similarly, the Bradley Review reports on the suggestion of Chapman and Lounkaew for an ICL of approximately \$1,000. The Review raised a number of unresolved issues and consequently refrained from recommending an ICL. These reservations are described in the next section.

ICL's for both tuition fees and living allowances have been used elsewhere, and are briefly summarised by Chapman (2006).⁸⁰ Of particular interest is the experience of New Zealand. New Zealand initially applied a high real interest rate, but reduced this to zero nominal during periods of study in response to vocal concerns about the accumulation of debt with real compounding interest, and have since reduced this to zero nominal for all periods (during and after study) (Chapman, 2006). While such a scheme would certainly be popular among students, it will undoubtedly imply massive taxpayer subsidies.

3.3.4 *The case against an income contingent loan*

As discussed in Chapter 2, adverse selection and moral hazard are two risks that can jeopardise the operations of poorly designed policy. While adverse selection is not a concern for a compulsory arrangement, a voluntary scheme such as the SFSS can be prone to poor outcomes. Thus, as with PPL, scheme design for a voluntary ICL for student living costs is critical. Specific design features and the implications to adverse selection and moral hazard are described below and further in Section 3.4 of this chapter.

Notwithstanding the risks to aggregate costs posed by adverse selection and moral hazard, there are negative views from some organisations regarding the possible extension of an ICL to student expenses beyond tuition. First, the criticisms of the SFSS raised in the NUS submission to the Bradley Review (NUS, 2008) are shared by others (e.g. UWA Student Guild, 2008). Apart from these criticisms, the most

⁸⁰ Chapman (2006) provides a summary of the international experience more generally with income contingent loans for education.

common reservation stems from a belief among some that increased HECS rates and fees have discouraged participation, particularly among low SES and indigenous students.⁸¹ However, substantial evidence has been presented to the contrary as summarised by Chapman (2006). Such evidence was used by the AVCC in their submission to the 2005 Senate Committee into student income support as justification for their suggestion of an extension of HECS loans to non-tuition costs (Commonwealth of Australia, 2005b, p6). Despite this, NUS (2008) provides counter-evidence that while HECS loans remove credit constraints for high performing year 12 school leavers (regardless of SES), high fees act as a constraint on ambition among low SES middle high school students. They argue that while income contingency creates a complex situation, it is nonetheless not surprising that demand to study would be elastic to study debts. Some groups have used this point to argue against the extension of HECS to non-tuition costs (e.g., NTEU, 2008).

A related criticism is that of affordability. AFUW (2008) opposes a new ICL by arguing that HECS is already placing a burden on graduates, compromising their ability to finance long-term housing or establish families. This was a view shared in a submission by the University of South Australia to the 2005 Senate Committee (Commonwealth of Australia, 2008a, p.62).

Given the rationality of the proposition that students are price sensitive, despite the broad evidence against reduced participation, a cautionary approach should be taken to ICL policy development. In the first instance, an ICL in this context is proposed as a *supplement* to existing income support policy, not as a replacement. Recent policy changes have gone some way to addressing the deficiency in income support, so the required amount of an ICL would be relatively small. Second, such a scheme would be voluntary. The implication is that while some particularly risk averse, price sensitive students may not take out the loan, others in need would. This could only lead to an increase in participation and/or improved academic outcomes in higher education, as those not taking out the loan would be in the same position as prior to introduction of the scheme.

Despite this point, there would remain a risk that introduction of an ICL could be used as a wedge whereby grants are replaced with loans. This was a criticism of the

⁸¹ e.g., UWS, 2008; NLS, 2008; USQ, 2008.

SFSS when it was first introduced (NUS, 2008), and is a complaint against how HECS policy has developed over the years: ‘governments will always find it easier to increase resources to education by increasing the student contributions rather than government contributions’ (NTEU, 2008, p11). A solution is not offered here, however, it is noted that this risk is present across policy implemented by government where subsidies are provided.

While an ICL involves private contributions, the cost of public subsidies may be a barrier to extension of HECS. Schwartz (2008) suggests charging a real rate of interest in order to make the system equitable to all taxpayers rather than just favouring those who attend university. The advantages and disadvantages of charging a real rate have been discussed at length in Chapter 2, but are raised in the current context in Section 3.4.3 along with consideration of using a surcharge in place of a real rate of interest.

As mentioned at the end of the previous section, the Bradley Review refrained from recommending extension of FEE-HELP to student income support on the basis that there are unanswered questions about how such a scheme would operate (Commonwealth of Australia, 2008b). In brief, the questions they raised are as follows: regardless of taxpayer subsidies, initial outlays would need to be financed from government; while outlays could be reduced by restricting eligibility through means testing, explicitly incorporating means-testing into an ICL is generally undesirable, and; it is not clear how the ICL would be delivered or the administrative costs associated with delivery (Commonwealth of Australia, 2008b, p.65). Some of these issues are discussed and possible solutions proposed further in this chapter.

3.3.5 The unmet demand for student income support

That demand exists for greater student income support is clear. In Section 3.2.2, and as attested by the 300 submissions to the Bradley Review, many of which referred to student income support, it was shown that numerous deficiencies exist in current policy. While some of these deficiencies have been addressed in recent changes as described in Section 3.2.3, in Section 3.3.1 it was shown that the changes will not

fill the shortfall between available income and needs, and high levels of paid employment will persist, to the detriment of academic performance, in order to supplement the support provided by government.

The Universities Australia survey of student finances in 2006 (James *et al.*, 2007) paints a picture of pervasive financial hardship and high rates of paid employment. The statistics that gauge the level of paid employment, and the recognition that this employment is damaging academic performance, are substantial. Table 3.4 provides a summary.

TABLE 3.4 DOMESTIC STUDENT POPULATION REPORTING NEGATIVE IMPACT OF EMPLOYMENT ON STUDY

Category of student	Population number	Percentage of students employed during semester	Agree that their work commitments adversely affect university performance		Regularly miss class or study because of paid employment	
			Percentage of employed students	Estimated total number	Percentage of employed students	Estimated total number
Undergraduate	530,000	72.3	43.1	165,000	25.7	98,000
Postgraduate	175,000	81.2	47.8	68,000	26.7	38,000

(source: James *et al.*, 2007)

That is, from 2006 statistics it is estimated that over 100,000 domestic students regularly miss class or study because of paid employment, and over 200,000 domestic students believe that their work commitments are adversely affecting their performance. These values provide a tentative indication of demand for greater student income support among existing students, as it is reasonable to speculate that it would be these individuals who are most likely to reduce their level of paid employment if other income sources were available.

However, what the values fail to provide is an estimate of how many prospective students are not participating in higher education as a consequence of insufficient income support policy. An extant data source that may shed light on potential demand for tertiary education among is the 2005 Survey of Education and Training from the Australian Bureau of Statistics. Analysis of the associated Confidential Unit Record File (CURF) indicates that over 2.3 million persons aged between 15 and 69 expressed a desire to undertake an educational qualification at the university or TAFE level in the year prior to the survey. Of these, over 750,000 persons stated that they did not pursue study in the last 12 months due, at least in part, to financial

reasons. If we just consider young students (aged less than 30), the number is still substantial at over 270,000.

As a consequence, it is conceivable that the educational outcomes for half a million persons, made up of existing and prospective students, could benefit from improved financial support. This is not to say that an ICL of \$2,000 or \$3,000 per annum would be sufficient incentive to convince all non-participants to take out the loan; however it is likely that at least some may be swayed by such a facility.

3.4 Designing and costing an ICL for student income support

In this section, design parameters for an ICL for student income support are considered and some simple costing is undertaken. The costing follows the approach of Chapter 2, whereby earnings, debt and repayments are projected for specific scenarios. The effect of the proposed ICL on taxpayer subsidies in the presence of HECS is investigated.

3.4.1 *Eligibility and loan purpose*

In the simplest example, eligibility for the income support ICL would be available to all students who had secured a university place, regardless of their particular living arrangements or financial needs. While this would be the most administratively simple arrangement, since the scheme would be voluntary there is the risk of adverse selection that could lead to greater average taxpayer subsidies. To discourage students from taking out the loan who are not in genuine need, a real interest rate or surcharge could be imposed. This is discussed further in Section 3.4.3.

A criticism of the arrangement above is that funds could be wasted on non-essential needs. There is a real risk that this could occur given that students will be confronted with a relatively substantial sum of money, many for the first time, and may not have the sound financial skills necessary to properly manage the funds. The temptation to spend the ICL on luxuries may be great. This risk could be eliminated

by limiting the ICL to specific goods⁸², such as textbooks and university-contracted accommodation. Reservations with this approach are that it may be difficult to administer, and importantly, essential needs extend beyond campus; e.g., many students rely on accommodation that is not university-contracted.

A third option would be to limit eligibility to students who meet hardship criteria. While this may at first seem logistically impractical, Australian universities currently use student services to assess student requests for financial support. Some institutions currently offer interest-free student loans, scholarships and grants for study-related uses to students facing financial hardship, and many have noted that demand consistently exceeds supply.⁸³ They are constrained by limited loan pools and small loan amounts. Under this alternative arrangement, applications for the ICL would be conducted through student services within each university, but the government would provide the funds for the loans and repayments would proceed through the ATO as with HECS. The key advantages of this approach are that adverse selection would be limited, outlays would be reduced relative to outlays under universal eligibility, and funds would be earmarked for exactly those students most in need. This would limit the risk that the funds may be wasted on non-essential needs, yet would avoid the impracticality of restricting the use of the funds to university goods and services.

3.4.2 Loan duration and amount

As shown in Section 3.3.1, an annual loan of \$2,000 for independent rate Youth Allowance recipients would appear to cover the estimated shortfall on average for a student expected to engage in paid employment exclusively during study breaks. For the modelling undertaken in Section 3.4.6, subsidies are calculated based on this amount. It is assumed that the income support ICL would be available for each year of university study. Assuming either three or four years of study, this implies \$6,000 or \$8,000 of additional debt per student, on top of existing HECS debts.

⁸² This approach was advocated by Roger Dean (Commonwealth of Australia, 2005b, p2).

⁸³ e.g., University of Newcastle, 2008; QUT, 2008; EDU, 2008.

3.4.3 *Debt indexation and surcharge*

If externalities are predominantly accommodated through HECS for tuition and existing income support measures, then zero real indexation on an ICL for student living costs could be seen as regressive - taxpayers would be subsidising graduates with higher than average incomes.

By charging a real interest rate equal to the government's opportunity cost one may assume that taxpayer subsidies would be confined to dealing with default risk. However, the implications for costs to both taxpayer and debtor depend critically on the timing of the income support ICL repayments relative to HECS repayments. If a new ICL has priority in repayment with the effect of deferring HECS repayments, then subsidies associated with HECS will increase. If, on the other hand, the ICL for student income support is not repaid until after existing HECS debts, then while interest rate subsidies associated with the income support ICL would be zero, there is a risk of high accumulated debt due to the compounding of real interest. The implications of different repayment arrangements are explored in the modelling of Section 3.4.6.

The purpose of this policy instrument should be to further encourage and facilitate participation in higher education by addressing the market failure, while not burdening the broader population with costs. Thus, an indexation mechanism that can reduce subsidisation while not compromising participation is sought. A loan surcharge, such as that applied to FEE-HELP and as suggested for the PPICL in Chapter 2 is an attractive alternative to real interest rates in this instance. As shown through modelling in Chapter 2, a surcharge is most attractive relative to a real indexation rate for low income earners who repay slowly. If adverse selection can be limited (through eligibility criteria or otherwise) so that an ICL for student income support is not favoured by those with lower income earning potential, then it is likely that a loan could be structured so as to be both equitable and cost-neutral. A further advantage arises due to administrative simplicity. HECS-HELP and FEE-HELP debts are indexed at CPI only; a student income support ICL could be added to existing outstanding debt without the need to consider separate indexation and repayment arrangements. Furthermore, the administrative mechanism for recording and imposing a 20 per cent surcharge already exists under FEE-HELP.

As a consequence of these considerations, in the modelling undertaken in Section 3.4.6, zero real indexation and a 20 per cent surcharge is first imposed on the income support ICL debt. This is then followed with modelling that assumes real indexation for comparison.

3.4.4 Other assumptions

An assumption of CPI growth of 2.5 per cent per annum, wage growth of 4 per cent per annum, and a nominal discount rate of 5.5 per cent per annum are used in the modelling of Section 3.4.6. These values are consistent with those of Chapter 2. In contrast to Chapter 2, existing HECS rules for repayment thresholds and rates are used for the income support ICL.

Finally, it is assumed that the provision of supplementary income through an ICL would not be subject to income tax, and would not count towards taxable or assessable income for the purpose of determining eligibility for government benefits and allowances.

3.4.5 Costing the ICL – income assumptions and scenarios

The purpose of modelling in this chapter is to quantify the effective cost of offering an income support ICL on top of an existing HECS debt. To this end, representative HECS debtors are considered. Three static income profiles are used: the first starting at \$41,594, being the minimum threshold level; the second starting at \$57,782, being the income threshold corresponding with the 6 per cent repayment rate, and; the third starting at \$77,247, being the highest income threshold (corresponding with the 8 per cent repayment rate). It is assumed that income increases with wage growth of 4 per cent per annum, but is otherwise static. The implication is that repayments proceed at the 4 per cent, 6 per cent and 8 per cent rates for the three scenarios for the duration of the projection period. As earnings mobility is not incorporated into the income assumptions, the resulting subsidies measure interest rate risk only; default risk is not measured. In Chapter 4, the modelling process and implications to costing ICLs when labour force and earnings mobility are allowed for are described.

In addition to the three income assumptions, eight outstanding HECS debts are considered corresponding with the four HECS-HELP contribution bands, and 3- or 4-year degrees. The maximum EFTSL amounts under HECS-HELP for students enrolled in 2010, and the corresponding approximate student debts for 3-year and 4-year degrees are given in Table 3.5.

TABLE 3.5 MAXIMUM STUDENT CONTRIBUTION LIMITS (\$) UNDER HECS-HELP.

Category	per EFTSL	3-year degree	4-year degree
National Priorities (mathematics, statistics, science)	4,249	12,700	17,000
Band 1 (behavioural science, social studies, education, clinical psychology, foreign languages, visual and performing arts, humanities, nursing)	5,310	15,900	21,200
Band 2 (engineering, surveying, agriculture, allied health, computing, other health)	7,567	22,700	30,300
Band 3 (law, accounting, administration, economics, commerce, dentistry, medicine, veterinary science)	8,859	26,600	35,400

Source: Part 3-2, Division 93-10, Higher Education Support Act 2003 (Commonwealth of Australia, 2010b) Notes: EFTSL refers to the yearly study load for a full-time student.

The income support ICL applied in the cost estimates is \$2,000 per annum, or \$6,000 for the 3-year degree and \$8,000 for the 4-year degree program. For simplicity, it is assumed that the total debt is incurred at the end of the degree. The scenarios considered for each of the three income levels are summarised in Table 3.6.

TABLE 3.6 SCENARIOS USED TO COST INCOME SUPPORT ICL

Scenario	HECS-HELP Category	HECS loan (\$)	Income support ICL loan (\$)	HECS + Income support ICL (\$)
3-year degree				
1	National priorities	12,700	6,000	18,700
2	Band 1	15,900	6,000	21,900
3	Band 2	22,700	6,000	28,700
4	Band 3	26,600	6,000	32,600
4-year degree				
5	National priorities	17,000	8,000	25,000
6	Band 1	21,200	8,000	29,200
7	Band 2	30,300	8,000	38,300
8	Band 3	35,400	8,000	43,400

3.4.6 Costing the ICL – debt, repayment and subsidy estimates

Table 3.7 summarises the results of the costing exercise under the assumption of zero real indexation and the 20 per cent surcharge. Four values for each scenario and income level are given. First, the interest rate subsidy proportions under HECS only

are presented. These are equal to the present value of HECS repayments divided by the amount of the HECS loan. Although a discount is given in the event of up-front payment of HECS, this feature is excluded in the subsidy estimates. As shown in Chapman and Leigh (2009), the discount acts as an implicit surcharge, thus forcing up subsidies.⁸⁴

While in each of the scenarios, incomes are above the minimum threshold and the total loan is repaid, the HECS subsidies differ due to the timing of the repayments. Higher subsidies are associated with lower incomes, lower compulsory payment amounts, and consequently longer terms until complete loan repayment.

Next, the subsidy proportions under the combined HECS plus income support ICL are given. The inclusion of the income support ICL adds \$2,400 per annum to the amount owing.⁸⁵ In the absence of a surcharge the subsidies would always be higher under the combined scheme than under HECS solely, due to the longer period to repayment as a consequence of the additional debt. However, the presence of the surcharge acts as a real interest rate, with the implication that repayments can potentially exceed the outstanding debt leading to lower subsidies for debtors with higher incomes. For the majority of cases with lower incomes, the increase in subsidy from the extra time to repayment due to the increased debt more than offsets the potential drop in subsidy from the surcharge.

The effect can be more clearly seen in the next set of values in Table 3.7, being the present value of the extra repayments made as a consequence of the income support ICL. For low income earners, the repayments are lower than the amounts outlaid of \$6,000 or \$8,000, due to the lower compulsory payments and hence longer time until repayment. For higher income earners, repayments are made more quickly and the present value can exceed the amount outlaid due to the surcharge. This is also reflected in subsidy proportions that capture the net effect of the income support ICL.

⁸⁴ Those who opt not to pay their HECS-HELP debt upfront effectively face a surcharge of 25 per cent due to the 20 per cent discount that they would otherwise receive if they paid upfront. The question of whether or not to include this feature depends on one's beliefs of the true tuition charge (e.g., see Chapman, 2006).

⁸⁵ The amount outstanding on the extra component is 20 per cent greater due to the imposition of the surcharge

TABLE 3.7 SUBSIDIES AND PV REPAYMENTS - INCOME AT 4%, 6% AND 8% REPAYMENT THRESHOLDS. 0% REAL INDEXATION, 20% SURCHARGE FOR INCOME SUPPORT ICL.

Scenario	Subsidy (%): HECS only			Subsidy (%): HECS + Income support ICL		
	4%	6%	8%	4%	6%	8%
3-year degree						
1	10	5	3	9	2	-1
2	12	6	4	12	4	0
3	17	9	5	18	8	3
4	19	10	6	20	9	4
4-year degree						
5	13	7	4	14	4	0
6	16	8	5	17	7	2
7	21	11	7	23	11	5
8	24	13	8	26	13	6
Scenario	PV of extra repayment made			Subsidy (%): net effect		
	4%	6%	8%	4%	6%	8%
3-year degree						
1	5,507	6,300	6,664	8	-5	-11
2	5,243	6,143	6,579	13	-2	-10
3	4,745	5,830	6,381	21	3	-6
4	4,492	5,661	6,264	25	6	-4
4-year degree						
5	6,758	8,042	8,678	16	-1	-9
6	6,354	7,781	8,528	21	3	-7
7	5,603	7,280	8,173	30	9	-2
8	5,233	7,015	8,013	35	12	0

Notes: the HECS repayments used in the subsidy estimates here exclude the effect of the 20 per cent upfront discount. Including a 25 per cent HECS surcharge results in higher net subsidies, due to the longer time until repayment in the presence of higher debt. For example, net subsidies for scenario 1 become 13%, -2% and -10% as compared to 8%, -5% and -11%.

Interest rate subsidies under HECS alone, subsidies under HECS plus the income support ICL, and the net effect, are given in Figure 3.5 and Figure 3.6 for Scenarios 1 and 8 for a range of incomes. The subsidies take on a stepped appearance due to the stepped repayment regime for HECS. Of most interest in Figure 3.5 are two features: the overlap in subsidy curves; and the transition to a negative net subsidy. In Figure 3.5 the debt is repaid slowly at low incomes. While the surcharge adds to the repayments, for incomes less than \$57,000 the long period until repayment leads to large costs due to zero real indexation, so that the overall subsidy exceeds that under HECS alone. For greater incomes, although the extra debt still implies a longer time until repayment than under HECS, the presence of the surcharge offsets the extra costs arising from zero real indexation to the extent that the subsidies under HECS plus the income support ICL are less than the subsidies under HECS alone.

FIGURE 3.5 SUBSIDIES FOR SCENARIO 8. 0% REAL INDEXATION, 20% SURCHARGE FOR INCOME SUPPORT ICL.

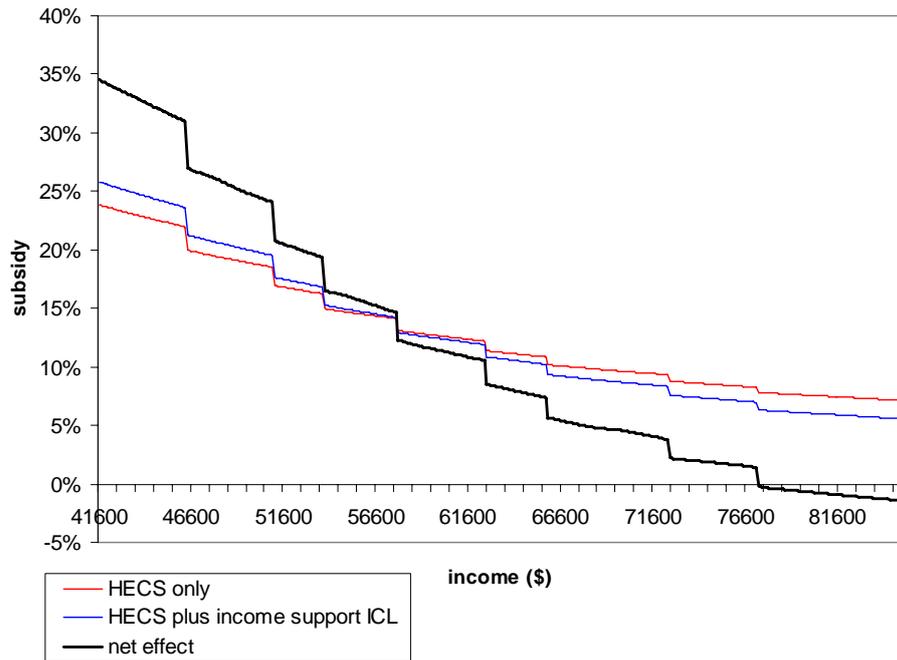
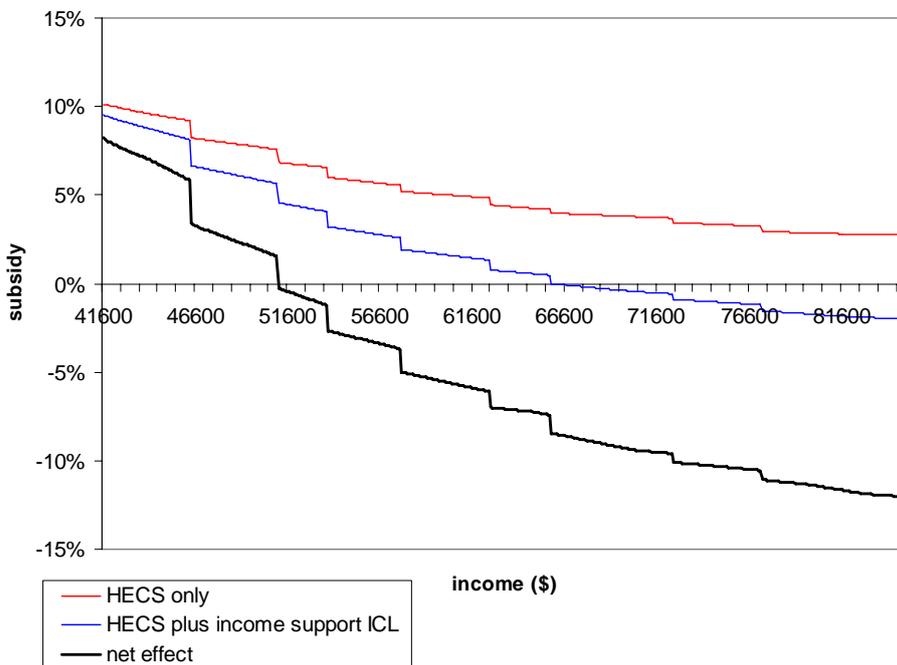


FIGURE 3.6 SUBSIDIES FOR SCENARIO 1. 0% REAL INDEXATION, 20% SURCHARGE FOR INCOME SUPPORT ICL.



A more critical transition is when the present value of the extra repayments is equal to the present value of the extra amount outlaid; this occurs in Figure 3.5 at approximately \$77,000. This transition will of course occur at different income levels depending on the magnitude of the HECS debt and the income support ICL. Figure 3.6 is included to illustrate this point.

Clearly, those persons on low incomes are subsidised the most under these arrangements, with at least partial cross-subsidisation occurring from higher income earners who repay more quickly. The net position to the taxpayer will depend on the distribution of future incomes of the population of debtors taking out the income support ICL.

The extra time until repayment of the total debt for each scenario is given in Table 3.8. For earners at the lowest repayment threshold, the income support ICL adds on between 3 and 5 years to the time until repayment depending on the length of the degree. The extra period is of course much shorter for higher income earners.

TABLE 3.8 TIME TO REPAYMENT (YRS) - INCOME AT 4%, 6% AND 8% REPAYMENT THRESHOLDS. 0% REAL INDEXATION, 20% SURCHARGE FOR INCOME SUPPORT ICL.

Scenario	HECS only			HECS + Income support ICL		
	4%	6%	8%	4%	6%	8%
3-year degree						
1	8	4	3	12	6	4
2	10	5	3	13	7	4
3	13	7	4	17	9	5
4	15	8	5	19	10	6
4-year degree						
5	10	5	3	15	8	5
6	12	6	4	17	9	5
7	17	9	5	21	11	7
8	19	10	6	24	13	8

An alternative arrangement to a surcharge and zero real indexation is to charge a real indexation rate equal to, at a minimum, the government's cost of capital. In this exercise a 5.5 per cent nominal discount rate is assumed, implying a real indexation rate of 3 per cent on top of CPI of 2.5 per cent. For comparison, a 5 per cent real rate is also applied, which is more akin to market rates of interest.

The costs of imposing an income support ICL with real indexation will depend on the repayment arrangements. Under all arrangements considered here, it is assumed that the maximum total repayment possible is limited by the HECS thresholds and rates. This avoids one of the criticisms of the SFSS, namely that repayments in any year could be excessive. For example, for an individual with income at \$41,594 per annum their total repayment would be 4 per cent, or \$1,664. Whether this amount should be deducted first from the HECS debt, the income support ICL debt, or both (under a proportionate arrangement), is the question at hand. Three approaches could be considered:

1. repayments are deducted from the income support ICL debt, and only after the income support ICL is fully repaid are future repayments then deducted from HECS;
2. repayments are deducted from the HECS debt, and only after the HECS debt is fully repaid are future repayments then deducted from the income support ICL;
3. repayments are deducted from the HECS and income support ICL debts proportionately. In this instance the repayments in each year reduce both debts in proportion to the size of each debt.

The decision to impose a real interest rate does not necessarily imply zero interest rate subsidies. Even with a real rate of indexation equivalent to the government's discount rate, high positive interest rate subsidies can result under approaches 1 and 3 because the inclusion of the income support ICL repayments leads to partial deferment of HECS repayments. The results under the three approaches are given in Table 3.9.

TABLE 3.9 SUBSIDIES (%): NET EFFECT - INCOME AT 4%, 6% AND 8% REPAYMENT THRESHOLDS. 3% REAL INDEXATION.

Scenario	Approach 1: Income support ICL first, HECS last			Approach 2: Income support ICL last, HECS first			Approach 3: Income support ICL and HECS concurrently		
	4%	6%	8%	4%	6%	8%	4%	6%	8%
3-year degree									
1	19	10	6	0	0	0	10	5	3
2	23	12	7	0	0	0	12	6	4
3	30	16	10	0	0	0	16	8	5
4	34	19	11	0	0	0	18	10	6
4-year degree									
5	24	13	7	0	0	0	12	7	4
6	28	16	9	0	0	0	15	8	5
7	37	21	13	0	0	0	19	11	6
8	41	24	14	0	0	0	22	12	7

Notes: the HECS repayments used in the subsidy estimates here exclude the effect of the 20 per cent upfront discount. Including a 25 per cent HECS surcharge results in higher net subsidies for approaches 1 and 3, due to the longer time until repayment in the presence of higher debt. For example, subsidies under approach 3 / scenario 1 becomes 12%, 6% and 4% as compared with 10%, 5% and 3%.

There are clearly implications for each of these approaches. Approach 1 is the most attractive option for debtors and least attractive for taxpayers. Repaying the income support ICL first is beneficial for the debtor because this minimises the compounding of real interest. However, this is at the expense of deferment of the repayment of the HECS debt, which forces up interest rate subsidies considerably.

This should be dismissed as a viable option if one assumes that the majority of externalities are already captured through existing policy.

Approach 2 is the most attractive option for non-participating taxpayers. It results in zero net interest rate subsidy (i.e., in the absence of default risk, the present value of extra repayments will exactly equal the income support ICL) since payments are made after HECS is repaid and the rate of indexation is equal to the assumed discount rate. While this is clearly attractive to taxpayers, there is the real likelihood of resistance from debtors due to the potential for large accumulated balances. It was this fact that led to the alteration of indexation rules in New Zealand (Chapman, 2006), and is a concern to the National Union of Students (NUS, 2008). For example, for scenario 1 with earnings at the 4% threshold, the outlay for a debtor under approach 2 would be \$7,790 in real dollars (for a debt of \$6,000). This contrasts with \$6,262 under approach 1, and \$7,000 under approach 3. The level of opposition to this option, however, will depend on the real rate charged.

The third approach is a compromise between the two and is arguably the most equitable as it strikes a balance between the needs of the taxpayer and debtor. Under this approach, the surcharge is superior financially from the perspective of taxpayers for moderate and higher income earners; it is only for earners within the lowest repayment threshold where a real rate of 3 per cent results in lower costs than the surcharge.

A rate of indexation closer to market rates (i.e., 5 per cent real) is applied for comparison, and interest rate subsidies are given in Table 3.10.

The potential for large accumulated debt under approach 2 (and greater policy opposition from student lobby groups) is noticeable for higher real indexation rates. In this instance (i.e., 5 per cent real indexation) the outlay in real dollars for a debtor for scenario 1 with earnings at the 4% threshold under approach 2 would be \$8,580 (for a debt of \$6,000). The higher interest compounded under approach 2 leads to a longer time until repayment relative to approaches 1 and 3. This is most apparent for those at the lowest repayment threshold. Table 3.11 gives the time to repayment under the three approaches, and under HECS alone for comparison.

TABLE 3.10 SUBSIDIES (%): NET EFFECT - INCOME AT 4%, 6% AND 8% REPAYMENT THRESHOLDS. 5% REAL INDEXATION.

Scenario	Approach 1: Income support ICL first, HECS last			Approach 2: Income support ICL last, HECS first			Approach 3: Income support ICL and HECS concurrently		
	4%	6%	8%	4%	6%	8%	4%	6%	8%
3-year degree									
1	16	8	5	-20	-9	-5	-1	0	0
2	20	10	6	-25	-11	-6	-1	0	0
3	27	15	9	-34	-15	-8	-1	1	1
4	31	17	11	-30	-17	-10	-1	1	1
4-year degree									
5	20	11	6	-29	-13	-7	-3	-1	0
6	25	14	8	-35	-15	-8	-3	0	0
7	34	19	11	-49	-21	-11	-3	0	1
8	38	22	13	-57	-24	-13	-3	1	1

Notes: the HECS repayments used in the subsidy estimates here exclude the effect of the 20 per cent upfront discount. Including a 25 per cent HECS surcharge results in higher net subsidies for approach 1, due to the longer time until repayment in the presence of higher debt. For approach 3 the subsidies change only marginally and remain very close to 0 for all scenarios; for example approach 3 / scenario 1 remains at -1%, 0% and 0%.

TABLE 3.11 TIME TO REPAYMENT (YRS) UNDER HECS, AND HECS PLUS INCOME SUPPORT ICL - INCOME AT 4% REPAYMENT THRESHOLD. 5% REAL INDEXATION.

Scenario	HECS only	HECS + Income support ICL		
		Approach 1: Income support ICL first, HECS last	Approach 2: Income support ICL last, HECS first	Approach 3: Income support ICL and HECS concurrently
3-year degree				
1	8	11	13	12
2	10	13	15	14
3	13	16	19	18
4	15	18	22	20
4-year degree				
5	10	15	18	16
6	12	17	21	18
7	17	21	27	24
8	19	23	30	26

Results for approach 3 are arguably close to optimal under the current assumptions; the greater cost associated with the additional time until repayment of the HECS debt is almost perfectly offset by the real indexation on the income support ICL debt. Notably, this is the case for all the scenarios and income bands considered.

The evidence presented here supports a proportionate repayment arrangement (as under approach 3) in the event that a real rate of indexation was to be applied to an income support ICL. This is not to say that this is superior to zero real indexation

with a 20 per cent surcharge. A reservation with real indexation is that large debts can accumulate for low-income earners; those who repay more slowly will always be more disadvantaged than those who repay quickly, while this is not a concern with a surcharge. Not only does a surcharge place a cap on debt, thereby giving financial certainty to students, it also allows cross-subsidisation from those more advantaged to those less advantaged.

Regardless of whether a surcharge or real interest rate is imposed, doubtful debt will be present due to individuals falling below the minimum repayment threshold. According to recent DEST estimates, HECS doubtful debt is close to 20 per cent (DEST, 2007, p405). This provides a guide to the magnitude of the unrecoverable debt as a consequence of default risk.⁸⁶ Although one could eliminate this risk by offering assistance as a government loan with no income-contingent mechanism, the default risk feature is a critical selling point as it substantially reduces the perceived and real financial risk of participation in higher education. By abandoning the income-contingent feature, the attractiveness would be reduced, compromising increased participation.

3.5 The specific case of mature aged training

3.5.1 How much is needed?

In their final report, the Bradley Review recognised that mature aged workers with dependants face financial barriers to education above those faced by typical university students (Commonwealth of Australia, 2008b). Many mature aged students who engage in retraining undertake postgraduate study, yet income support for postgraduate students has been particularly deficient. The Universities Australia survey identified postgraduate coursework students as the group under the most severe financial pressure (James *et al.*, 2007). This is being addressed to an extent by the announcement of income support eligibility for all coursework masters programs from July 2012 (Gillard, 2009). As noted by NUS (2008), this action will increase the number of full-time mature aged students, allowing quicker re-skilling of the professional workforce.

⁸⁶ While, the spectre of greater take-up from higher risk groups (following the experience of the SFSS) remains, the proposed ICL scheme loan amounts, conditions and indexation arrangements differ considerably from the SFSS, and hence participation would also be expected to differ.

While this change will lead to a greater number of prospective students being eligible for Austudy, as shown in Figure 3.4 Austudy rates (supplemented by the Start-up Scholarship and Rent Assistance) are insufficient to support a full-time student in the absence of considerable additional income. This additional income is typically derived from paid employment that can have a detrimental effect on academic performance. Many students will not have the option to study full-time due to financial circumstances and will instead study part-time, relying on part-time employment for the majority of income.

While an ICL for student income support should be available to undergraduates and postgraduates regardless of their age, the financial implications for students with dependants (the majority of whom are mature aged) needs to be separately considered to appreciate the financial barriers to participation. Such students often are ineligible for scholarships as they work part-time. They are faced with childcare costs, on top of either mortgage or rental payments. As noted by USQ, 'little incentive is provided to single parents who undertake study as a pathway to free themselves from a dependence on welfare' (USQ, 2008, p15).

As single parents with dependants may be eligible for Family Tax Benefit (FTB)⁸⁷, their aggregate financial situation in the event of study is not immediately clear without further analysis. Following the approach of Section 3.3.1, the financial circumstances for mature-aged students with dependants is considered. For the examples that follow it is assumed that students are over the age of 25 and have one child, aged 10.⁸⁸

A single female parent aged 35 has median full-time earnings of \$49,300 (this equates to an hourly rate of \$25) and part-time earnings of \$24,200 (ABS, 2004;

⁸⁷ FTB benefits are conditional on income, so the act of reducing employment to study may increase the amount of FTB A or B that a family is entitled to. Parents are eligible for FTB A and B if they have a dependent child (under 25 for FTB A, and under 16 for FTB B (or under 18 for full-time students not on Youth Allowance)) in their care and provided the family income is below specific limits. The income limits for FTB A vary according to the number and age of dependent children. For example, for a family with one child, the income limit at which the FTB A is no longer paid is approximately \$100,000. For FTB B, the maximum benefit is payable to single parent families if the person earns less than \$150,000. For two parent families, so long as the primary earner makes less than \$150,000, then the benefits provided are contingent on the income level of the secondary earner. Specific income test limits for both FTB A and B are given by Centrelink (2009). Maximum rates for FTB B are approximately \$136 per fortnight for families with a youngest child under 5, and \$95 for families with youngest child between 5 and 18. For families eligible for Family Tax Benefits, a supplement of \$726 per child is payable for FTB A, and \$354 per family for FTB B.

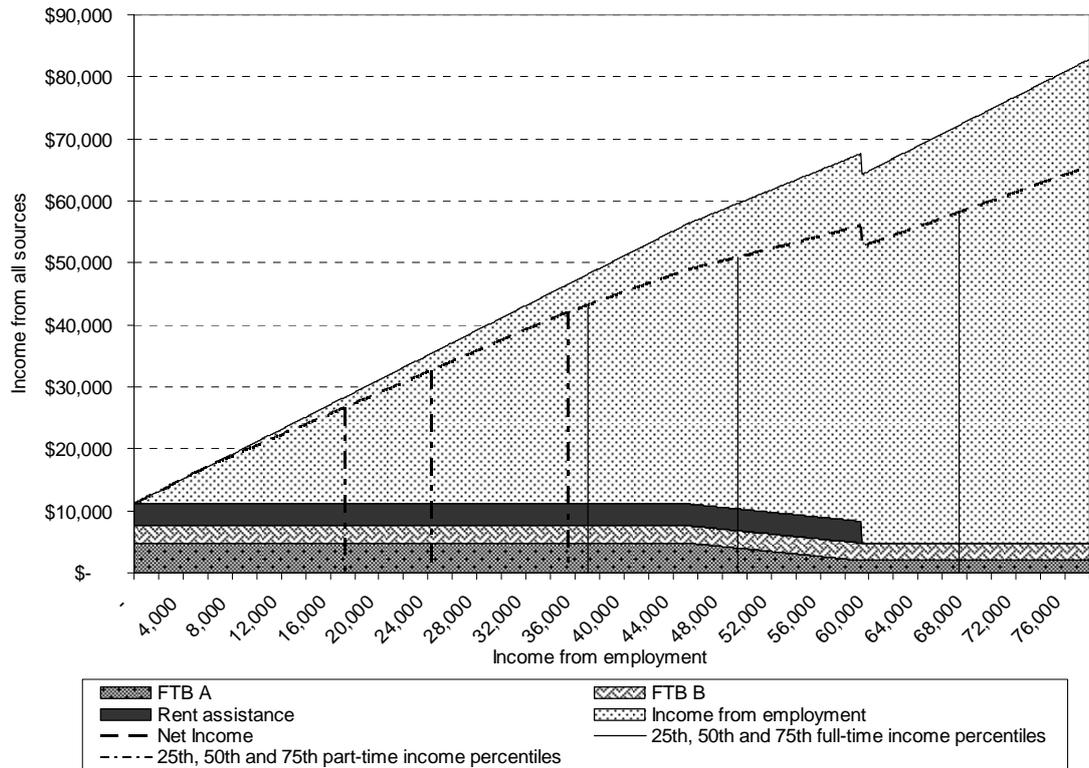
⁸⁸ An implication is that the parents are not eligible for Parenting Payment.

ABS, 2006c). Corresponding disposable income is estimated after taking into account Family Tax Benefit, Rent Assistance, and income tax. This can be seen in Figure 3.7 where 25th, 50th and 75th income percentiles for full-time and part-time female earnings are marked by vertical lines. The figure illustrates the financial position for a single parent full-time in the workforce prior to entering university.

Students studying part-time are not eligible for Austudy or associated student income support payments, so their financial circumstances would also appear as in Figure 3.7. If a single parent transitioned from median full-time to median part-time earnings as a consequence of part-time study, their disposable income would reduce from \$50,900 to \$32,700. If the same individual was a full-time student they would be eligible for Austudy payments. This makes a dramatic difference to affordability; a full-time student working only part-time during study breaks (at the median hourly rate for 35 year old females of \$25) would have disposable income close to \$31,000 per annum.⁸⁹

⁸⁹ This is based on the assumption of 15 weeks of part-time employment (19 hours per week) at a rate of \$25 per hour. If the parent worked full-time during the study breaks this would equate to a disposable income of \$35,500 per annum.

FIGURE 3.7 SOURCES OF INCOME EXCLUDING STUDENT INCOME SUPPORT. SINGLE WOMAN, AGE 25+, ONE CHILD AGED 10. QUARTILES FOR FULL-TIME AND PART-TIME EMPLOYMENT INCOME FOR 35 YEAR OLD FEMALE SUPERIMPOSED.



Results for a range of assumptions are summarised in Table 3.12.

TABLE 3.12 DISPOSABLE INCOME FOR A SINGLE WOMAN AGED 35 WITH ONE CHILD AGED 10. PRIOR TO AND DURING STUDY.

Prior to study		Part-time study		Full-time study	
Mother's income	Disposable household income	Mother's income	Disposable household income	Mother's income during 15 week study break period	Disposable household income
FT upper quartile	\$58,100	PT upper quartile	\$42,100	PT upper quartile	\$33,500
FT median	\$50,900	PT median	\$32,700	PT median	\$31,200
FT lower quartile	\$43,200	PT lower quartile	\$26,700	PT lower quartile	\$29,700

Notes: It is assumed that the parent may be eligible for student income support when studying full-time, but not part-time. Disposable income calculations include FTB A and B, employment income, rent assistance and student income support payments when eligible, net of tax. When estimating income earned during study breaks, hourly rates of \$34, \$25 and \$19 were applied, corresponding with female employment earnings for upper quartile, median, and lower quartile for earnings.

An implication of the existing student income support measures is that the net financial position for a median earning single parent would be comparable if they were to study part-time and work part-time, or study full-time, with greater financial benefits of full-time study relative to part-time study apparent for lower income earners.

Notwithstanding this observation, a key question is whether disposable incomes within this range are sufficient to allow a single parent to undertake university study. While the amounts in Table 3.12 are considerably greater than the Henderson poverty line for a single parent with one child (\$22,900 for those not in the workforce, and \$26,900 for those in the workforce (Melbourne Institute, 2010)), Henderson poverty lines are not the appropriate measure of cost of living for university students due to different cost pressures.

To gauge the costs of living, the value of \$23,200 sourced from the Australian Scholarships Group as the average cost of shared independent living, is taken as the starting point for costs of a single parent attending university. It is necessary to add an amount to reflect the annual costs of raising a child. Through updated budget standards, Henman (2005) estimated that a modest but adequate amount for additional funds required for a full-time single parent to raise a 10 year-old child in 2005 was \$8,500 (excluding child care costs).⁹⁰ Thus, expected costs for a single parent with a 10 year-old child are approximately \$32,700 per annum (when adjusted for inflation). Coincidentally, this amount is equivalent to the estimated disposable income for single parents on Austudy who supplement their income with paid employment. While the values here represent averages, they nevertheless suggest that a student income support ICL of as little as \$2,000 per annum may increase disposable income for some to a level that makes participation in higher education feasible.

A similar example can be given for couples with dependants. It is assumed in this example that the father studies, the mother works part-time and receives median part-time wage, and there are two children aged ten and eight.⁹¹ If the father moves from full-time to part-time employment in order to pursue part-time study, this reduces median household disposable income from \$76,000 to approximately \$56,500. If the parent pursued study full-time they may be eligible for Austudy. When determining entitlements to Austudy students in relationships face

⁹⁰ The full-time single parent costs reflect higher outside care requirements for the child due to less direct care from the parent. Whether the parent is engaged in part-time study (and part-time work), or full-time study, this effectively constitutes a full-time load for the parent and thus the full-time single parent costs are appropriate in this context. While the estimate for a full-time single parent was \$11,730, approximately \$3,200 of the \$11,730 are gross childcare costs. As Child Care Rebate and benefits are available to parents with low incomes, the net costs of raising the child will likely be closer to \$8,500.

⁹¹ It is further assumed that the parents are not renting, hence no rental assistance is available.

disincentives to study as a consequence of a spouse income test in addition to the personal income test also faced by singles (SFAN, 2008). Hourly wage for a median male income earner is estimated from ABS CURF data at \$32 per hour. This equates to approximately \$18,300 that could conceivably be earned during academic breaks. The corresponding disposable family income in this example is \$52,500. Results for a variety of combinations of parental income are summarised in Table 3.13.

TABLE 3.13 DISPOSABLE INCOME FOR A COUPLE AGED 35 WITH TWO CHILDREN AGED 10 AND 8. PRIOR TO AND DURING STUDY.

Prior to study		
Father's income	Mother's income	Disposable household income
FT median	PT median	\$76,000
FT median	PT lower quartile	\$70,000
FT lower quartile	PT lower quartile	\$59,500

Father in part-time study			Father in full-time study		
Father's income during 15 week study break period	Mother's income	Disposable household income	Father's income during 15 week study break period	Mother's income	Disposable household income
FT median	PT median	\$56,500	FT median	PT median	\$52,500
FT median	PT lower quartile	\$52,000	FT median	PT lower quartile	\$49,000
FT lower quartile	PT lower quartile	\$45,500	FT lower quartile	PT lower quartile	\$47,500

Notes: It is assumed that the father may be eligible for student income support when studying full-time, but not part-time. Disposable income calculations include FTB A and B, employment income, and student income support payments when eligible, net of tax. When estimating income earned during study breaks, hourly rates of \$32 and \$23 were applied, corresponding with male FT employment earnings for median and lower quartile incomes respectively.

The key conclusion from this analysis is that if a male median income earner transitions to either part-time or full-time study, this will result in a reduction of disposable income of \$15,000 to \$25,000, resulting in a median disposable household income of close to \$50,000.

To estimate how this compares with household budgetary needs, begin with the ASG estimate of \$23,200 for shared independent living. Living costs for a single person not studying are roughly derived by taking this amount and subtracting costs associated predominantly with university study (namely, text books, equipment and supplies, internet and computer, and establishment costs) giving \$20,000. Equivalence measures between couple and single person households can then be

applied. Harmer (2008, p22) reports equivalence measures ranging from 0.6 to 0.79 as estimated from a range of data and using 14 different approaches. Applying these measures, and adding back costs associated with university for the father, gives couple costs ranging from \$29,000 to \$37,000 per annum. Budget standards provide an estimate of the additional costs faced by couples with two children in this age range. These are estimated at approximately \$18,000 (taken from Henman, 2005, and adjusted with inflation to 2010). The total estimated needs, therefore, range from \$47,000 to \$55,000.

As for singles, the disposable income for a typical family with dependants reduces to an amount arguably close to base needs in the event that the main breadwinner chooses to undertake tertiary study. For many who earn at, or slightly below, median income, relatively small amounts of additional financial support could improve quality of life and facilitate further study.

In summary, as seen in the above figures and associated analysis, parents of dependants face considerable costs above those faced by a typical student without dependants. While family welfare payments can meet some of these costs, the net financial position for many parents who study may be insufficient to provide for themselves and their children. It was shown through the analysis that an income support ICL of \$2,000 could make a substantial difference to some families, and potentially increase higher education participation rates.

3.5.2 The case for addressing opportunity costs

Regardless of whether basic costs of living can be met, the temporary reduction in lifestyle associated with studying, and opportunity cost of foregone income during the period of study, may act as a deterrent to participation. For single parents and couples, the reduction in household disposable income for a median earner who engages in study may be in the order of \$15,000 to \$25,000.⁹² In both cases, higher income earners face greater opportunity costs.

⁹² Chapman, Higgins and Taylor (2009) undertake a similar exercise and show that the income shortfall for low-income professionals at a variety of ages with dependent children ranges from \$15,000 to as much as \$40,000.

While the opportunity costs of study can be considerable for mature aged workers, it is those workers with previous employment experience (with or without dependants) who should arguably be encouraged into further education. In this section evidence is presented that justifies targeting mature aged workers for retraining.

The Bradley Review emphasised that the needs of the mature aged should not be overlooked: ‘...financial support arrangements must encourage older workers to retrain or upgrade qualifications’ (Commonwealth of Australia, 2008b, p.47). In an Australia Industry Group (AIG) 2008 survey of CEOs, improving existing human capital was seen as a way to address skill deficiencies and thereby lift innovative capacity in Australia:

‘Across both firm size and sectors, the retraining of existing staff is considered the most effective method for meeting current skill needs. In fact, 61.2% of all respondents identified the retraining of existing staff as an effective method for overcoming skills shortages’ (AIG, 2008, p11).

Skill development can also lead to longer workforce participation:

‘To the extent that higher skilled jobs tend to be less ‘back breaking’ and more interesting, it also means that older higher skilled workers are more likely to be willing and able to maintain a connection with the workforce than less skilled workers’ (Access Economics, 2005, p10).

Specific areas of skill deficiencies exist in science, mathematics and engineering. Skills within these areas are vital to contribute to economic productivity and R&D, technical innovation, as well as to financial management (AIG, 2008). Professions Australia (2008) reports that the mathematics skills crisis has arisen due to fewer high school students studying advanced or intermediate mathematics which will ultimately lead to shortages in fields such as engineering, science, finance, actuarial studies, and mathematics education. The Association of Professional Engineers, Scientists and Managers (APESMA) has suggested the Federal Government fund programs to encourage retraining of experienced professionals as mathematics teachers to address the teaching shortage (Professions Australia, 2008).

The substantial barriers to participation are recognised at Bond University where fast-tracked degree programs have been devised:

‘...mature students who often already have a first degree, and who are up-skilling and looking to change careers. Many of them have commitments and responsibilities which make it necessary for them to make significant personal sacrifices to return to full-time study...the availability of accelerated programs makes it desirable for students retraining in this way to study full-time, as this enables a fast return to the workforce.’ (Bond University, 2008, p12)

The University of Southern Queensland also emphasises the importance of the upgrading of graduate skills in the context of lifelong learning, but believes that mature aged workers are price sensitive to tuition fees, noting that increases in HECS costs have led to a decrease in the course load (in part to avoid risk of failure) and corresponding increase in the time taken for completion (USQ, 2008). The Bendigo Student Association (BSA, 2008) is also concerned that the pressure of a HECS debt may be deterring mature age participation, and Edith Cowen University (EDU, 2008) comments that mature aged students who are earning over the minimum threshold may be repaying HECS at the same time as they are studying. While this last point is true, HECS rates are such that the repayment amount during the period of study should be a relatively small fraction of the total fee charged; furthermore, the minimum repayment threshold ensures that payments are only made if income is at a sufficient level such that repayments are affordable.

As noted by the AIG (2008), cost is seen as a major barrier to improving skills. Universities Australia (2008) comment on reductions in commencements among mature aged students which they speculate are due to higher opportunity costs in the context of increasing costs of study and lack of adequate income support. While some universities are becoming more accessible and offer flexible study arrangements for mature aged students, they view income support as a barrier restricting development of a new cohort of students.

3.5.3 An ICL to address opportunity costs of re-skilling

The evidence above highlights the barriers to participation and the potential benefits of encouraging higher education for mature aged persons. For all mature aged students choosing to change careers, their future earnings profiles will be shorter generally than those of younger students, increasing the likelihood of greater taxpayer subsidies. With this in mind, Chapman, Higgins and Taylor (2009) suggest an ICL specifically for income support in the re-training of already educated mature aged persons. By intentionally restricting the ICL to existing professionals, this increases the likelihood of repayment since such individuals are more likely to complete further study and have high earning potential. This reduces the potential for adverse selection and moral hazard. While they show that subsidies based on an ICL of \$15,000 (and outstanding HECS debt of \$10,000) may be affordable given the earnings potential of this group, the spectre of adverse selection remains. Additionally there are equity and efficiency issues, as those prospective mature aged students without a degree would be ineligible, yet societal returns to education may be greatest for such individuals.

A novel solution that is proposed in this section involves accessing ICL funds from individual superannuation rather than relying on consolidated revenue. If the spectre of adverse selection, moral hazard, default risk and resulting excessive taxpayer subsidisation remain, an alternative to a traditional ICL financed through government funds would be to allow individuals to draw on their illiquid asset wealth, superannuation.

A reservation that the Bradley Review had with an income support ICL is that initial outlays would need to be financed by government (Commonwealth of Australia, 2008b, p65). Chapman (2006, p40) discusses the options for financing ICLs, including the involvement of commercial banks. The proposal here avoids external parties - the individual would fund the period of income support using their own accumulated wealth, albeit wealth preserved for retirement. An implication is that eligibility would only be extended to individuals who had accumulated sufficient superannuation; hence, those who had been in the workforce for a sufficient time. The time needed, however, would not be long: for example, five years of

employment at only \$35,000 per annum generates over \$15,000 in superannuation funds.⁹³

While drawing on superannuation prior to retirement would clearly deplete one's retirement balance, it is proposed here that an ICL mechanism would apply; the amounts borrowed would be repaid back into the individual's superannuation account under appropriate ICL thresholds and repayment rates (HECS or otherwise). This would ensure minimal disruption to retirement savings and, consequently, age pension outlays. Importantly, this approach would essentially eliminate moral hazard, but would retain consumption smoothing. An indexation rate could be imposed on the debt to ensure that the principal as well as forgone interest is repaid. Default risk would be reduced substantially, but not eliminated; non-repayment of withdrawn amounts would result in reduced superannuation balances and this may increase the take-up of the age pension. To guard against default risk, eligibility could be further restricted to an age limit so as to increase the likelihood of sufficient duration of employment post study, and could be restricted to selected courses of study.⁹⁴ Individual utility would increase due to the flexibility and voluntary nature of the loan facility, and the borrowed funds will increase the likelihood of workforce attachment and other societal returns.

Accessing superannuation to finance retraining has previously been the subject of government consideration. A report into planning for retirement by the Senate Select Committee on Superannuation was released in 2003 (Australian Senate, 2003), and chapter eight of the report specifically considered the proposal to finance retraining with superannuation. The key criticisms of the proposal were as follows: the cost of retraining should rest with government and employers; jobs may not be available at the end of retraining; reducing superannuation would reduce the end retirement benefit; and risk of damage to consumer understanding of the role and importance of superannuation in providing for retirement. Each of these criticisms is addressed briefly below.⁹⁵

⁹³ Assuming a 9% contribution rate and no investment earnings.

⁹⁴ For example, courses that are deemed of national importance based on skill shortages.

⁹⁵ While these criticisms are addressed, significant logistic questions would remain including: specific eligibility and course requirement conditions, administrative arrangements to ensure compliance and integrity, treatment of defined benefit versus accumulation funds, etc...

Criticism 1: The cost of retraining should rest with government and employers.

While it is fair to argue that government and employers should bear the cost of retraining, the ICL suggested here is not for tuition, but rather to fund lost income during the period that training takes place, thereby improving education participation rates and skill development.

Criticism 2: Jobs may not be available at the end of retraining.

This risk is partially removed, as eligibility would be constrained to persons with sufficient superannuation balances and therefore previous workforce attachment. This risk could be further reduced by limiting eligibility to specific age groups (to ensure sufficient likelihood of re-employment), and by restricting the scheme to courses that are more likely to lead to employment.

Criticism 3: Reducing superannuation would reduce the end retirement benefit.

As described above, the ICL mechanism would be structured to replenish the superannuation balance, and eligibility conditions could be imposed to limit the risk of default. If an individual does not repay the debt (and lost interest), it would affect their consumption options in retirement and possibly increase their age pension eligibility; a potentially greater age pension outlay would be the only risk sharing feature of the ICL in this context, and is likely to be negligible if eligibility conditions for the loan are appropriate.⁹⁶

Criticism 4: Risk of damage to consumer understanding of the role and importance of superannuation in providing for retirement

This final criticism encapsulates the entire philosophy of superannuation, namely as a vehicle for retirement savings. This, and certain other criticisms raised, is predicated on the understanding that superannuation is *exclusively* for retirement. This raises a philosophical question as to the justification for superannuation as a scheme to provide for only one, albeit long, period of non-employment (retirement),

⁹⁶ Modelling of this policy proposal to test this assumption is not taken up in this thesis, but will be the topic of future research.

when other such periods may exist throughout a person's life. The Superannuation Guarantee is a means of forced consumption smoothing, and the proposed use of superannuation funds to smooth other times of interrupted employment is arguably consistent with this role.

In particular, if a period of non-employment coincides with development of one's stock of human capital, then there is a good chance that both the private and public returns on the outlay justify the investment. Indeed, an implication is that an individual participating in skill development enabled through this scheme would have superior financial wellbeing in retirement relative to the outcome had they not participated, as a consequence of the returns to the investment in their education.

3.6 Discussion

It was shown in this chapter that there is a deficiency in student income support resulting in sub-optimal educational achievement among existing students and reduced university participation. An ICL was proposed to address this deficiency. A summary of the arguments and findings from this chapter are given below.

Returns to society from university education are unquestioned, with widespread evidence of positive correlation between education and economic growth. Inadequate investment in education can result in educated labour shortages, with a consequence of inflationary pressures. Shortages of skilled workers are restricting economic growth and innovation in Australia (AIG, 2008). On the back of such evidence, the Bradley Review of Australian Higher Education concluded that in the interest of national productivity, there is a need for greater participation in higher education (Commonwealth of Australia, 2008b).

There is evidence that inadequacies in income support are a significant concern for tertiary students, and are perhaps the most significant barrier to participation for many (e.g., ANZSSA, 2008). The Bradley Review concluded that relaxing the eligibility requirements for existing income support and improving the level of support would encourage university participation, particularly among economically disadvantaged groups (Commonwealth of Australia, 2008b). While the federal government conceded and made some important changes to student income support policy (Gillard, 2009), it was shown in Section 3.3.1 that the overall benefit remains

insufficient to cover student costs of living without supplementation from other sources. While it is reasonable to suggest that students supplement their income with paid employment during study breaks, it was shown that the duration of employment that is required to provide sufficient income on top of government income support would, in many instances, adversely affect educational outcomes.

To achieve the estimated level of income required for a university student (excluding tuition), after allowing for existing income support arrangements, it was shown in Section 3.3.1 that 20 or more weeks of paid work would be required. Under the assumption that employment during the university year should be confined to study breaks, it was argued that an amount of \$2,000 or \$3,000 per annum could make up the shortfall for many financially independent students without dependants.

While commercial loans are increasingly available to meet such short-falls, the terms of such loans are restrictive, requiring collateral or a credit-worthy co-signatory as a consequence of uncertain returns on human capital investments. Although government guarantees can remove the risk of default for the lender, such loans require regular and level repayments, regardless of the debtor's financial circumstances. This increases the risk of hardship and bankruptcy and may deter risk-averse prospective students from university participation.

It has long been argued that an ICL for student living costs could be used to supplement existing income support. While Australia's first foray into extending HECS through the SFSS was discontinued after 10 years, there are strong arguments for considering an appropriately restructured ICL in this context. Such an instrument would provide a source of funds, allowing students to be less reliant on paid employment than currently - the income contingent feature reduces the risk of financial hardship and removes the threat of bankruptcy, and therefore would appear more attractive to prospective participants than traditional loans. Additionally, as shown in Section 3.4, depending on the indexation arrangements used, the ICL could be structured so that taxpayer costs are low, recognising the private benefits to the debtor.

Critically, an income support ICL can lead to a lengthening of the time until HECS is repaid. An implication is that net taxpayer subsidies can potentially be significant even when a real interest rate is imposed on the debt. While real indexation

arrangements are considered that can lead to essentially nil interest rate subsidies for the income support ICL, such arrangements can potentially result in large accumulated debts for low-income earners due to compounding interest. It is plausible that there would be greater take-up and less opposition to the ICL if a surcharge was imposed instead of real interest rates. An implication of this feature is that cross-subsidisation would occur from higher earners to lower earners, and thus greater costs are borne by those who can most afford to pay. The aggregate costs of such an approach will depend, however, on the future income distribution of participants.

Finally, in Section 3.5 the case of mature aged students was considered, and it was shown that while an ICL of \$2,000 may increase educational participation and outcomes for some, the opportunity costs of further training are considerable and will restrict participation, exacerbating skill shortages. A novel policy suggestion was proposed, predicated on the following observation: funds are deducted from wages and salaries to smooth consumption at retirement, yet are unavailable when individuals face other periods of interrupted employment. A student income support ICL was proposed, targeted at mature aged students for further education, where the funds are sourced from an individual's superannuation and are paid back into superannuation via an ICL mechanism. This could be structured to almost eliminate moral hazard and default risk, yet would increase individual utility and could help address the skill shortage crisis facing Australia.

While aggregate modelling of the \$2,000 income support ICL was not undertaken here, in the next chapter the implications of earnings model complexity to ICL costs are examined. The earnings models developed and lessons from Chapter 4 can be applied in future research to accurately cost both interest and default risk of proposed income support ICLs, such as those described in this Chapter.

4 Earnings model complexity and ICL costing⁹⁷

4.1 Introduction

4.1.1 *Background and outline*

In this chapter, variability in earnings among prospective ICL debtors is investigated and earnings models for simulation are developed. While ICL costs are affected by multiple variables, including scheme rules, related government policy, interest rates, mortality rates, voluntary repayments, and take-up rates, a critical component of any model – and one to which costs will be shown to be particularly sensitive – are the future assessable earnings of scheme participants. This chapter seeks to explore the extent to which ICL debt and repayments are affected by the levels of complexity and realism imparted in the earnings models underlying the cost estimates.

The layout of this chapter is as follows. In Section 4.2, a description of broad modelling structures for costing ICLs is given. Prior to embarking on model development, a cursory empirical analysis of HILDA earnings data and labour force state transitions is presented in Section 4.3. The data are used in the development of static representative debtor models for earnings, akin to that described in Chapter 2, and these are applied to estimate ICL repayments and debt for a simple example. The findings from this section serve as motivation for the subsequent discussion and modelling undertaken.

Modelling dynamic earnings requires multiple components: a model of labour force transitions, and a model of earnings conditional on labour force state. In Section 4.4, nested logistic labour force transition models are developed using HILDA data. In Section 4.5, empirical and theoretical aspects of earnings modelling in the literature is detailed, including earnings mobility, correlates of income dynamics, permanent and transitory earnings components, and stochastic model structures.

⁹⁷ This chapter uses unit record data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA Project was initiated and is funded by the Australian Government Department of Families, Housing, Community Services and Indigenous Affairs (FaHCSIA) and is managed by the Melbourne Institute of Applied Economic and Social Research (Melbourne Institute). The findings and views reported in this chapter, however, are those of the author and should not be attributed to either FaHCSIA or the Melbourne Institute

This information is used in Section 4.6 in the development of hourly wage models. These vary from a simple regression model with covariates and iid errors, to a model that accommodates unobserved variables through residual decomposition into serially dependent permanent and transient error components. In Section 4.7, a non-parametric model is proposed for the number of hours worked, and this is combined with the models for hourly wage to predict earnings. While a stochastic model is ultimately developed for hours worked, considerably more attention is given to model development for hourly wage than hours worked in this chapter.

In Section 4.8, the labour force, hourly wage and hours worked models are combined and the implications of model complexity to ICL debt and repayments are examined through simulation. In Section 4.9, the key conclusions from the chapter are summarised.

As a caveat, the models here are not intended to be prescriptive. They are not an end in themselves, but rather are developed to allow a critique of the appropriateness and pitfalls of using basic, exploratory models for costing ICLs. Nonetheless, the assumptions made and techniques used in model selection and development, particularly for labour force transitions and hourly wage, are intended to be statistically rigorous and sufficiently rich such that the models could be refined for use in costing ICLs via microsimulation.

4.1.2 *Earnings defined*

Assessable income as defined for HECS-HELP⁹⁸ is the income measure upon which compulsory repayments are calculated, and is equal to taxable income, plus any reduction in taxable income due to rental loss, plus fringe benefits and exempt foreign employment income. Fringe benefits and exempt foreign employment income are, for the most part, negligible components of overall income (ABS, 2006c) and can be ignored when modelling ICL repayments.

Taxable income consists predominantly of taxable sources from: wages and salaries, business earnings, investment returns, and government pensions and allowances.

⁹⁸ See <http://www.goingtouni.gov.au>

The principal source of taxable household income among typical ICL debtors is wages and salaries. ABS data (2009) show that approximately 80 per cent of lone persons under 35, over 90 per cent of couples under 35, and between 80 and 90 per cent of couples with dependent children, have wages and salaries as their principal income. A closer analysis of ABS Survey of Income and Housing Costs data (ABS, 2004) shows that for males aged less than 55, between 80 and 90 per cent of weekly income is derived from wages and salaries. Percentages for women are marginally smaller (between 70 and 85 per cent of weekly income consists of wages and salaries), as a consequence of part-time work due to child-rearing. While income from government pensions and allowances is a non-trivial component of income for women with dependants or for lone parents, the majority of government benefits for these groups are via the Family Tax Benefit A or B, both of which are tax-free and non-assessable for ICL purposes.

While income from other sources can remain, such as investment income, superannuation income, and the age pension for older Australians, the key point is that the vast majority of taxable income over the repayment period for a typical ICL debtor will be from wages and salaries. While earnings is usually defined as income from an individual's labour, and thus can include self-employed business profit, for simplicity the definition in this chapter assumes earnings is restricted to income from wages and salaries.

4.2 Modelling structures

While this chapter's focus is on modelling earnings from wages and salaries, an earnings module is just one of a number of modules required in costing ICLs. The choice of earnings model will depend in part on the broader ICL model structure. A brief introduction to ICL model structure options is presented in this section.

Modelling can be achieved through three main structures: Representative Debtor models (akin to Representative Worker models in social security modelling (e.g., see Toder *et al.*, 2000)), where the costs for hypothetical or representative debtors are projected; Cell-based models, where debtors are aggregated into subgroups for the purpose of costing; and microsimulation models, where each individual decision

making unit (i.e., each debtor) is projected separately. Each of these modelling structures can be generated with static or dynamic components, and projections can follow deterministic or stochastic processes.

4.2.1 *Representative Debtor Models*

In a Representative Debtor model one or more hypothetical debtors, taken to be representative of the possible cohort of all debtors, are modelled. This approach was used for the ICL costing estimates of Chapter 2 where representative debtors with a particular living status (single or partnered), number of children, and income level (25th, 50th or 75th income percentile), were projected. A limitation of these models is that the costing estimates produced can be misleading if the future circumstances of the representative debtor (e.g., their future living status, employment status and earnings) differ from the profile assumed. As explored by Toder *et al.* (2000), multiple wage profiles can enhance the usefulness of these types of models. While the use of three income percentiles in the modelling undertaken in Chapter 2 is in this vein, the credibility of the outcomes of such models in the absence of a comparison with more realistic income models is open to scrutiny.

4.2.2 *Cell-based models*

In a cell-based model the individual units of interest, namely ICL debtors, are placed into like subgroups (e.g., according to gender, age, or other factors) and projections for each group are performed. The results for one individual in each group are assumed to hold for all individuals in that group, and the results for the groups are summed to produce an overall estimate of cost. Subgroups may be small, such as five-year age-sex groups, however the key point is that the subgroups do not represent individual decision-making units.

This approach was essentially used for the ICL aggregate costing estimate of Chapter 2. The representative debtors described above were each taken to represent a sub-group of the total debtor population. Simulated earnings for the representative debtors were used to determine compulsory repayments and outstanding debt in

each future year. The results were then multiplied by the predicted number of debtors within each subgroup, and summed across all subgroups, in order to obtain an estimate of the total cost.

As with Representative Debtor models, a deficiency in this approach is that the variability in characteristics between individuals, beyond that allowed for in determination of the initial subgroups, is not accommodated in the modelling. All units within each subgroup are considered identical for the purpose of projections. This may overlook variability in earnings that has a material effect on results. The extent to which this has an impact on ICL cost estimates will depend on the number or size of the subgroups and specific factors used to distinguish subgroups – if the subgroups are small and numerous (i.e., if multiple factors with multiple levels are used and separate projections are based on each set of subgroup characteristics), this will better preserve the heterogeneity within the debtor population.

4.2.3 Microsimulation modelling

As the number of sub-groups in a cell-based model increases such that each individual decision-making unit is projected separately, the model becomes known as a microsimulation model. Microsimulation modelling was first advocated for socio-economic analysis by Orcutt (1957) and has been embraced by policy modellers due to its ability to test potentially complex policy options in a realistic setting. The growth of microsimulation modelling has been possible due to the revolution in personal computing and continued development of processor speeds and memory. Microsimulation is carried out by projecting the decision-making units, such as individuals, households or firms. Given a set of exogenous variables and policy constraints, this allows for the production of results at an aggregate level, at a sub-group level, but critically also at an individual unit level.

In a microsimulation model the individual units are ‘aged’, that is, they are projected into the future one period at a time, where periods can vary from weeks to years. The focus on individuals units means microsimulation models are dependent on micro-data throughout the model-building process, though the extent of reliance depends on the complexity of the model. Techniques can be static, dynamic,

deterministic and/or stochastic, with dynamic stochastic modelling leading to the most complex but potentially realistic microsimulation models. A description of these techniques is given in the following section.

Large-scale microsimulation models have been developed and are in use internationally for the design and evaluation of public policy⁹⁹, and for investigation of inequality and redistribution under existing and simulated taxation and social security structures (e.g., Creedy *et al.*, 2002). Large-scale microsimulation models for which earnings modules form a part have been developed in Australia, the United States, the United Kingdom, France, Canada, Sweden, and Norway among others.¹⁰⁰ An overview of the structure of the earnings and labour force modules for many of the well-known microsimulation models is given in Appendix A2 of this thesis.

4.2.4 *Deterministic, Stochastic, Static and Dynamic modelling*

The level of realism in a model will be affected by whether the model components are structured as static or dynamic, and whether the processes being followed are deterministic or stochastic.

In a static, deterministic income model, the income of the individual or subgroup being modelled is assumed to follow a pre-determined path devoid of transitions to other states and stochastic variability. The costing models of Chapter 2 were of this form; an individual starting at the 25th income percentile was assumed to continue at the 25th income percentile for the duration of the projection period.

The term ‘static’ in the lexicon of microsimulation can also refer to how states and behaviours are assigned from one projection period to the next. In microsimulation, weights are typically used to ensure that the individual units, which usually are a sample representative of a larger population, sum to the population that the model represents. In static ageing, weights may be adjusted to correspond with aggregate control variables (e.g., see Anderson, 1997; Toder *et al.*, 2000; Mitton *et al.*, 2000),

⁹⁹ particularly social security; for a summary of applications to social security policy analysis see Toder *et al.*, 2000

¹⁰⁰ For a comprehensive list and review see O’Donoghue (2001) and O’Donoghue *et al.* (2009).

or alternatively variable levels may be directly changed to correspond with changes in certain aggregate measures. The later method was followed in the modelling of Chapter 2 where a parent's income at time $t+1$ was not a function of their income at time t , but rather was a particular age-gender specific income percentile taken from a cross-sectional survey adjusted for average earnings growth.

For dynamic models (and also for dynamic ageing in microsimulation) the current period endogenous variables are functions of other current period or previous period endogenous variables. In contrast with a static model, in a dynamic income model the individual's level of future income is permitted to drift according to some process. The drift may follow a deterministic path; for example, income may be assumed to shift to a higher income percentile in a pre-determined way continuously or discretely – income at time $t+1$ may be modelled as a function of income at time t plus other characteristics. Alternatively income may drift from a pre-determined path according to one or more stochastic processes. For example, income at time $t+1$ may be modelled as a function of income at time t plus other characteristics *plus* an error term that follows a specific distribution. A consequence of dynamic modelling is that the composition of the population may change in each period of the projection, as individuals change their labour market characteristics and wage. In dynamic ageing, the population is projected by replicating the processes in the model rather than by relying exclusively on exogenous aggregate measures.

In a stochastic model, unexplained variability in a process is allowed for through one or more error terms. Multiple stochastic processes may be involved depending on the model complexity. For example, income may be modelled through a two-step process, whereby labour force state is first simulated as a stochastic process, and income at $t+1$ is a function of the simulated labour state, previous income level and other characteristics plus a further, independent random error. The key point is that future earnings in a dynamic, stochastic income model are simulated from stochastic processes. This ensures greater realism than a static model, or a dynamic deterministic model, provided the stochastic processes chosen are appropriate, and it allows presentation of results as a distribution rather than a point estimate, thus making it possible to state how confident we are that a particular output might occur.

In practice a model can have both deterministic and stochastic components. For example, labour force state might be treated stochastically, while earnings within each labour state may be modelled as deterministic.

In a dynamic stochastic microsimulation model, the individual is the driver in the analysis. In the context of an income model, if an individual's labour force state changes this will affect the probability that a certain income level will be reached and also the probability of transition to future labour force states. Additionally, regardless of whether the processes are deterministic or stochastic, if dynamic personal characteristics drive income (either directly, or through labour force state), a dynamic microsimulation model should ideally accommodate these characteristics. For example, an individual's level of education has a direct bearing on their employability and their income level, however education is not static. This can lead to the situation where a dynamic microsimulation model of earnings also requires modules that allow simulation of personal characteristics, including marital status, birth and growth of children, education, and partner's labour force status. While development of a complex dynamic microsimulation model for the purpose of detailed policy analysis would ideally require such a model, the current motivation is the relative impact of model complexity on ICL cost estimates – hence, many of these characteristics are kept static for the purposes of the current chapter.

While there are obvious advantages arising from dynamic microsimulation, including enabling distributional outcomes and production of results for subgroups as well as at an aggregate level (e.g., Harding, 1999), the level of detail and complexity required in developing a dynamic model is significant. Errors can arise from sampling variation when selecting the starting population and from random noise from the simulation process. The latter can be reduced by variance reduction techniques (e.g., see Morrison, 2000). Most notably mistakes can arise in the misspecification of stochastic processes (including parameter uncertainty). Burtless (1996) questions the reliability of simulation due to limitations in understanding micro behaviour, and O'Donoghue (2001) and Harding (1999) both highlight the clear need for good micro data from which to develop microsimulation models and estimate transition probabilities. As a consequence of such difficulties, calibration with aggregate outputs from macro models is commonly used (O'Donoghue, 2001).

The method used to simulate a stochastic process in a dynamic model typically involves generating uniform random numbers (or pseudo-random numbers) and using these to generate the values of random variables from the distributions in question. Simulation, as defined here, is often referred to as Monte Carlo methods (or stochastic simulation methods). A standard technique for simulating values from a chosen distribution is via the Inverse Transform Method, though many other methods exist (e.g., see Ross, 2006). For example, consider a discrete random variable with the probability mass function $P\{X = x_j\} = p_j$, where $j = 0, 1, \dots$ and $\sum_j p_j = 1$. For each case for which we are simulating a value, denoted X , we generate a random number U between zero and one (i.e., uniformly distributed over $(0,1)$) and if $\sum_{i=1}^{j-1} p_i \leq U < \sum_{i=1}^j p_i$, we set $X = x_j$.

For a continuous variable, if we know the distribution function then we can often use the inverse transform algorithm to generate a variate from that distribution: for any continuous distribution function F the random variable X defined by $X = F^{-1}(U)$ has distribution function F . The Monte Carlo approach is used for simulating from the stochastic earnings models in Section 4.8.

4.3 Preliminary analysis

Prior to developing models for earnings, exploratory data analysis of Australian earnings data is undertaken. The motivation here is to examine and identify the different levels of variability in earnings, and specifically variability over time for individuals. It is shown in this section that considerable earnings mobility exists within the full-time and part-time labour force states. This is followed by development of a basic ICL model of debt and repayments and a representative debtor model with static earnings based on percentiles within fixed labour force states. It is shown that increasing the number of percentiles in a static model does not necessarily improve the accuracy of ICL estimates, as earnings mobility within each state is not replicated in the static approach. Further, it is shown that considerable mobility exists across labour force states, and this may have a significant impact on prediction of earnings, and consequently debt and repayments.

A conclusion is that it is inappropriate to use static earnings approaches for aggregate costing of ICLs. The data used in the analysis is the Household Income and Labour Dynamics in Australia Survey (HILDA). A brief description of this data, and data sources for modelling earnings more generally, is first presented.

4.3.1 *Data sources*

A cause of many deficiencies in microsimulation income models is the lack of available longitudinal data to generate models:

‘The technical estimation difficulties plaguing DYNACAN¹⁰¹, in modelling the distribution of lifetime income properly, as well as changes in individual incomes from one year to the next, will likely plague any microsimulation model. This is because their root cause is the absence of rich longitudinal data on individual incomes, covering both income and its major determining variables, for spans of 20 years or longer. Such databases are simply not available anywhere, so that it becomes essential to compensate for their absence by analytical ingenuity’ (Swan, 1997:10).

As Swan wrote this over 10 years ago, lack of panel data with long durations is less of a problem now in the US, UK, and some other countries, where panel data sets have accrued an additional ten years of observations. As will be described in Section 4.5, recent econometric research has been able to take advantage of longer panel series and test models of earnings with complicated error structures.

The European Community Household Panel (ECHP) provides panel data for more than ten European Union member countries from 1994 to 2001. The British Household Panel Survey (BHPS) commenced in 1991, and consists of more than 10,000 persons (e.g., Ramos, 2003), while other European countries (e.g., Northern Ireland, Switzerland and Germany) have undertaken similar panel surveys. The most widely used dataset among researchers into income dynamics is the Michigan Panel Study on Income Dynamics (PSID). This is a longitudinal survey of the civilian non-institutional US population since 1968 and has been the main survey used for analysis and modelling of income dynamics in the United States, as attested by the

¹⁰¹ DYNACAN and other dynamic microsimulation models are described in Appendix A2.

numerous research papers that have utilised the data (e.g., see Table 4.6 in Section 4.5.2 below).

In Australia, there are a number of publicly available datasets that could be used to develop income projection models. These are HILDA, The Negotiating the Life Course Project (NLC), and Australian Bureau of Statistics Cross-sectional Confidential Unit Record data (ABS CURFs). The Australian Bureau of Statistics regularly collects income information from the Australian population through the five-yearly census and through surveys of income and housing. While useful distributional information can be obtained through these sources, an obvious limitation is that the data is cross-sectional. The Negotiating the Life Course Project commenced in 1996 with the purpose of providing empirical evidence about changes in the life course of Australian individuals and families (Breusch and Mitchell, 2003). It consists of interviews with approximately 1,500 Australian respondents every three years. While the data is in panel form and income information is available, the relatively small sample size and three-yearly data collection makes it less than ideal for studying earnings dynamics.

The paucity of sufficient-length longitudinal data has restricted dynamic modelling in Australia, although the creation of the HILDA project in 2001 has sought to remedy this problem. HILDA is the longest Australian panel data available with labour market, income and socio-demographic and economic correlates. Although every additional wave of HILDA improves the ability to generate income models, there are currently only eight waves available. Nevertheless, HILDA is the primary source of data utilised here in order to establish predictive models for earnings. The first wave consisted of almost 8,000 households and 20,000 individuals (Watson, 2010).

While inference generated from analysis or modelling of panel data needs to recognise possible biases in the data through errors in reporting, for the purpose of this thesis and for this chapter it is assumed that measurement error in HILDA is negligible.¹⁰²

¹⁰² In the majority of models (including those developed for the purpose of this thesis), it is assumed that reporting error is normally distributed with zero mean and constant variance, is uncorrelated with true earnings and the observed explanatory variables, is uncorrelated over time for a given individual, and can therefore be incorporated into the classical residual error component. Under these

Variables in HILDA that are considered in the modelling in this chapter are as follows: age last birthday, sex, highest education level achieved, marital status, age of youngest child, labour force state, hours per week usually worked (in all jobs), and weekly wage/salary from all jobs. For those variables included as factors, the levels used in the modelling undertaken are described further in this chapter. Hourly wage rates can be estimated for employed persons by dividing their current weekly gross wages and salaries (in all jobs) by the number of hours per week usually worked (in all jobs) (Watson, 2010:37). The estimate of wages and salaries that is used includes incorporated business income, but excludes unincorporated business income (see Watson, 2010: 51).

4.3.2 *Earnings mobility in HILDA*

Earnings mobility can be defined ‘...as a change in individual ranks within a distribution’ (Moffitt and Gottschalk, 1998: 18). Examination of earnings cross-sections over time may present a picture of relative stability, evidenced by low variability in distributional statistics, such as mean, median and other percentiles, and measures of inequality such as Gini coefficients. However, as will be shown in this section, when one considers individual earnings mobility, the stability disappears.

Earnings mobility in HILDA is explored by decomposing male and female full-time and part-time earnings from wages and salary into quintiles, and measuring the proportion of individuals within each quintile in Wave 1 that remain in the same quintile, or move to other quintiles in subsequent waves. The full-time quintiles in each wave are derived from full-time wage and salary earners aged 20 to 60 in Wave 1 who have remained full-time in subsequent waves. Part-time quintiles have been similarly derived. Table 4.1 (A) and (B) report rates of earnings mobility for persons who have remained employed full-time. Table 4.1 (C) gives the earnings mobility

assumptions, if we assume that reporting error exists for our dependent variables (labour force state and earnings), then this has the effect of increasing the residual variance (and therefore, the standard errors), but does not bias the parameter estimates (Brownstone and Valleta,1996). Unfortunately, recent research suggests that reporting errors are not classical as previously assumed. Brownstone and Valleta (1996) describe an approach using multiple imputation to account for measurement error, and verify their approach through the use the PSID Validation Study. Despite these findings, for the purpose of this thesis and for this chapter it is assumed that measurement error is negligible.

rates for females who have remained employed part-time.¹⁰³ More complete results are presented in Figure 4.1 and Figure 4.2.

TABLE 4.1 MOBILITY RATES ACROSS EARNINGS QUINTILES FOR FULL-TIME AND PART-TIME EMPLOYMENT. HILDA, WAVES 1 TO 7

(A) MALES, FULL-TIME EMPLOYED

Wave 1 to Wave 2						Wave 1 to Wave 7				
Quintile	1 st	2 nd	3 rd	4 th	5 th	1 st	2 nd	3 rd	4 th	5 th
1 st	0.63	0.24	0.10	0.02	0.02	0.54	0.25	0.09	0.09	0.03
2 nd	0.24	0.51	0.17	0.07	0.02	0.29	0.38	0.19	0.10	0.04
3 rd	0.08	0.19	0.49	0.21	0.03	0.10	0.25	0.38	0.17	0.11
4 th	0.02	0.05	0.20	0.56	0.17	0.05	0.08	0.25	0.39	0.23
5 th	0.02	0.02	0.05	0.14	0.77	0.01	0.04	0.10	0.24	0.60

(B) FEMALES, FULL-TIME EMPLOYED

Wave 1 to Wave 2						Wave 1 to Wave 7				
Quintile	1 st	2 nd	3 rd	4 th	5 th	1 st	2 nd	3 rd	4 th	5 th
1 st	0.60	0.26	0.07	0.04	0.04	0.48	0.26	0.19	0.04	0.03
2 nd	0.19	0.51	0.24	0.06	0.01	0.21	0.46	0.20	0.11	0.02
3 rd	0.08	0.15	0.51	0.24	0.02	0.18	0.19	0.33	0.21	0.09
4 th	0.08	0.06	0.15	0.51	0.20	0.06	0.06	0.16	0.45	0.27
5 th	0.05	0.03	0.03	0.16	0.73	0.08	0.03	0.11	0.19	0.59

(C) FEMALES, PART-TIME EMPLOYED

Wave 1 to Wave 2						Wave 1 to Wave 7				
Quintile	1 st	2 nd	3 rd	4 th	5 th	1 st	2 nd	3 rd	4 th	5 th
1 st	0.63	0.25	0.07	0.04	0.02	0.46	0.24	0.22	0.07	0.02
2 nd	0.14	0.49	0.26	0.08	0.03	0.14	0.38	0.14	0.27	0.06
3 rd	0.11	0.20	0.43	0.22	0.03	0.16	0.18	0.29	0.20	0.16
4 th	0.06	0.04	0.19	0.50	0.21	0.11	0.14	0.26	0.27	0.22
5 th	0.06	0.02	0.05	0.16	0.71	0.13	0.06	0.09	0.18	0.55

Table 4.2 gives the number of respondents in each category that remained either full-time or part-time employed over the various survey waves.

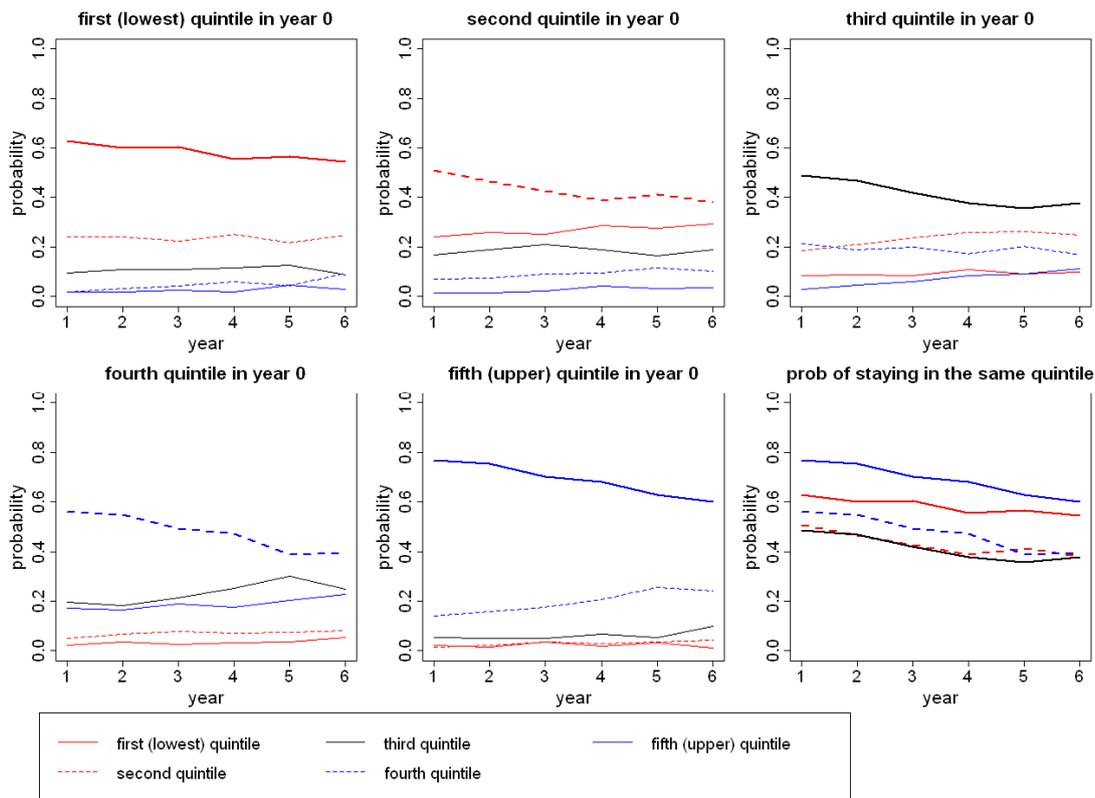
TABLE 4.2. NUMBER OF SURVEYED AGES 20 TO 60 WHO HAVE MAINTAINED THE SAME EMPLOYMENT STATE.

	Wave 1	Waves 1 to 2	Waves 1 to 3	Waves 1 to 4	Waves 1 to 5	Waves 1 to 6	Waves 1 to 7
Males: Full-time employed	3,000	2,506	2,121	1,864	1,687	1,540	1,403
Males: Part-time employed	348	170	98	58	45	42	36
Females: Full-time employed	1,705	1,234	976	789	676	581	515
Females: Full-time employed	1,402	935	660	503	420	342	275

Notes: those with zero, negative, or missing earnings have been excluded

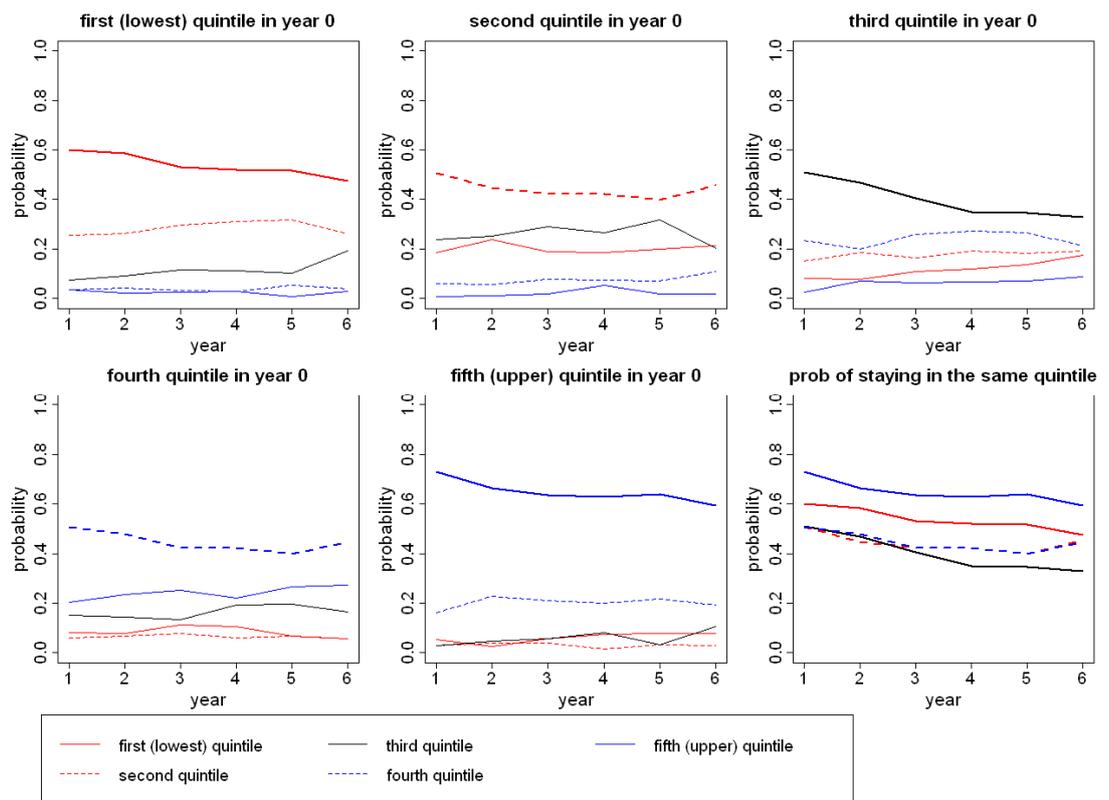
¹⁰³ Mobility rates for males with part-time employment over the seven waves have not been included here as they are particularly variable due to the low number of respondents in the survey with these characteristics.

FIGURE 4.1 MALES, FULL-TIME EMPLOYED IN WAVE 1 (YEAR 0): MOBILITY ACROSS FULL-TIME EARNINGS QUINTILES



It is clear from this analysis that there is considerable mobility within the earnings distribution for those who remain employed either full-time or part-time. For both males and females in the first (lowest) full-time quintile, there is almost a 40 per cent chance of moving to a higher quintile within one year. As expected, the majority who leave only move up to the next highest group, however, close to 15 per cent move two or more quintiles. Despite the large proportion transitioning in the first year, the majority who started in the first quintile remain in that group six years later (in Wave 7), indicating strong persistency in earnings. The pattern for the fifth, or highest, quintile is similar, with a majority remaining in the highest quintile within one year, and a smaller though still large proportion persisting after 6 years. For those not at the extremes of the earnings distribution, there is scope for moving up or down and consequently persistency of earnings is not as marked as for the tails of the distribution.

FIGURE 4.2 FEMALES, FULL-TIME EMPLOYED IN WAVE 1 (YEAR 0): MOBILITY ACROSS FULL-TIME EARNINGS QUINTILES



The proportion moving two or more quintiles within one year ranges from 4 to 15 per cent depending on the starting group. This increases to over 25 per cent for some full-time groups after six years, with even greater mobility for part-time earners.

The large proportion moving one quintile, and the smaller yet still substantial proportion shifting two or more quintiles in the HILDA data, is consistent with the international and domestic literature on income mobility. Moffitt and Gottschalk (1998) report numbers similar to those of Table 4.1 above for US data.¹⁰⁴ As observed here, Moffitt and Gottschalk note that mobility at the upper and lower quintiles is smaller than in the middle quintiles. In an examination of British income mobility from 1991 to 1996, Jenkins (2000) shows that fewer than 60% of individuals remain in the same income group from year to year (where six groups are chosen based on weekly income). The majority who move income groups do so to an adjacent group. Breusch and Mitchell (2003) explore income mobility between 1997 and 2000 for 18-54 year olds in Wave 1 of the NLC data. They consider family incomes rather than individual incomes and find a large degree of income mobility

¹⁰⁴ They report percentages of 67, 21, 8, 3, and 1 for the one-year quintile mobility rates from the bottom quintile, and 7, 21, 44, 22 and 6 for the middle (third) quintile mobility rates.

in the NLC sample. Adjusting for household size and composition, they noted that around 53 per cent of the sample remained in the same quintile between the two waves, close to 28 per cent moved to a higher quintile, and 18 per cent moved to lower quintiles. They also observed relative stability of the highest quintile with nearly 80 per cent remaining in the top category between the two waves. Keegan and Thurecht (2008) summarise the evidence for income mobility from Australia, observing that males generally experience greater income mobility than females.

4.3.3 *Static representative debtor models for ICL*

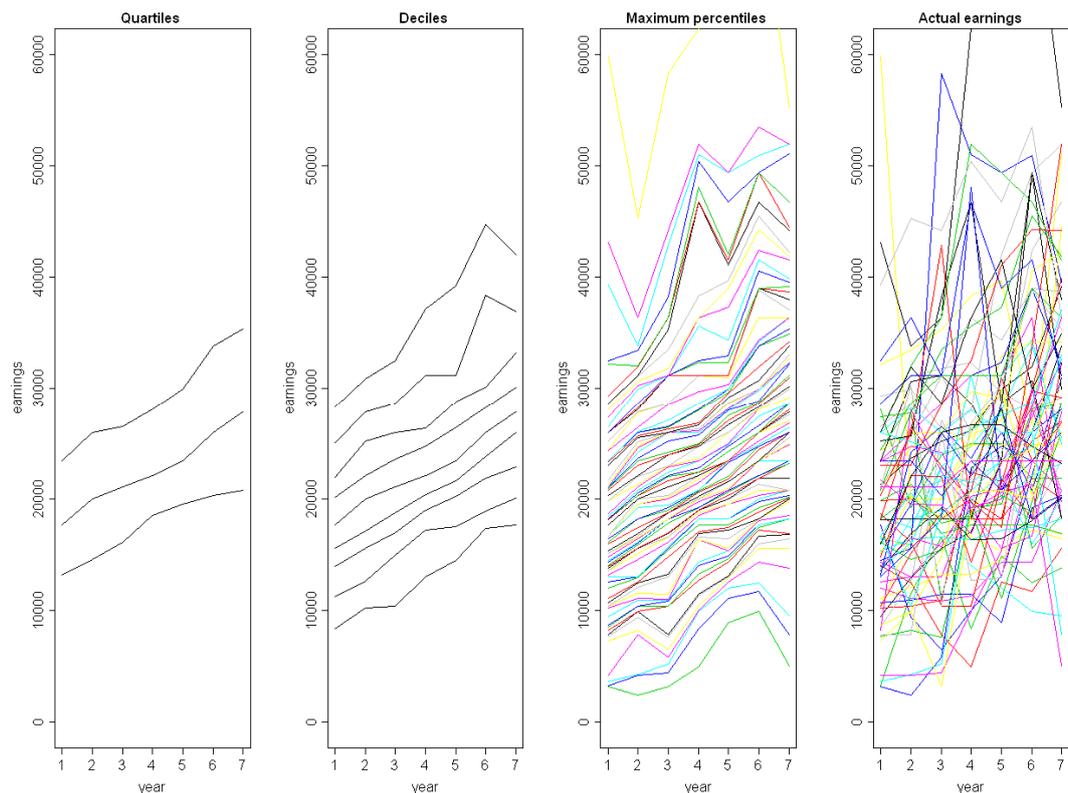
To assess the implication of ignoring earnings mobility on ICL's, a basic ICL model is constructed and the debt and repayments are calculated for individuals with fixed employment states and static earnings. The static earnings used in the ICL model were calculated by extracting earnings percentiles for full-time and part-time males and females for each of the seven waves of HILDA. Quartiles, quintiles, deciles (ten percentiles) and vigintiles (twenty percentiles) were generated from the data for 10-year age groups for each employment state and gender sub-group. In addition, the maximum possible number of percentiles for a given population was considered; n earnings percentiles were extracted for a population of size n . This is subsequently referred to as 'maximum percentiles'.

Earnings mobility was omitted in the static earnings estimates by restricting each individual to the same earning percentile for the duration of the seven-year period. For example, a person in the upper full-time earnings quartile in year 1 was assumed to continue in the upper full-time quartile for all subsequent waves.¹⁰⁵

An illustration of the difference between static earnings in this context and dynamic earnings is shown in Figure 4.3 where earnings quartiles, deciles and maximum percentiles are compared with a sample of actual panel earnings.

¹⁰⁵ This is analogous to the method used for estimating earnings in Chapter 2. The quartiles used here are different to those presented for full-time and part-time males and females in Chapter 2 from ABS CURF data, as they are extracted from different data sources. However, the magnitude of the income values is similar.

FIGURE 4.3 FEMALES, AGED 30-39, QUANTILES, DECILES, MAXIMUM PERCENTILES, AND A SAMPLE OF ACTUAL EARNINGS FOR PART-TIME EMPLOYED



For the ICL model considered here, the income thresholds and rates proposed for paid parental leave in Chapter 2 are used.¹⁰⁶ As these are expressed in terms of 2008/09 dollar amounts, in order to be consistent with the thresholds, the earnings values that are compared with the thresholds when determining repayment rates are inflated with average weekly ordinary time earnings growth (AWOTE) to February 2009.¹⁰⁷ It is assumed that the starting debt is \$6,500, being approximately equal to the proposed paid parental leave loan plus surcharge for a 10-week period from Chapter 2. It is also assumed that outstanding debt is indexed at a rate of 2.5 per cent per annum nominal (zero per cent real). The ICL model is run over the seven-year period for which data is available, and the debt and compulsory repayments over this period are output.¹⁰⁸

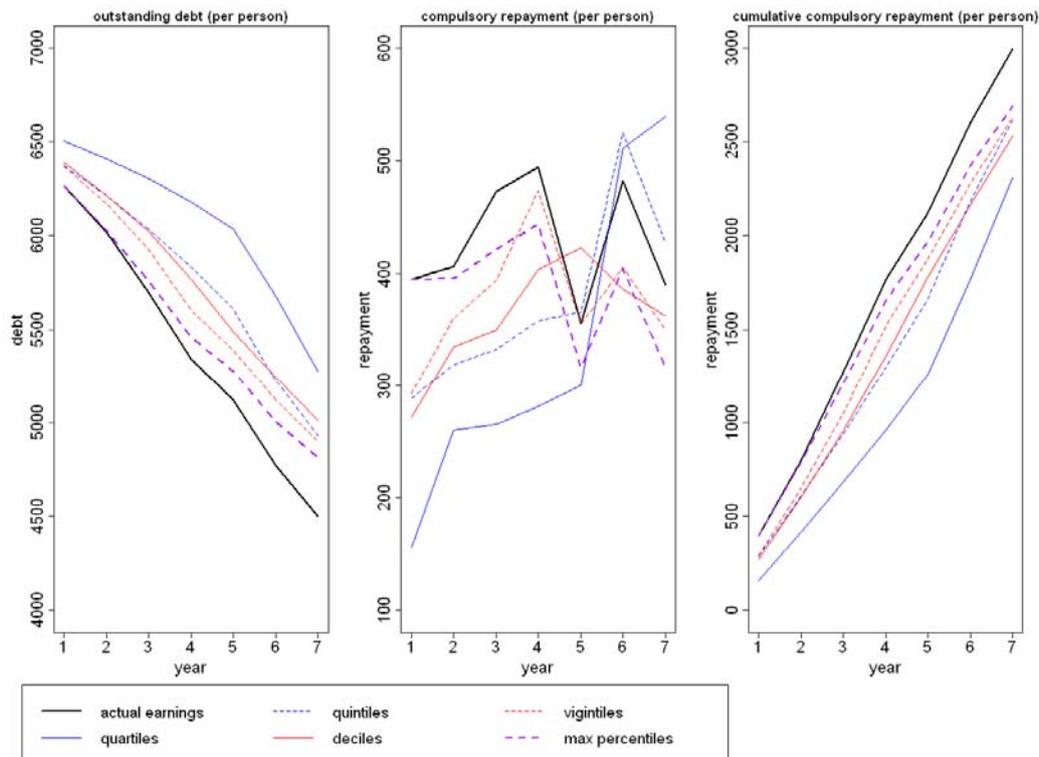
¹⁰⁶ These are the 2008/09 HECS income thresholds and rates, adjusted by allowing for a lower threshold as described in Section 2.4.6 of Chapter 2.

¹⁰⁷ The AWOTE values were sourced from the ABS, Average Weekly Earnings, February 2010 (ABS, 2010). For example, the earnings in Wave 1 were multiplied by the ratio of the AWOTE index for February 2009 to the index for February 2001.

¹⁰⁸ For each set of static earnings assumptions with k percentiles, an ICL estimate was produced. The average ICL output was equal to the sum of the results across all k percentiles divided by k . For example, for earnings based on quartiles, an ICL estimate was produced for the 25th, 50th and 75th earnings percentiles, and the average results were obtained by dividing the sum of the results by three.

Figure 4.4 presents the results for part-time and full-time females aged 30 to 39, of the outstanding debt, compulsory repayments, and cumulative compulsory repayments per person, for each of the seven years. In each of the figures the ICL results based on actual earnings are compared with results of static earnings based on quartiles, quintiles, deciles, vigintiles and maximum percentiles.

FIGURE 4.4 ICL RESULTS. FEMALES, AGED 30-39. STATIC EARNINGS AND PART-TIME EMPLOYMENT STATE.

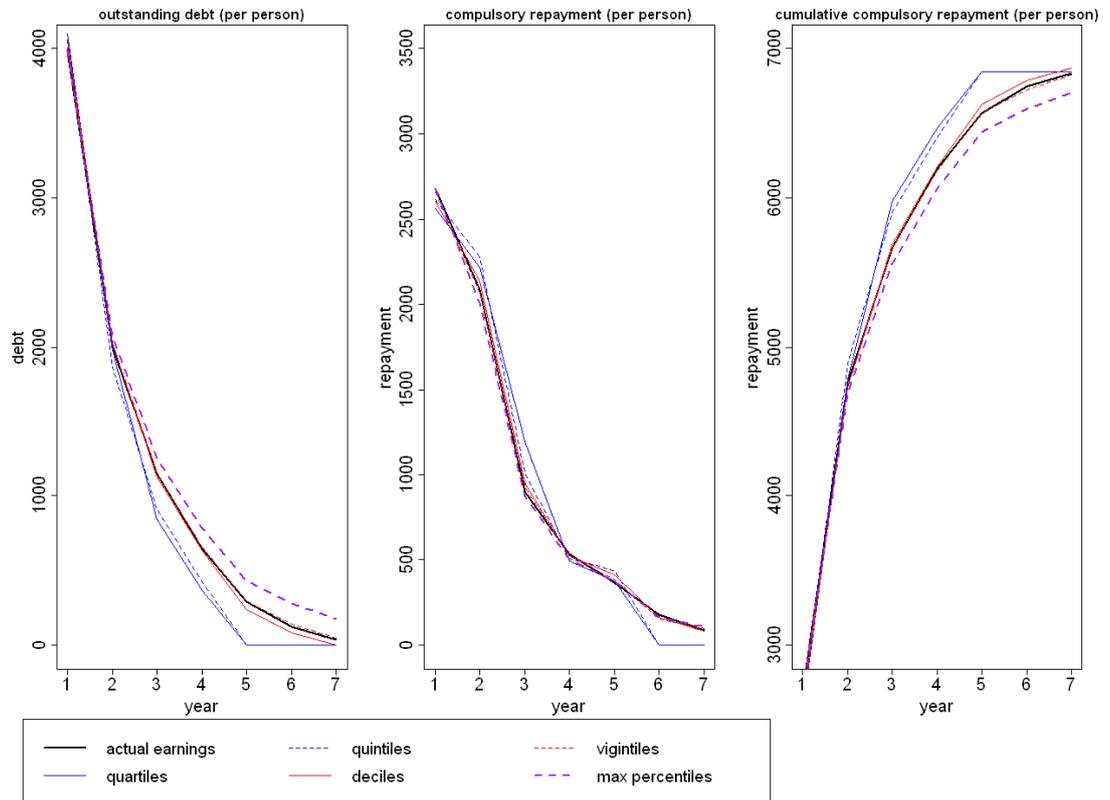


It is clear from Figure 4.4 that the quality of the estimates generally improves as the number of earnings percentiles increases, however, there are caveats with this statement. First, it can be seen that the difference in outstanding debt and aggregate compulsory payments widens as time increases, raising doubts as to the accuracy of this approach for longer projection periods. Second, introducing a large number of quantiles that approaches the sample size may capture specific temporal data features that are not appropriate for projection (i.e., spurious precision). Third, while additional quantiles increases the accuracy for part-time employed females, this doesn't appear to be the case for full-time employed (see Figure 4.5), where imposing the maximum number of percentiles decreases the accuracy relative to

earnings deciles.¹⁰⁹ A conclusion is that utilising static earnings within fixed labour force states can lead to misestimating ICL repayments and debt levels, even over relatively short time periods.

Regardless of the benefits of using static quantiles for simulating earnings, the population taking out an ICL will not be an idealised sample with persistent full-time, or part-time, earnings. Rather, the population may transition between labour force states and thus experience periods of uneven or interrupted repayment. This motivates the next section, where it is shown that mobility between labour force states can have a more substantial effect on ICL estimates than earnings variation within a fixed employment state.

FIGURE 4.5 ICL RESULTS. FEMALES, AGED 30-39. STATIC EARNINGS AND FULL-TIME EMPLOYMENT STATE.



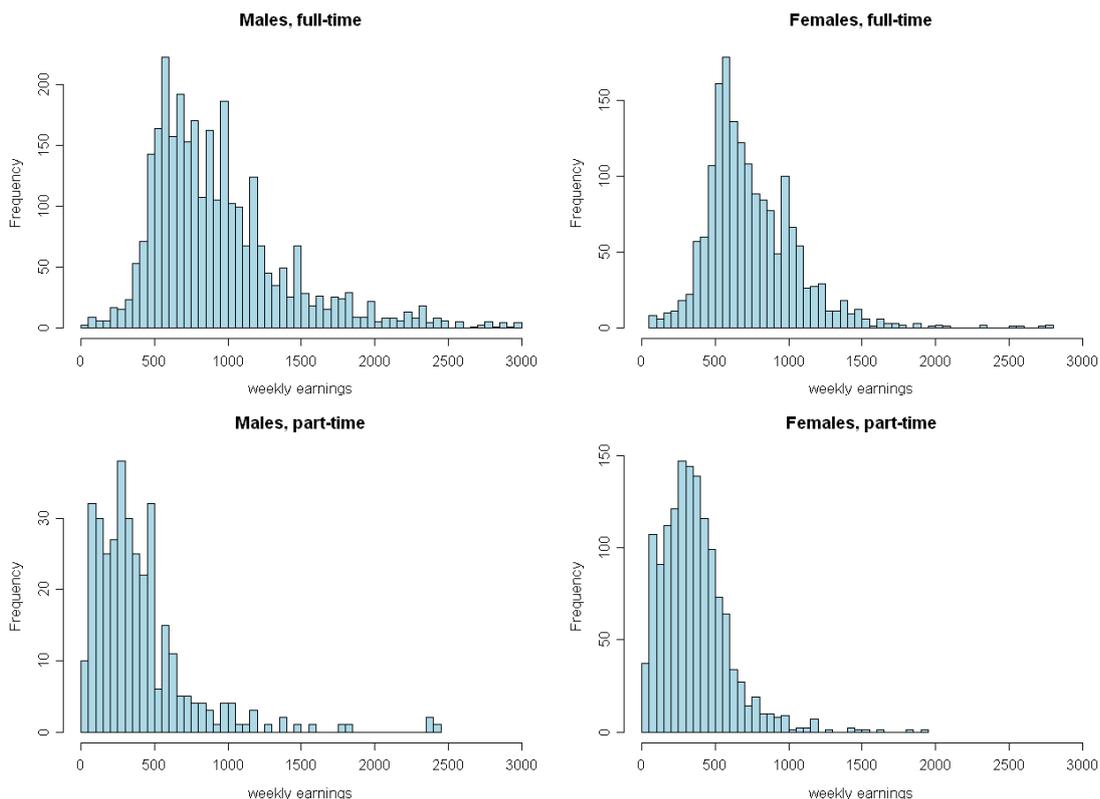
¹⁰⁹ This final observation holds for both sexes, as well as other age ranges and various loan amounts.

4.3.4 Labour force mobility in HILDA

While mobility in earnings can arise due to labour force variation brought about by life course events¹¹⁰, the analysis above reports earnings mobility within static labour force states. The causes of earnings mobility considered above are associated with changes due to promotion or demotion, industry or occupation, and have excluded movements between labour force states.

Figure 4.6 presents histograms of weekly earnings for part-time and full-time persons from Wave 1 of HILDA, illustrating both the variation in earnings within the full-time and part-time categories, but also the variation between these categories.

FIGURE 4.6 WEEKLY EARNINGS DISTRIBUTIONS (AGES 20 TO 60) FOR WAVE 1: FULL-TIME AND PART-TIME EMPLOYED



That substantial movement exists between labour force states, compounding variability in earnings, is examined through HILDA data. Individuals at Wave 1

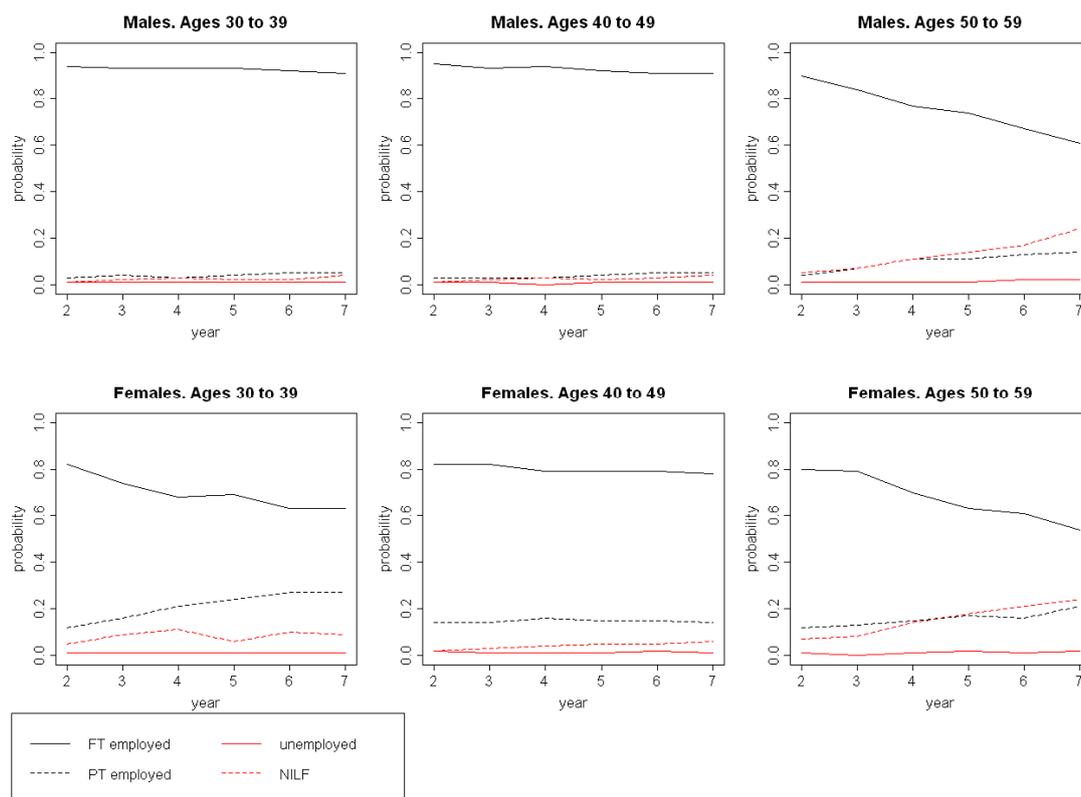
¹¹⁰ e.g., the birth of a child leading to part-time employment or leaving the labour force; reduced child dependency leading to mother entering full-time employment; education leading to periods of interrupted employment; reductions in work hours as preparation for retirement, etc.

within each of the four main labour force states (full-time employed, part-time employed, unemployed, and not in the labour force (NILF)) were extracted and the probability of transitioning to each of the four labour force states over the subsequent six waves were calculated. This was repeated for males and females, and the four age groups 30-39, 40-49, 50-59 and 60-69. Results are given in Figure 4.7 and Figure 4.8.

Of those men aged 30 to 49 employed full-time in Wave 1, close to 95 per cent remain employed full-time by Wave 2, and this drops to 91 per cent by Wave 7, indicating high persistence in participation. As expected, continuation in full-time employment for older men is much lower; the one-year continuation rate for males aged 50 to 59 in full-time employment is 90 per cent, but the six-year continuation rate drops to 61 per cent. The decline in full-time participation is offset by an increase in both part-time employment, and exits from the labour force. The pattern of reduced full-time employment and increased labour force exits is magnified for those aged over 60. Notably, for women aged 30 to 39 in Wave 1 with full-time employment, continuation rates are much lower than for men. Approximately 80 per cent maintain full-time employment within one year, but this drops to 63 per cent by year 7. That these lower rates are due to childbirth and child rearing is given support by noting the higher retention rates among 40 to 49 year old women (82 per cent only dropping to 78 per cent by year 7). As with males, there is a clear decline in full-time employment for those aged 50 and above.

For part-time men aged 30 to 39 in Wave 1, approximately 90 per cent either stay in part-time employment (56 per cent) or transition to full-time employment (33 per cent). Within three years the majority have taken up full-time employment. A similar pattern exists for part-time males aged 40 to 49. In contrast, for part-time women aged 30 to 39, while approximately 90 per cent also stay in part-time or full-time employment, a much higher proportion (ranging from 72 per cent to 56 per cent) remain in part-time work, and this pattern persists for ages 40 to 49. For older male and female cohorts while the chance of transitioning to full-time work is slim (<20 per cent), the majority continue in part-time work and this persists for the duration of the survey period, though persistence falls markedly for those over age 60.

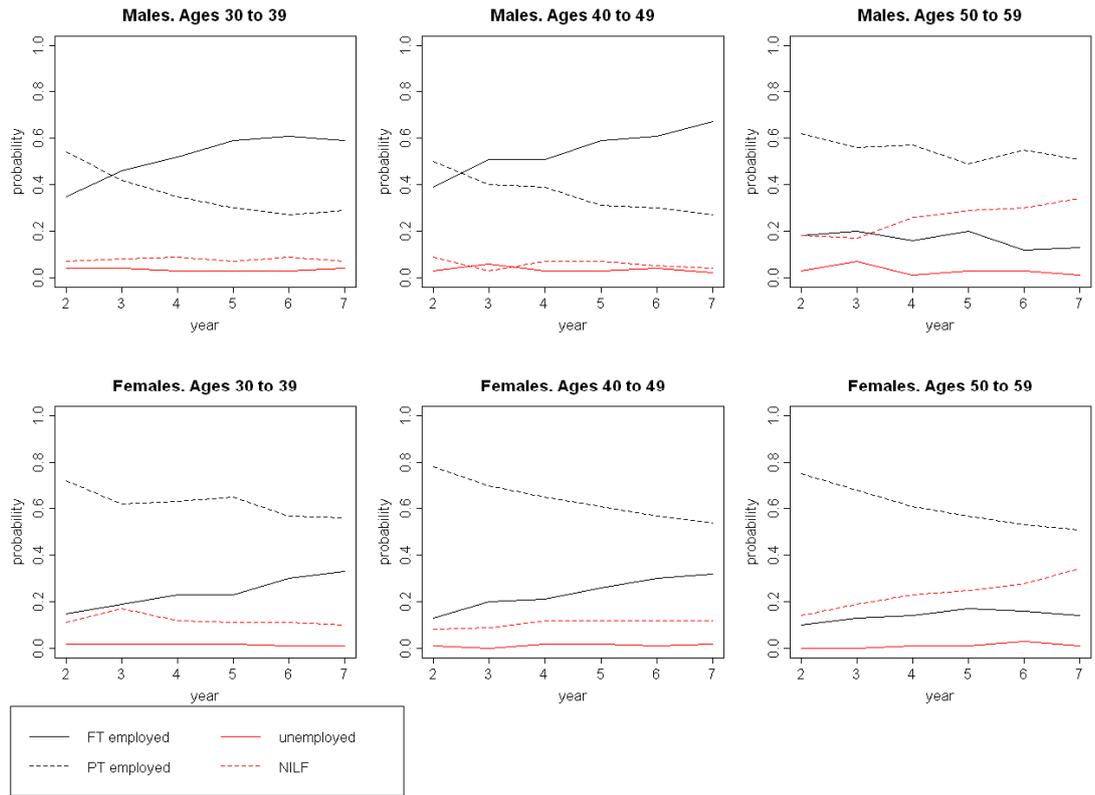
FIGURE 4.7 MALES AND FEMALES, FULL-TIME EMPLOYED IN WAVE 1 (YEAR 1):
MOBILITY ACROSS LABOUR FORCE STATES



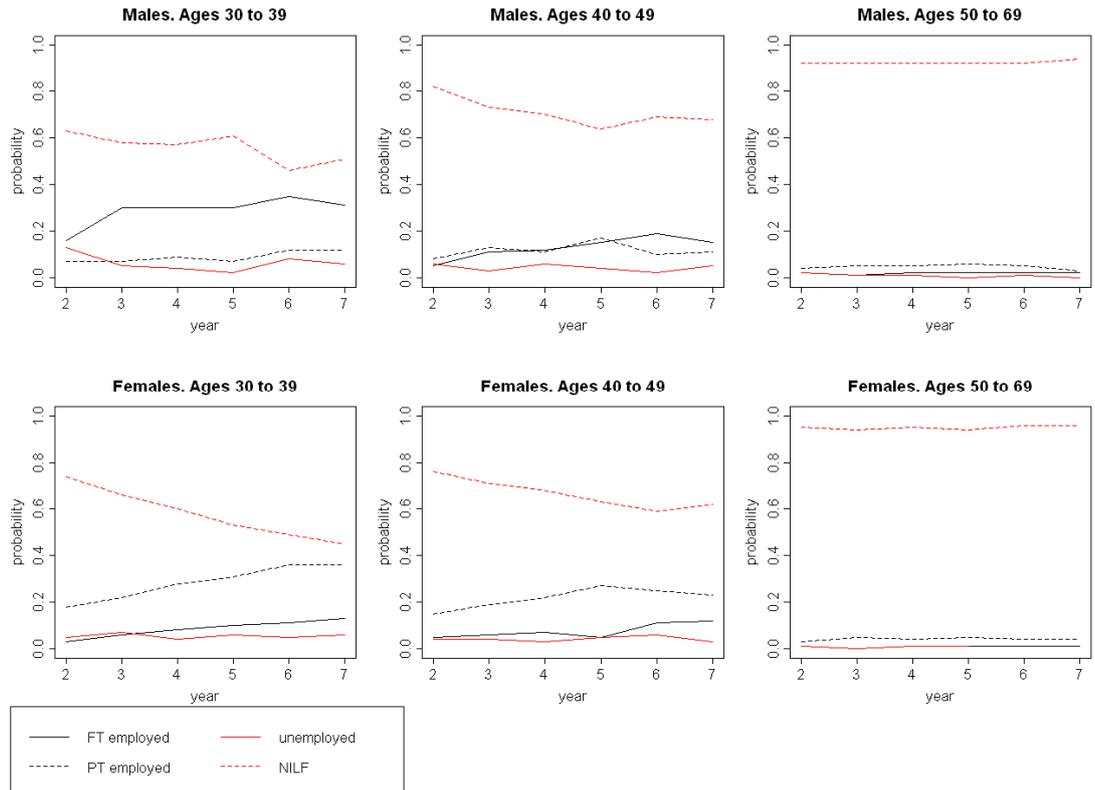
It is worth noting that the majority of men and women aged above 30 who are out of the labour force at the beginning of the survey period tend to remain removed 6 years after first observing them. While the rate declines for 30 to 39 year olds over this period and is offset by an increase in the chance of employment, for 50 year olds plus the chance of remaining out of the workforce is substantial (over 80 per cent for men and 90 per cent for women).

Although not plotted here, persistence in unemployment for all ages and both genders appears low. While the one-year rate of continued unemployed for those unemployed is close to 30 per cent, this drops to 10 to 15 per cent by six years after the commencement of the survey period. This is consistent with the observations of the NLC by Breusch and Mitchell who note that the data ‘...suggest that the percentage of households remaining in [the jobless] state for long periods is extremely small’ (2003:14).

**FIGURE 4.8 MALES AND FEMALES, PART-TIME EMPLOYED IN WAVE 1 (YEAR 1):
MOBILITY ACROSS LABOUR FORCE STATES**



**FIGURE 4.9 MALES AND FEMALES, NOT IN THE LABOUR FORCE IN WAVE 1 (YEAR 1):
MOBILITY ACROSS LABOUR FORCE STATES**



Following the ICL model methodology of Section 4.3.3, ICL estimates are produced for individuals in the part-time employed state in Wave 1. In contrast to the earlier estimates where labour force remained static, the ICL estimates based on actual earnings assume that labour force state and earnings follow the observed data for Waves 2 to 7. The earnings quantiles included in Figure 4.10 are the same as those in Figure 4.4; namely, they are based on those debtors who remained part-time employed over all waves.

There is clearly a large spread between the ICL results that are based on actual earnings and labour force states, and static part-time earnings in Figure 4.10. Part-time earners have a relatively low probability of persistence and moderate rate of transfer to full-time employment. Hence, when part-time debtors in Wave 1 are followed through to subsequent waves, there is an increase in average compulsory repayment (and drop in debt) for debtors following real labour force transitions, relative to those continuing exclusively part-time.

The simulated ICL calculations of Figure 4.10 illustrate the importance of including labour force variation and of not focussing solely on continuously working individuals when estimating repayments and debt.¹¹¹ It is the presence of labour force dynamics and earnings mobility that are key motivations behind a dynamic earnings model for income contingent loans. By ignoring mobility and by assuming that earnings remains at a fixed percentile over time, the compulsory repayments (and doubtful debt) for an ICL may be estimated poorly.¹¹²

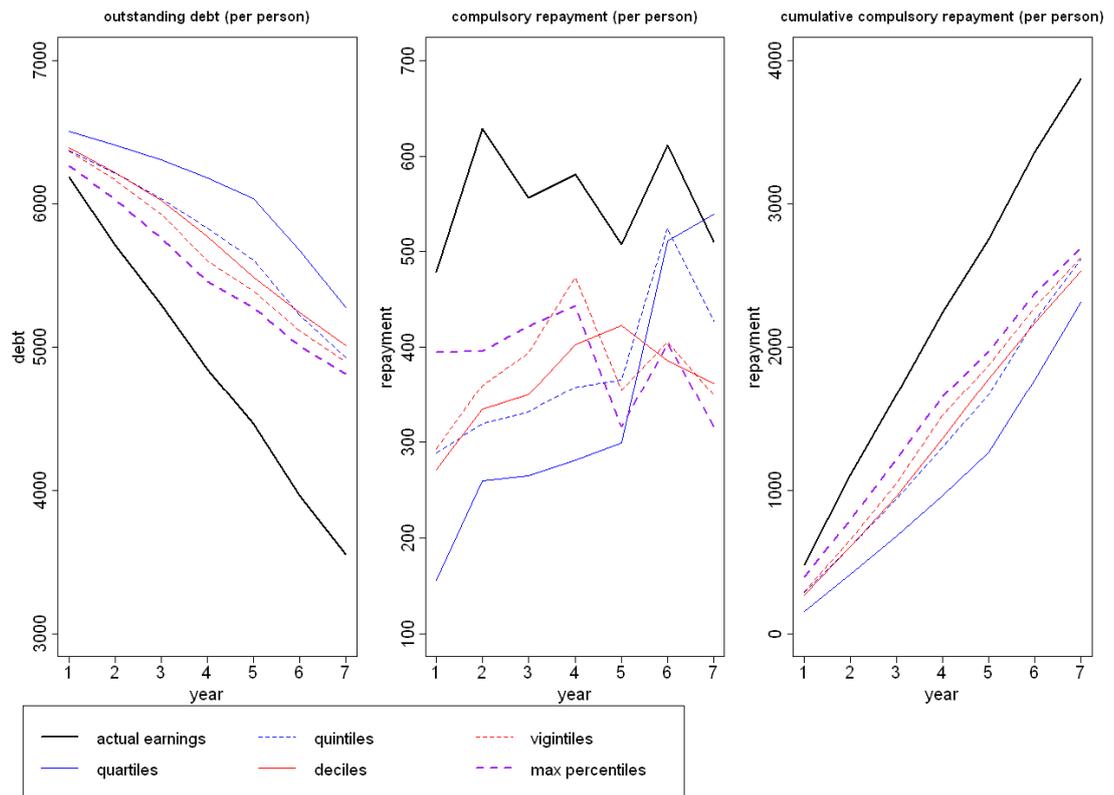
The analysis and simulation in this section confirms that accurate estimates of ICL repayments and debt levels require dynamic models of both labour force transitions and earnings within labour force states. In the remainder of this chapter predictive models of labour force and earnings are developed using HILDA data. These allow a

¹¹¹ Analogous to labour force change, Jenkins shows that there is a high chance (almost 50%) of some kind of demographic change (e.g. birth, death, marriage, divorce, change in household head, etc.) among British households between 1991 and 1996, and thus demographic change ‘...cannot be ignored in any study of the correlates of income dynamics’ (Jenkins, 2000: 541). As the models in this chapter are based on individuals, not households, it is individual demographic change that is important in the current context. This is accommodated in the labour force and earnings models developed in later sections of this chapter by including age, sex, marital status, and other individual characteristics as covariates.

¹¹² An analogous circumstance is described by Jenkins (2000) in the context of poverty. Jenkins shows that the proportion of the British population touched by poverty over a six year period between 1991 and 1996 (32%), is close to twice the proportion who experience poverty in a single year (18%); by ignoring mobility, poverty in the community may be underestimated.

closer examination of the implications of model assumptions on ICL costs by incorporating mobility into the model structures, and by enabling projection beyond the HILDA period.

FIGURE 4.10 ICL RESULTS. FEMALES, AGED 30-39, PART-TIME EMPLOYED AT TIME 0. ACTUAL EARNINGS INCLUDE ALLOWANCE FOR LABOUR FORCE VARIATION. EARNINGS PERCENTILES ARE CALCULATED FOR PART-TIME EMPLOYED IN ALL WAVES.



4.4 Developing models of labour force transitions

Variability in earnings can occur both due to observed and unobserved differences between individuals and over time for the same individual. Earnings variability can arise within a particular labour force state and between labour states. In this section the focus is on modelling labour force state, as predicting an individual's future labour force state is necessary prior to predicting future earnings.

For any given year, there is variability in labour state due to socio-demographic differences. For example, a person with a higher level of education might be expected to have superior employment prospects; a parent with young children may have less opportunity and desire for full-time employment; a person in their late

teens may opt out of the labour force due to participation in full-time education. In addition to personal characteristics, interpersonal factors such as a spouse's labour force status and earnings may impact on an individual's work choices. Both personal and interpersonal socio-demographic characteristics may remain static over the projection period, but some characteristics, such as education, marital status, dependants, health status, occupation or industry of employment, may vary with time. Changes in these and other temporary characteristics are associated with upward or downward earnings mobility. Becker (1962) first outlined a relationship between earnings and personal characteristics in his model of Human Capital, including education and experience specifically. His model also allowed for other measurable, observable factors as well as unobserved factors.

Employee labour force and earnings simulation modules used in microsimulation have as input variables a range of observable personal and interpersonal characteristics. Microsimulation models are developed frequently for projection, and thereby have features worthy of consideration for the modelling undertaken in this chapter. Appendix A2 summarises the main features of the earnings modules for a sample of microsimulation models, and lists the determinants used in the simulation of labour force and earnings events. These models generally approach the choice of dependent variable when modelling labour force state in three ways; first, by not explicitly modelling labour force transitions, but rather by considering time duration until employment or non-employment, or continuation of current labour state, through hazard functions or number of hours worked (e.g., PENSIM, PRISM); second, by first modelling employment status as a bivariate choice, and subsequently full-time or part-time employment conditional on being employed as a second bivariate choice (e.g., DYNACAN, SVERIGE, HARDING, DYNAMOD); and third by modelling labour force in one step as a multinomial choice between several states (e.g., full-time employed, part-time employed, unemployed, and not in the labour force) (e.g., CORSIM, SAGE, and APPSIM).

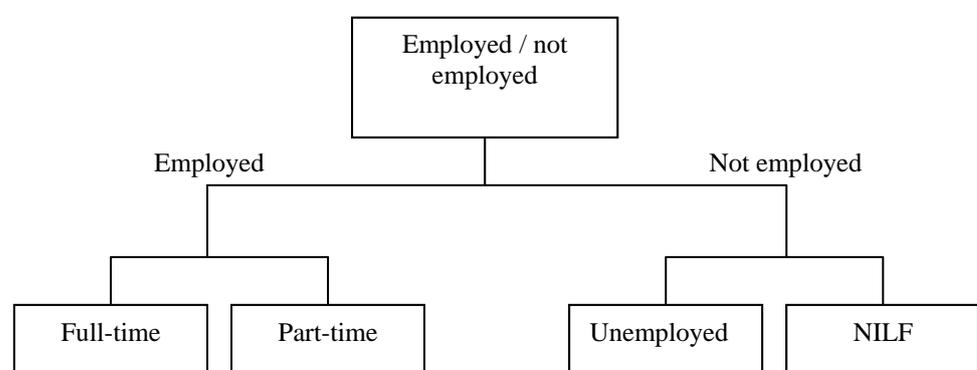
Labour force state was first modelled as discrete multinomial choices. An appropriate model in this context is the multinomial logit (see Greene, 2003). Consistent with SAGE and APPSIM, four states were considered; full-time

employed, part-time employed, unemployed and not in the labour force (NILF).¹¹³ Multinomial logistic models require the ‘independence of irrelevant alternatives’ (IIA) assumption to hold; if we consider two choices A and B, the presence of an additional choice, C, may change the relative odds between the two alternatives A and B. It is reasonable to suspect that for some, the odds of choosing between full-time employment or exiting the labour force will depend on the alternative choice of part-time employment, but the multinomial logistic assumes the odds ratios are independent. We can test for the validity of the IIA assumption by using the Hausman and McFadden test (Greene, 2003).¹¹⁴ As expected, the majority of the multinomial logistic models that were fit fail the IIA assumption.

An alternative is to decompose the modelling problem into nested bivariate logit models. This has the advantage of maintaining the IIA assumption within the groups, and thereby doesn’t suffer from the limitations of the multinomial logistic when applied to consumer choice (Greene, 2003). This is the process followed for modelling labour force state in this chapter.

Three bivariate logistic models are developed. The first determines whether an individual is employed or not employed. Conditional on being employed, the second model determines whether an employed individual works full-time or part-time. Conditional on the first choice being not employed, the third model determines whether the individual is unemployed or not in the labour force. The choices are summarised in Figure 4.11.

FIGURE 4.11 DIAGRAM OF LABOUR FORCE CHOICES MODELLED.



¹¹³ The function ‘multinom’ in the library ‘nnet’ in the R statistical package was used to fit the multinomial logistic regression models.

¹¹⁴ The function ‘hmfest’ in the library ‘mlogit’ in R was used to carry out the IIA tests.

We can motivate the logit model through random utilities. HILDA is panel data and information is incorporated for the same individual over multiple time periods denoted by t . For example, let the utility of choosing ‘employed’ be U_{it1} for individual i at time t and U_{it0} for ‘unemployed’. The choice k taken by individual i at time t is the one that gives highest utility. As the utilities are not observed, we assume they can be represented by a function of exogenous characteristics, \mathbf{x}_{it} , plus an unobservable error term v_{itk} :

$$U_{itk} = \boldsymbol{\beta}'_k \mathbf{x}_{it} + v_{itk}, \quad \text{for } k = 0, 1,$$

where $\boldsymbol{\beta}$ is a vector of unknown parameters. It can be shown that if the errors are assumed to follow a type I extreme value distribution (Greene, 2003), then, if Y_{it} is a random variable that indicates the choice made:

$$P(Y_{it} = k | \mathbf{x}_{it}) = \frac{\exp(\boldsymbol{\beta}'_k \mathbf{x}_{it})}{1 + \exp(\boldsymbol{\beta}'_k \mathbf{x}_{it})}, \quad \text{for } k = 0, 1.$$

Using the superscripts a , b , and c to denote the three bivariate logistic models:

$$P(Y_{it}^a = k | \mathbf{x}_{it}) = \frac{\exp(\boldsymbol{\beta}'_k \mathbf{x}_{it})}{1 + \exp(\boldsymbol{\beta}'_k \mathbf{x}_{it})}, \quad k = 0 \text{ (not employed), } 1 \text{ (employed)}, \quad (1a)$$

$$P(Y_{it}^b = k | \mathbf{x}_{it}, Y_{it}^a = 1) = \frac{\exp(\boldsymbol{\beta}'_k \mathbf{x}_{it})}{1 + \exp(\boldsymbol{\beta}'_k \mathbf{x}_{it})}, \quad k = 0 \text{ (part-time), } 1 \text{ (full-time)}, \quad (1b)$$

$$P(Y_{it}^c = k | \mathbf{x}_{it}, Y_{it}^a = 0) = \frac{\exp(\boldsymbol{\beta}'_k \mathbf{x}_{it})}{1 + \exp(\boldsymbol{\beta}'_k \mathbf{x}_{it})}, \quad k = 0 \text{ (NILF), } 1 \text{ (unemployed)}. \quad (1c)$$

These probabilities can be used to estimate the likelihood of participation within each of the four labour force states. Let π_{ij} be the probability that individual i is in state j at time t , conditional on a vector of exogenous characteristics, \mathbf{x}_{it} , such that

$$\pi_{ij} = P(L_{it} = j | \mathbf{x}_{it}), \text{ where } L_{it} \text{ indicates the state for individual } i \text{ at time } t.$$

The relationship between π_{ij} and the logistic models is given below:

$$\begin{aligned}\pi_{it1} &= P(L_{it} = full-time | \mathbf{x}_{it}) = P(Y_{it}^b = 1 | \mathbf{x}_{it}, Y_{it}^a = 1) P(Y_{it}^a = 1 | \mathbf{x}_{it}) \\ \pi_{it2} &= P(L_{it} = part-time | \mathbf{x}_{it}) = P(Y_{it}^b = 0 | \mathbf{x}_{it}, Y_{it}^a = 1) P(Y_{it}^a = 1 | \mathbf{x}_{it}) \\ \pi_{it3} &= P(L_{it} = unemployed | \mathbf{x}_{it}) = P(Y_{it}^c = 1 | \mathbf{x}_{it}, Y_{it}^a = 0) P(Y_{it}^a = 0 | \mathbf{x}_{it}) \\ \pi_{it4} &= P(L_{it} = NILF | \mathbf{x}_{it}) = P(Y_{it}^c = 0 | \mathbf{x}_{it}, Y_{it}^a = 0) P(Y_{it}^a = 0 | \mathbf{x}_{it})\end{aligned}\tag{2}$$

The choice of explanatory variables \mathbf{x}_{it} can be informed by the review of microsimulation models in Appendix A2. Determinants for labour force participation in all the models reviewed include age and sex, and the majority also use educational attainment. Other factors that have been commonly adopted are marital status¹¹⁵, age of youngest child, and lagged labour force state¹¹⁶. Motivation for including lagged labour force state comes from the recognition that ‘...the longer the time spent in a given state...the more the propensity to leave it decreases.’ (Courgeau and Lelievre, 1992: 43).

The explanatory variables chosen for all labour force models fitted in this chapter are age, education, marital status, and age of youngest child. Models are only developed for women, hence gender is omitted as a covariate. The variables, and their type and levels are listed in Table 4.3. Lagged labour state is also included in many of the models; this is discussed further in this section.

TABLE 4.3 VARIABLES FOR CONSIDERATION IN ALL LABOUR FORCE MODELS

Variable	Type	Levels
Age	Continuous	30 to 70
Marital status	Nominal (2 levels)	married/defacto (base), not married (includes separated, divorced, widowed, never married)
presence of child/age of youngest dependant child	Nominal (3 levels)	no dependant child (base), age 5 or under, age 6 and over
Education	Nominal (3 levels)	bachelor/postgrad degree (base), diploma/certificate, year 12 and below

Marital status and the presence of a child below primary school age may impact on the ability to enter into and continue employment, particularly for women. That

¹¹⁵ e.g., DYNASIM, CORSIM, DYNACAN, MOSART, DYNAMOD and APPSIM, among others

¹¹⁶ e.g., CORSIM, SAGE, LIFEPAHS, SVERIGE, MOSART, HARDING, DYNAMOD and APPSIM.

educational attainment is correlated with labour force participation and employment is well known (e.g., see Laplagne *et al.*, 2007). It is equally recognised that age and employment participation are related, though the relationship is typically nonlinear with a lower chance of employment for younger persons and for women of child-bearing age, and diminishing rates of participation for older persons approaching retirement. This nonlinearity is allowed for by including a cubic spline in age with 3 degrees of freedom. This is a flexible alternative to including linear, quadratic and cubic terms in a polynomial model involving age.

While other variables feature within the microsimulation and econometric literature (e.g., occupation, industry, disability, earnings, partner's earnings), these are omitted and assumed to be part of the error structure. Kalb and Scutella (2002) allow for possible selection into employment due to the prospect of higher wage rates (i.e., employment is more likely to be taken up if wage rates are higher, following standard economic theory). Haynes *et al.* (2005) includes partner's income as a covariate when modelling female employment state. As the primary purpose of modelling in this chapter is to assess the implications of dynamic versus static modelling on ICL estimates, rather than to develop the optimum model for projection, we have assumed that these variables are part of the error structure. However, more complete models for ICL forecasting should consider these and other covariates.

First, three logit models with exogenous variables, but no state dependencies, are fit. In terms of random utility the model can be expressed as:

$$U_{itk}^m = \beta_k^m \mathbf{x}_{it} + v_{itk}, \quad \text{for } m = a, b, c. \quad (\text{L.0a, L.0b, L.0c})$$

While one could allow the parameters to vary with time, the current motivation for fitting these models is projection rather than explanation of labour force structures and patterns, and consequently simple, constant parameters are appropriate.¹¹⁷ As the probability of labour force transitions is dependent on past states, dynamic models with state dependence are also fit. While the variables given in Table 4.3 for

¹¹⁷ An informal test of the appropriateness of constant rather than time-varying parameters was undertaken by fitting year as a factor in model L.0, and inspecting the coefficients. While some of the coefficients in year were statistically significant, the pattern of the values was random with no discernable trend that would suggest inclusion of year when projecting labour force state.

\mathbf{x}_{it} are included in all of the labour force models developed, unique covariates are also incorporated for those models that include past labour force state. Rather than including lagged dependent variables in \mathbf{x}_{it} , they are specified separately:

$$U_{it}^a = \boldsymbol{\beta}_k^{t^a} \mathbf{x}_{it} + \sum_{l=1}^2 \gamma_{kl}^a y_{i,t-l} + \sum_{l=3}^5 \lambda_{kl}^a E_{i,t-l} + v_{itk}, \quad (\text{L.1a-L.5a})$$

$$U_{it}^b = \boldsymbol{\beta}_k^{t^b} \mathbf{x}_{it} + \sum_{l=1}^2 \gamma_{kl}^b y_{i,t-l} + \sum_{l=3}^5 \lambda_{kl}^b F_{i,t-l} + v_{itk}, \quad (\text{L.1b-L.5b})$$

$$U_{it}^c = \boldsymbol{\beta}_k^{t^c} \mathbf{x}_{it} + \sum_{l=1}^2 \gamma_{kl}^c y_{i,t-l} + \sum_{l=3}^5 \lambda_{kl}^c UN_{i,t-l} + v_{itk}, \quad (\text{L.1c-L.5c})$$

where, L.1 denotes the model with one lag ($l = 1$), L.2 denotes the model with two lags ($l = 1$ and 2), and so on.¹¹⁸ Here, y_{it} is labour force state with four levels for individual i at time t , γ_{kl} and λ_{kl} are coefficients for the lagged terms, and E_{it} , F_{it} and UN_{it} are lagged indicator variables such that:

$$E_{i,t-l} = \begin{cases} 1 & \text{if employed at } t-l, \\ 0 & \text{if not employed at } t-l. \end{cases}$$

$$F_{i,t-l} = \begin{cases} 1 & \text{if full-time at } t-l, \\ 0 & \text{if part-time at } t-l. \end{cases}$$

$$UN_{i,t-l} = \begin{cases} 1 & \text{if unemployed at } t-l, \\ 0 & \text{if not in labour force at } t-l. \end{cases}$$

During the model fitting process, the lagged term $y_{i,t-l}$ with four levels was considered for each of the lags from 1 to 5. This was compared with the indicator $E_{i,t-l}$ for the first logistic model (a), $F_{i,t-l}$ for the second model (b), and $UN_{i,t-l}$ for the third model (c). AIC was used to select between models, and it was found that $y_{i,t-l}$ produced a superior fit for $l = 1$ and 2 for all models, while for subsequent lags (3 to 5), the indicator variables resulted in superior fits.

¹¹⁸ For ease of exposition, reference to model L.x for x=0 to 5 assumes reference to each of the corresponding sub-models L.x(a), L.x(b) and L.x(c).

It is assumed for all models that v_{it} is iid with no serial correlation, namely, $E(v_{it} | \mathbf{x}_{i1}, \dots, \mathbf{x}_{iT}) = 0$, implying that \mathbf{x}_{it} is exogenous. While the lagged dependent variables $y_{i,t-l}$ and the lagged indicator variables are correlated with lagged v_{it} , we assume that there is no serial correlation in v_{it} , and hence there is no correlation between lagged covariates and contemporaneous v_{it} . Hence, estimation of the parameters for models L.0 and L.1-L.5 can be achieved through MLE.¹¹⁹ Models L.0 and L.1-L.5 can be considered pooled logistic multinomial models, as they don't explicitly allow for unobserved heterogeneity among individuals.

Model L.0 was fit to all waves of HILDA data. Models L.1-L.5 were fit to Waves 2 to 7. As individuals appear in multiple waves of HILDA they are represented multiple times in the models. Models L.0b-L.5b and L.0c-L.5c were restricted to employed and not employed individuals respectively.

Results of fitted models are presented in the remainder of this section. For comparison, models were produced both including and excluding two-way interactions between covariates. For the models with interactions, the explanatory variables listed above and all possible two-way interactions were considered for models L.0, L.1 and L.2. For models L.3, L.4 and L.5, two-way interactions between the lagged indicators E , F and UN and the other covariates were excluded. Model selection in each case was performed by comparing AIC for nested models.

As an example of the fitted models, the coefficients and standard errors for the models L.2a, L.2b and L.2c (without interactions) are given in Table 4.4.¹²⁰ Three coefficients for age are output, one for each of the terms in the natural spline. Those coefficients significant at the 10%, 5% and 1% level have been identified in the table.

¹¹⁹ The function 'glm' with the binomial family (and link=logit) in R was used to fit the logistic regression models.

¹²⁰ Values for the other fitted models are omitted in the interest of space, but can be provided on request.

TABLE 4.4 MODEL L.2: REGRESSION COEFFICIENTS AND STANDARD ERRORS

Independent variables	Model	L.2a	L.2b	L.2c
Intercept		2.849*** (0.116)	2.741*** (0.122)	-1.686*** (0.250)
Age (df=1)		0.310** (0.124)	0.307** (0.137)	-0.848*** (0.328)
Age (df=2)		-0.096 (0.223)	-1.114*** (0.261)	-2.152*** (0.606)
Age (df=3)		-1.430*** (0.132)	-1.454*** (0.200)	-3.252*** (0.515)
Education (diploma/certificate)		-0.123 (0.075)	-0.145** (0.073)	0.047 (0.173)
Education (year 12 or below)		-0.362*** (0.067)	-0.260*** (0.067)	-0.258 (0.161)
Marital status (not married)		0.003 (0.060)	0.343*** (0.065)	0.787*** (0.121)
Child (youngest dependent child aged 0 to 5)		0.669*** (0.093)	-0.422*** (0.102)	-0.086 (0.200)
Child (youngest dependent child aged 6+)		0.540*** (0.071)	-0.101 (0.070)	0.520*** (0.148)
Labour state at t-1 (PT)		-0.503*** (0.092)	-2.761*** (0.065)	-0.387 (0.237)
Labour state at t-1 (unemployed)		-2.214*** (0.134)	-1.690*** (0.168)	0.853*** (0.256)
Labour state at t-1 (NILF)		-3.446*** (0.092)	-2.648*** (0.115)	-1.218*** (0.234)
Labour state at t-2 (PT)		-0.322*** (0.088)	-1.570*** (0.066)	-0.096 (0.225)
Labour state at t-2 (unemployed)		-1.251*** (0.143)	-1.184*** (0.169)	1.122*** (0.260)
Labour state at t-2 (NILF)		-1.839*** (0.088)	-1.600*** (0.104)	-0.445** (0.224)

*** Significant at the 1% level; ** Significant at the 5% level; * Significant at the 10% level.

In all three sub-models of L.2 (a, b and c), previous labour state is a critical determinant of current labour state. While not presented here, in model L.0a the presence of a dependent child under the age of six is associated with a reduction in the probability of employment. This is expected, given the time demands of caring for a child prior to regular schooling. In contrast, for models of employment that include lagged labour state (including L.2a) the coefficient for a child under the age of six is positive and significant. This phenomenon can be explained by noting that when interactions between the ‘child’ variable and lagged labour state are included, the coefficient for a child under the age of six is no longer significant, but the coefficient for the interaction between ‘child under six’ and lagged ‘out of the labour force’ state is positive and highly significant. This suggests that women out of the labour force at *t*-1 with young children have a higher likelihood of being employed

at t than women out of the labour force at $t-1$ without young children.¹²¹ Model L.2b shows that the presence of a young dependant increases the probability of part-time employment relative to full-time. In addition, those who are unmarried with higher education have a greater likelihood of full-time employment relative to part-time.

The impact of the model fits on transition probabilities can be best understood graphically. A selection of fitted probabilities for model L.2 without interactions is given in Figure 4.12. These show that the persistence of a labour state for two periods (t and $t-1$) has a marked impact on the likelihood of continuation (to period $t+1$). While not included here, the figure based on model L.2 *with* interactions is very similar; the most notable difference being an increased likelihood of being out of the labour force for ages 30 to 40, with a commensurately lower chance of employment.

Model L.2 is used to illustrate the effect of other covariates on transition probabilities. This is brought out in Figure 4.13, where the fitted probabilities of being in various states at time $t+1$ are displayed for individuals not in the labour force at time t . The top left plot in the figure shows transitions for a woman who had been in full-time employment prior to leaving the labour force. Her marital status is single, with no children, and she has higher education. The plot shows that her chance of returning to employment is high relative to remaining out of the labour force at younger ages, though as expected, this slopes downwards for older women, with a commensurate increase in the probability of remaining out of the labour force with increased age. For a married woman with a young child (the plot at the top right of Figure 4.13), as expected the chance of remaining out of the workforce is higher and full-time employment lower. In the bottom left the same plot is given, however, the employment state at $t-1$ is part-time rather than full-time. In this instance, the chance of undertaking full-time work at time $t+1$ is close to zero. Finally, the bottom right plot in the figure shows the critical difference that a longer period out of the labour force can have on transition probabilities.

¹²¹ This is understandable; many women with young children intentionally take time out of the labour force temporarily with the view of returning to work, the cost pressures of raising children act as incentive to return, and the availability of child care services make a return to work possible while the child is young.

FIGURE 4.12 FEMALES, MARRIED/DEFACTO, YEAR 12 OR BELOW EDUCATION, WITHOUT YOUNG CHILDREN. PROBABILITY OF BEING IN VARIOUS STATES UNDER MODEL L.2 (WITHOUT INTERACTIONS) AT TIME T+1 GIVEN FULL-TIME AND PART-TIME EMPLOYED AT STATES T AND T-1.

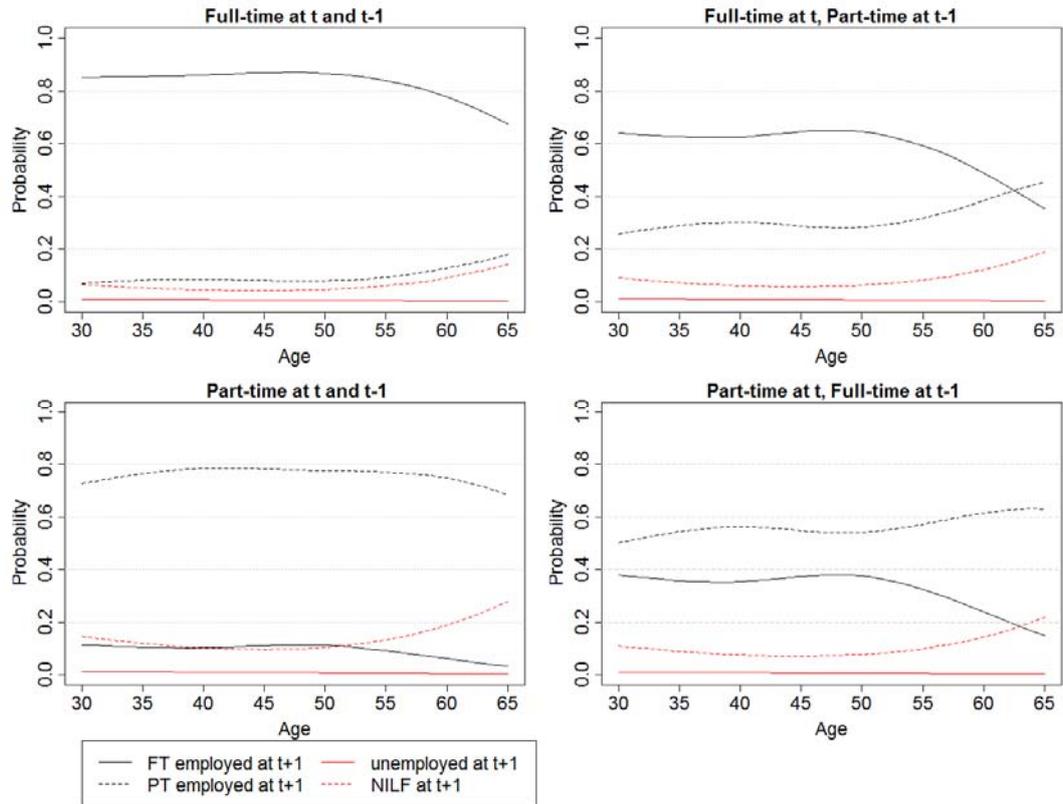
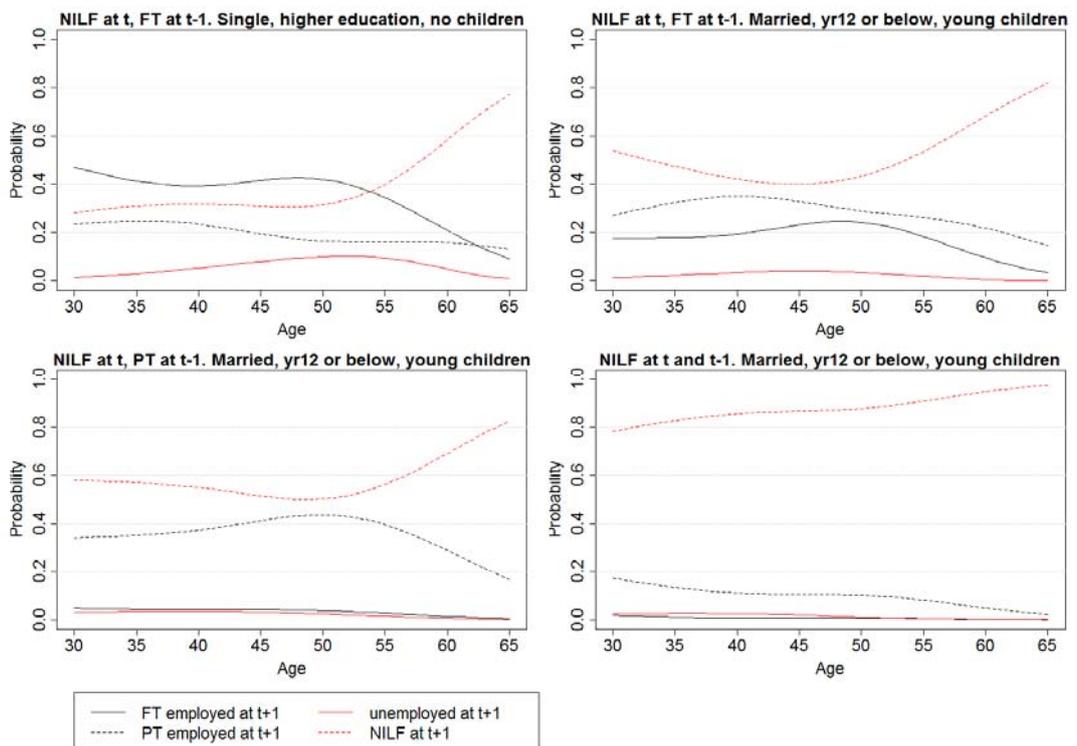


FIGURE 4.13 MODEL L.2 (WITH INTERACTIONS). FEMALES. PROBABILITY OF BEING IN VARIOUS STATES AT TIME T+1 CONDITIONAL ON NILF AT TIME T.



The actual transition probabilities were compared with the fitted probabilities from the fitted models. A subset of HILDA data was extracted according to age range, labour force state at Wave 1 (time $t = 1$), and other characteristics. Models L.0, L.1 and L.5 were used to calculate labour force state for $t = 2, 3, 4, 5, 6$ and 7 based on individual characteristics.

When calculating labour force state using models L.5, instead of imposing subjective initial conditions pertaining to previous labour force states, the models were only applied to those years where the lagged dependent variables were present. For example, model L.5 requires labour force states from $t-1$ to $t-5$, and hence was only used in the calculation of labour state for times 6 and 7 , while models L.1 to L.4 were used for previous states. Actual versus fitted model probabilities for females, aged 30-49 who were part-time at time $t=1$, are given in Table 4.5. The values are the probabilities of being within each state in each future year.

As expected, the model with most fitted lags leads to the best fit. Models based on fewer lags underestimate the persistence of part-time employment and over-estimate transitions out of the labour force. The results for females, aged 30-49, who are either full-time or part-time at year 1 are also presented graphically in Figure 4.14, along with actual probabilities of being in each state.

It is clear from Figure 4.14 that the model with a single lag results in a poor fit, while the model with two lags improves the fit considerably, and further improvements are seen when additional lags are included. Of most importance from this modelling exercise is recognition of the substantial variation in fitted probabilities from inclusion of additional lagged dependent variables. This illustrates the potential bias due to omitted variables, and raises questions about the accuracy of labour force state modules in many of the large dynamic microsimulation models which treat labour force state as a simple Markov chain.¹²²

¹²² Swan recognises this, suggesting that one way to fix the deficiencies in DYNACAN might be to incorporate more than one year of past participation into the model (Swan,1997:10).

TABLE 4.5 FEMALES, AGES 30-49, PART-TIME EMPLOYED AT TIME T=1. LABOUR FORCE DISTRIBUTION IN SUBSEQUENT YEARS. ACTUAL AND FITTED STATES FOR MODELS L.0-L.5 (WITH INTERACTIONS).

ACTUAL DISTRIBUTION.

Year	Full-time	Part-time	Unemployed	Not in the labour force
2	14.2	76.4	1.7	7.7
3	18.2	65.3	1.4	15.1
4	23.0	62.8	2.6	11.6
5	23.0	64.5	2.3	10.2
6	30.4	58.2	1.4	9.9
7	30.7	56.2	1.7	11.4

DISTRIBUTION BASED ON MODEL L.0

Year	Full-time	Part-time	Unemployed	Not in the labour force
2	27.6	38.4	3.4	29.8
3	29.1	37.8	3.4	29.5
4	30.7	38.1	3.1	27.6
5	31.0	38.4	3.4	27.3
6	32.4	38.2	2.8	26.4
7	32.7	37.8	2.8	26.4

DISTRIBUTION BASED ON MODEL L.1: ONE LAG

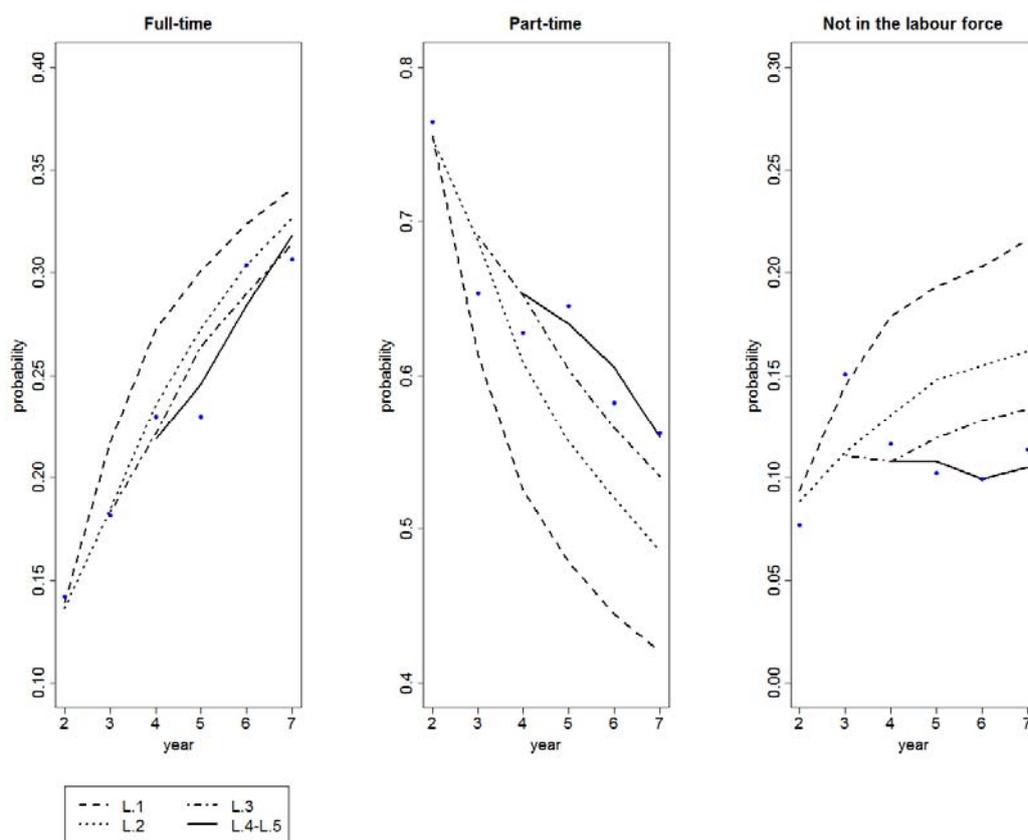
Year	Full-time	Part-time	Unemployed	Not in the labour force
2	13.4	75.9	1.7	8.7
3	21.7	61.4	2.0	14.5
4	27.3	52.6	2.3	17.9
5	30.1	47.9	2.6	19.3
6	32.4	44.5	2.6	20.3
7	34.1	42.0	2.6	21.6

DISTRIBUTION BASED ON MODELS L.1-L.5: ONE TO FIVE LAGS

Year	Full-time	Part-time	Unemployed	Not in the labour force
2	13.4	75.9	1.7	8.7
3	18.2	68.2	1.7	11.1
4	21.9	65.3	1.7	10.8
5	24.6	63.4	1.4	10.8
6	28.4	60.5	1.1	9.9
7	31.8	56.0	1.4	10.5

Notes: Model L.x was used to predict the year x+1 distribution

FIGURE 4.14 FEMALES, AGED 30-49, MEDIAN PROBABILITY ESTIMATES BASED ON MODEL L.1 TO L.5 (WITH INTERACTIONS). POINTS ARE ACTUAL PROBABILITIES.



To assess the impact of the alternative labour force state models on ICL predictions, a basic ICL model is developed following the approach of Section 4.3.3, and debt and repayments are calculated assuming debtors follow the labour force transitions predicted by the models developed in this section. The results of these simulations are presented in Section 4.8.

The models above have incorporated dependence among individuals via lagged labour force state. An interpretation is that the act of being in a particular current state alters the individual's preferences and constraints for being in a particular future state. This is known as true state dependence in the dynamic panel literature (Hsiao, 2003). An alternative interpretation, known as spurious state dependence, is that the individual's preferences and constraints are not influenced by the experience of being in a particular state, but rather unobserved individual effects are responsible for apparent labour force state persistence over time. An approach to modelling labour force state that allows for unobserved heterogeneity among individuals across

multiple waves includes decomposing the error into random or fixed effects, such that:

$$U_{itk} = \beta'_k \mathbf{x}_{it} + \sum_{l=1}^{t-1} \gamma_{lk} y_{i,t-l} + \alpha_i + v_{itk}.$$

This follows the approach of Haynes *et al.* (2005) and Laplagne *et al.* (2007) who consider a multinomial logit model with random effects applied to HILDA labour force data, however, both exclude lagged labour force state as a dependent variable.¹²³ Additionally, while the motivation of the models of Haynes *et al.* is for decomposition of historic labour force participation patterns, the motivation in the current chapter is prediction, which is impractical with random effects. Treating α_i as fixed effects overcomes this problem, however, the lagged labour force states $y_{i,t-l}$ will be correlated by construction with α_i . This implies endogeneity, which invalidates the use of simple maximum likelihood procedures.¹²⁴ Additionally, by including fixed effects, the available degrees of freedom for each individual is limited to the number of waves available; this drops further when multiple lagged labour force states are included.

Inclusion of lagged labour force state may proxy for unobserved individual effects, and consequently estimates may change very little when random or fixed effects are explicitly included in a model. However, reporting on Heckman's analysis of female employment through the PSID in the early 1980s, Hsiao notes that including lagged employment status as a proxy for heterogeneity leads to poor estimates. He concludes, 'Improper control for heterogeneity can lead to erroneous parameter estimates and dramatically overstate the effect of past experience on current choices.' (Hsiao, 2003: 220). While this may be the case when one lag is included, it is possible that the inclusion of multiple lags in models L.2 to L.5 may serve as a

¹²³ In addition, while Laplagne *et al.* (2007) find evidence of unobserved heterogeneity supporting the random effects multinomial logit model, they note similar predictive power for the random effects and standard multinomial logistic.

¹²⁴ In order to obtain the marginal distribution of the response the effects must be integrated out, yet the inclusion of multiple time periods in the analysis results in multi-dimensional integrals. A variety of numerical techniques exist to deal with these circumstances, including Gauss-Hermite quadrature and Adaptive Gaussian Quadrature (AGQ). An alternative technique applied to HILDA data simulates maximum likelihood by taking random draws using a Halton sequence (e.g., Buddelmeyer *et al.*, 2008). A flexible approach to parameter estimation that has been applied in the context of modelling employment status with random effects is Markov chain Monte Carlo simulation (MCMC) (e.g., see Haynes *et al.*, 2005).

superior proxy to the unobserved individual effects than the single lag model. If so, random or fixed effects will be greater for the models with fewer lags, and smaller for the models with more lags. Exploration of this possibility is limited by the low number of waves of HILDA currently available, and in light of the satisfactory fits provided through L.2-L.5, fitting of fixed effects labour force models is not taken up in this thesis.

A limitation in generating labour force transition rates from limited data is that the data will reflect the specific economic circumstances of that period (e.g., rapid economic growth, recession, etc.), and projections based on this information will presume a continuation of these economic conditions. This observation is a key reason why many microsimulation models align their simulations with exogenous aggregates. The APPSIM labour force model is being developed using HILDA data, which, as noted by Keegan, ‘...capture continuous healthy economic conditions with declining unemployment’ (2007:35), and consequently will be aligned with exogenous projections. While future projections must allow for expected trends in participation rates, the labour force model developed above does not do this. The key point is that an ideal model of labour force participation should not be generated exclusively from past data, but transitions between states should also reflect future expectations.

In Section 4.8.2 the models developed above are used to simulate labour force state and the implications to ICL projections of the different models are explored. In Sections 4.6 and 4.7 models of hourly wage and hours worked are developed, so that variation in earnings within each labour force state can be realistically captured. Prior to developing models of hourly wage, the next section proceeds with a review of the empirical evidence and development of earnings models in the literature is first presented.

4.5 Modelling earnings – empirical evidence and theoretical considerations

4.5.1 Components of earnings variability

While in some datasets factors that may help explain earnings variation (such as occupation, industry, and length of paid employment) are observed, most panel data is deficient in this respect. Empirical studies have shown that observed characteristics explain a relatively small proportion of variability in earnings (e.g., see Swan, 1997). Unobserved differences can arise due to temporary variation, through illness, higher duties, bonuses, and overtime, or due to permanent differences, like intellectual ability, drive and determination. In addition, permanent unobserved shocks to earnings may arise due to job mobility and promotions or demotions (e.g., see Meghir and Pistaferri, 2004), and other incidents not accommodated by observed transitions in labour force or life states. Together, the temporary and permanent differences would manifest as unexplained differences in earnings between individuals. Temporary differences and permanent shocks may also account for unexplained changes in earnings over time for the same individuals. The identification of multiple levels of earnings variability, some temporary and others permanent, is critical when choosing an appropriate model structure. The complexity in modelling earnings is increased further by noting that changes over time are also affected by productivity growth (i.e., real wage inflation) which will shape the rate of earnings, and business cycles, which may influence the number of hours worked.

Swan's discussion of the development of DYNACAN, a microsimulation model developed by the Canadian Government to project future liabilities of Canada's public retirement incomes program, provides an introduction to the problems encountered when developing earnings models. In DYNACAN annual earnings is modelled as the product of earnings per week and number of weeks worked per year. Each of these components is modelled as a function of various socio-demographic variables in addition to labour force status in the previous year and current year (which is itself predicted based on a separate model) and similar factors (Swan, 1997). Normally distributed error terms were added to both weeks worked and earnings per week, and although this captured the variation between individuals, it

overestimated the year-to-year variation in income. A possible solution, and that first adopted by the developers of DYNACAN, was to use multiple error terms for weekly earnings. The first error term was permitted to vary among individuals, but was kept constant over time, thereby representing the permanent differences between individuals not captured by the observable characteristics. The second error term was permitted to vary among individuals and also over time, representing temporary variation (Swan, 1997). Although this model was an improvement over earlier versions, it failed to account fully for the variation observed empirically in lifetime work patterns. As will be seen in the literature review below, more complex error structures have been applied by researchers to attempt to capture the observed variability in earnings.

Summarising, one must attempt to construct a model whereby three levels of variability are accommodated:

- earnings variability between individuals in a given year;
- variability in an individual's earnings over time;
- variability in lifetime employment earnings.

The first level, namely the variability in earnings between individuals at a point in time, and the second level, the variability over time for the same individual, must be consistent with empirical findings after controlling for systematic observed differences. If this goal is achieved and the model is appropriately constructed, the variability in lifetime earnings patterns between individuals should also be consistent with empirical findings. The multiple layers of variability lend themselves to modelling through variance component models. After controlling for observed differences, one error term may represent the influence on earnings of unobserved factors which vary among individuals and which permanently affect the individual's ability to earn (e.g., intellectual ability, drive, determination, occupation). Another error term may represent the influence of circumstances that vary among individuals, but are temporary in their effects (e.g., illness, overtime, higher duties). Additionally, the ideal model should allow for permanent shocks to earnings (e.g., due to unobserved promotions or job mobility).

4.5.2 Variance component models of earnings

Given the logical decomposition of unobserved earnings into permanent and transitory components, a coherent stochastic model structure is one which allows for variance components. Variance component models applied to dynamic earnings have been used by econometricians over the past 30 years, and have grown in complexity as panel data has expanded in duration. The complexity of the error structure dictates the complexity of the model.

Broadly, there are two types of models for earnings dynamics that have been favoured by researchers in the field. The first, which can be referred to as ‘profile heterogeneity’ assumes that individuals follow person-specific earnings profiles such that their initial earnings and growth rates vary in a systematic way across individuals. This assumption is consistent with economic theory; for example, heterogeneity exists in human capital investments across similar individuals (Becker, 1962). The second model assumes that serial dependency is a consequence of a random walk for earnings (i.e., earnings has a unit root) rather than persistent profile heterogeneity. Empirical support exists for both processes, however Baker (1997) tests the two processes against long duration longitudinal earnings data and concludes that there is greater evidence for profile heterogeneity. More recently Alvarez *et al.* (2002) have argued that both processes should be accommodated in earnings models.

Regardless of the dynamic process, there are other important considerations in earnings model development including the structure of the permanent and transitory error components.¹²⁵ For the remainder of this section a brief overview of the literature on earnings model development is provided, starting with Lillard and Willis’ (1978) application of a random effect model to working male earnings from the Panel Study for Income Dynamics in the late 1970s.¹²⁶ Lillard and Willis were among the first to recognise the need to model earnings dynamically, stating, ‘... most human capital earnings functions are incapable of describing the life cycle

¹²⁵ The decision to adopt the profile heterogeneity approach and allow earnings to follow a stationary process, or instead assume a unit root process, will affect the parametric form for the earnings model and the structure for the permanent and transitory error components.

¹²⁶ The Panel Study on Income Dynamics (PSID) is a longitudinal survey of the civilian non-institutional US population since 1967/68.

dynamics of the earnings distribution; they simply describe the average growth path of earnings for the representative individual.’ (1978:986)

They apply a standard earnings function consisting of observed variables such as education, length of work experience, and gender (represented by \mathbf{x}_{it} in the model below). Unobserved variables are represented by a random component that captures heterogeneity in permanent differences between individuals (u_i), and a stochastic error component (v_{it}):

$$y_{it} = \mathbf{x}_{it}\boldsymbol{\beta} + \Gamma_t + u_i + v_{it}, \quad i = 1, \dots, N; t = 1, \dots, T,$$

where y_{it} is the natural logarithm of real earnings of the i^{th} person in the t^{th} year. In addition to the permanent component which captures persistent heterogeneity, they allow for serial correlation in the transitory component through an AR(1) process plus a white noise error:

$$v_{it} = \rho v_{i,t-1} + \varepsilon_{it}.$$

The parameter ρ is a serial correlation coefficient common to all persons, which can be interpreted as reflecting either the effects of mean-reverting random shocks, or serially correlated unobserved individual-specific variables. Lillard and Willis (1979) apply this model to American scientist earnings, supporting the profile heterogeneity approach to modelling earnings dynamics.

MaCurdy (1982) experiments with alternative model structures to PSID data and concludes that an ARMA(1,2) or ARMA(2,1) process are more appropriate than an AR process for the transitory error component. He allows for persistency in earnings through a unit root, modelling the first difference of the natural log of earnings against covariates. For example, starting with the model proposed by Lillard and Willis (1978), lagged log earnings can be written:

$$y_{i,t-1} = \mathbf{x}_{i,t-1}\boldsymbol{\beta} + \Gamma_{t-1} + u_i + v_{i,t-1}.$$

Taking first differences:

$$\Delta y_{it} = \Delta \mathbf{x}_{it} \boldsymbol{\beta} + \Delta \Gamma_t + \Delta v_{it}.$$

MaCurdy argues that taking first differences simplifies the task of distinguishing between potential error specifications (by removing non-stationarity), and also eliminates the permanent (fixed) effect, u_i , removing the need to impose assumptions about the stochastic properties at this initial estimation stage. Once a process is estimated for the transitory error component, the first differencing can be ‘undone’ and a permanent error estimated.

The basic variance component structures adopted for earnings have been applied since the late 1970s and early 1980s, albeit in later years with more complexity. Moffitt and Gottschalk (2002) decompose PSID male annual earnings from 1969 to 1996 into permanent and transitory components. They isolate permanent variance by noting that this is equal to the total earnings variance in the event that transitory errors are uncorrelated, which is a reasonable assumption for pairs of ages sufficiently far apart¹²⁷ (Moffitt and Gottschalk, 2002: C69). In their preliminary analysis Moffitt and Gottschalk assumed, as was done by Lillard and Willis (1978) and MaCurdy (1982), that the permanent component is constant over time for individuals. They subsequently relaxed this assumption and fit a dynamic earnings model where the permanent component (u_{ia}) followed a random walk and varied with age a , and the transitory error (v_{it}) was modelled as an ARMA(1,1) process. As their research motivation was to explore how permanent and transitory effects have changed, they allowed the parameters to vary over time. They found that permanent and transitory components were roughly equally responsible for variance in earnings, though there had been fluctuations over time, with transitory income rising and then falling over the period considered, and permanent income rising steadily throughout.

By modelling the unobserved permanent component as a random walk, Moffitt and Gottschalk essentially combined the assumption of profile heterogeneity with that of

¹²⁷ Moffitt and Gottschalk use a five year lag and subsequently show, using a dynamic earnings model, that this period is sufficient.

a unit-root process for earnings. An initial permanent differential between individuals is considered at the start of their working life, due to unobservable factors such as intellectual ability, drive and ambition, and skill set. This captures variation between like individuals at the start of their working life and is akin to profile heterogeneity. By imposing a unit-root process on the permanent unobserved component the initial profile heterogeneity is maintained, while allowing for future variation due to permanent shocks.

Dickens (2000) and Ramos (2003) broadly follow the approach of Moffitt and Gottshalk (2002) to model earnings data from Great Britain with the intention of exploring the changing patterns of permanent and transitory earnings. Dickens' preferred fit includes a permanent component modelled as a random walk in age and a transitory component (v_{it}) modelled as an ARMA(1,2) process. Neither of the components exhibited stationarity through the sample period, so parameters were permitted to vary with year. Ramos used a random walk with a random growth term for the permanent component and an AR(1) process for the transitory error. Like Dickens, Ramos allowed for non-stationarity in time by using permanent and transitory time-specific factors, and also allowed for variation in life-cycle by applying cohort-specific factors to the error terms. Baker and Solon (2003) applied a dynamic earnings model to Canadian data from 1976 to 1992 and allowed for nonstationarity. They include a random walk for the permanent component, and model the transitory error as an AR(1) process.

The assumptions surrounding persistency of earnings shocks have been found to be significant in explaining empirical patterns of earnings. For example, Guvenen (2007 and 2009) compared what he called the Restricted Income Profiles process (where individuals are subject to very persistent income shocks) with the Heterogeneous Income Profiles process (where individuals are subject to shocks with modest persistence and individual-specific profiles), and showed the importance for allowing for profile heterogeneity when estimating income persistence.

The research discussed above assumed that random shocks are normally and identically distributed. Recent empirical research has suggested that error terms are non-normal, and modern statistical methods have allowed application of more

sophisticated stochastic processes. Geweke and Keane (2000) developed a dynamic earnings model using non-Gaussian shocks applied to the PSID from 1968-1989.¹²⁸ While the functional form of their model differed from that of Lillard and Willis (1978), they included a broadly similar error structure, consisting of a permanent error component and a transitory effect that is modelled by an AR process which includes an independent random term (η_{it}), where η_{it} and certain other components were modelled as mixtures of three normal distributions. Geweke and Keane (2000) showed that their model produced a far superior fit to one assuming normally distributed transient errors. Notably, with regards to mobility, the mixture model predicted fewer periods spent in lower income quintiles (but greater persistence for those entering the low income state) for both non-graduates and university graduates than for the normal model. Hirano (1998, 2002) used a similar approach to Geweke and Keane, relaxing the assumption of normality. He assumed a Dirichlet process prior, which enables an infinite normal mixture model, and used Bayesian methods to estimate the parameters. Others who have assumed non-normality include Ulrick (2000), who used an instrumental variable approach to fit a model based on non-parametric transitory and permanent components. Ulrick found that assuming normality tended to overestimate the likelihood of upwards mobility.

Chamberlain and Hirano (1999) proposed a variance components model similar to that of Lillard and Willis and others, but treated the variance of the transitory error as a gamma distributed random variable, in contrast to the constant variance of most models.¹²⁹ More recently, Meghir and Pistaferri (2004) fitted a variance components model to PSID for 1967 to 1992, also abandoning the assumption of iid income shocks. They allowed for heteroscedasticity in the variance of earnings associated with the transitory and permanent components of error through ARCH models, and provided evidence of heterogeneity in earnings variances across individuals.

¹²⁸ Geweke and Keane (2000) model earnings and marital status jointly (using a probit equation) as they note from previous studies that marital status has a large positive partial correlation with earnings. To fit the model they used Bayesian inference via Gibbs sampling. An advantage of a Bayesian approach is that it allows one to form posterior distributions for earnings given particular individual conditions which allow for parameter uncertainty (rather than being based on classical point estimates). As noted by Geweke and Keane (2000), in the context of dynamic earnings with various unmeasurable effects, allowing for parameter uncertainty is an important advantage of Bayesian inference.

¹²⁹ The authors devise optimal ways to combine individuals' specific earnings information with longitudinal data on earnings histories from a survey of individuals in order to provide a conditional distribution for the individual's future earnings.

Finally, returning to the matter of profile heterogeneity versus unit roots, Alvarez *et al.* (2002) allowed for both, arguing that a realistic model should permit stationary processes for some individuals and unit root processes for others. They modelled the residuals for an earnings model applied to Danish panel data as an ARMA(1,1) process, but rather than applying a heteroscedastic variance structure to deal with heterogeneous variability among individuals, they allowed both the AR and MA parameters to vary for individuals.¹³⁰ Their key finding was that there is more heterogeneity (between and within groups) than is typically allowed for in dynamic earnings models. One important finding was an apparent positive relationship between starting income and the size of short-run variance. Importantly, when they fit a similar model allowing for heterogeneity to PSID a completely different process to that of the Danish data fits best, suggesting that ‘one size fits all’ does not apply when it comes to dynamic earnings models. An implication is that it is important to allow the data to inform decisions regarding how to model the error structure, rather than imposing a particular structure prior to analysis without regard to the data.

A summary of a selection of key papers in the earnings modelling literature is given in Table 4.6.

¹³⁰ Hu and Ng (2004) supported this view, arguing that the AR coefficient for the transitory component of error varies across individuals. They showed that imposing homogeneity on the AR coefficients caused upward bias in the estimates of the transitory error term and downward bias in the persistent error term.

TABLE 4.6 A SUMMARY OF KEY DYNAMIC EARNINGS VARIANCE COMPONENTS MODELS

Authors	Population	Explanatory (control) variables	Permanent component	Transitory component
Lillard and Willis (1978)	PSID 1967-1973. heads of households aged 18-58.	Race, education, labour force experience/job status, marital status, geography, unemployment rate, union membership.	Random normal variable	AR(1)
MaCurdy (1982)	PSID 1967-1976. married, heads of households aged 25-46.	Education, age, year	Random normal variable	ARMA(1,2) or ARMA(2,1)
Chamberlain and Hirano (1999)	PSID 1967-1991. heads of households aged 24-33.	Education, race	Random normal variable	AR(1) with gamma distributed variance
Geweke and Keane (2000)	PSID 1968-1989. heads of household aged 25-65.	Lagged earnings, education, age, race, parent's education, marital status	Random normal variable plus first period transitory shock, part of which can be permanent	AR(1) with mixture of three normals (belong to a 7-parameter family)
Ulrick (2000)	PSID 1968-1989. heads of households aged 25-65.	Lagged earnings, education, age, race, parent's education, marital status	Non-parametric random variable	AR(1) following non-parametric distribution
Dickens (2000)	Great Britain New Earnings Survey, 1975-1995. full-time, aged 22-59.	Occupation, age, year	Random walk	ARMA(1,2)
Moffitt and Gottschalk (2002)	PSID 1969-1996. heads of households aged 20-59.	None (an earlier working paper (1998) considered age and education)	Random walk	ARMA(1,1)
Alvarez, Browning, Ejrnaes (2002)	Danish skilled blue collar. 1981-1996. Aged 30-39 in 1981	Age, experience, Education, birth cohort	Total error is ARMA(1,1) with parameters that vary by individual (ie. heterogeneity in both the AR and MA parameters)	
Baker and Solon (2003)	Canadian income tax records 1976-1992. aged 24-59	Age, year, birth cohort	Random walk in cohort, and year	AR(1), with year-specific factor loadings on the white noise innovation
Ramos (2003)	British Household Panel Study, 1991-1999 full-time.	Age, education, experience, year, occupation, industry, region, marital status, union coverage	Random walk in age and year	AR(1) (also considers ARMA(1,1)
Meghir and Pistaferri (2004)	PSID 1967-1992. heads of households aged 25-55.	Education level, year, age, race, region of residence.	Random walk, ARCH(1) for error variance (heterogeneous errors)	MA(1) with ARCH(1) for error variance

Notes: In the majority of these cases a two step process was followed, where regression was first conducted on a series of covariates and the residuals were modelled as a second stage. In all cases only employed male workers (with positive earnings) were considered in the modelling.

Despite the variety of models used, there has been general acceptance throughout the literature that the error term should be separated into transitory and permanent components. There is debate on the appropriate process for each component, including the choice of conditional mean and variance. In summary, the following questions must be addressed when developing dynamic earnings models:

- Should one assume profile heterogeneity, unit root processes, or incorporate both for the earnings process?
- What process should be adopted for the permanent error component? This will differ depending on the process selected in step 1. Alternatives considered in the literature include a normal random variable, a random walk with constant variance, and a random walk with heteroscedastic variance.
- What process should we use for the transitory component? Alternatives from the literature have included a normal random variable, processes that allow for serial correlation including AR and ARMA with errors ranging from Gaussian with constant variance to non-Gaussian errors with heterogeneous variance.

The choices taken should ideally be informed by empirical patterns of earnings and should be consistent with economic theory.

A limitation of the variance component modelling described here is that the studies were confined to a relatively homogenous group, namely employed male workers. As noted by Jenkins (2000), the variance component approach is not well suited to taking into account permanent changes in labour force or life stage (such as unemployment or shifts to part-time work). A way of mitigating this restriction is to fit separate models of earnings to each labour force state. Earnings functions are then developed which account for the particular labour force circumstances facing each individual.¹³¹

¹³¹ In practice, earnings are separated into hourly wage and number of hours per week. Both the models developed for hourly wage and hours per week distinguish between part-time and full-time employment state.

4.6 Developing models of earnings - hourly wage

When modelling full-time annual earnings it is arguable whether predictability will be improved by decomposing earnings into a wage rate and number of hours worked. In contrast to full-time earnings, there is considerable volatility in part-time earnings as a consequence of variability in the number of hours worked per week. Further, the socio-economic determinants of wage rate and hours worked differ and consequently there are advantages in separating these out when modelling.

For modelling purposes it may be convenient to express annual earnings in terms of the number of hours worked, or number of weeks worked per annum. Under this formulation, annual earnings become:

$$\text{Annual Earnings} = \text{hourly earnings} \times \text{hours per week} \times \text{weeks per year}$$

or,

$$\text{Annual Earnings} = \text{weekly earnings} \times \text{weeks per year}$$

While hourly wage is a superior measure of earnings for individuals who work irregular hours week to week but are paid a fixed rate, weekly earnings is superior for individuals who may work varying hours but have a fixed annual salary (Keegan and Thurecht, 2008). The choice of whether to derive equations for weekly earnings or hourly earnings depends on how labour force state is produced in the modelling. Part-time status typically manifests as a reduction in the number of hours per week worked, rather than a reduction in the number of weeks of full-time work per annum. Consequently, it is rational that those who are estimated as being part-time workers will also require an estimate for the number of hours of work per week. Under this structure hourly wage is a more appropriate earnings measure than weekly earnings¹³².

In this section models of hourly wage are developed, with hours per week separately modelled in Section 4.7. Hourly wage is extracted from HILDA by dividing weekly wage by the number of hours worked per week. Hourly wage values used in the

¹³² This is consistent with the approach taken for the NATSEM microsimulation model APPSIM (Keegan and Thurecht, 2008).

analysis and modelling in this section are first adjusted by inflating to 2008/09 values with AWOTE.

Many of the models that are developed in this section are subsequently used to simulate earnings when costing ICLs in Section 4.8. A mean model of hourly wage (W.0) is first developed in Section 4.6.1 based on individual characteristics. Like the labour force model L.0, this model ignores serial correlation. Second, serial correlation in the residuals is identified and modelled via decomposition into a permanent and transitory component. Model W.1 is developed in Section 4.6.2, being the mean level W.0, plus a fixed permanent component unique to each individual. In this formulation there is no allowance for mobility in earnings beyond that permitted through W.0. This assumption is then relaxed for model W.2, also developed in Section 4.6.2, where a transitory variance component is incorporated alongside the permanent component. Finally, a series of increasingly complex models are proposed for the residuals (see Sections 4.6.3-4.6.4), culminating in model W.5 in Section 4.6.5, where the permanent component is a random walk and both the permanent and transitory shocks are non-Gaussian.

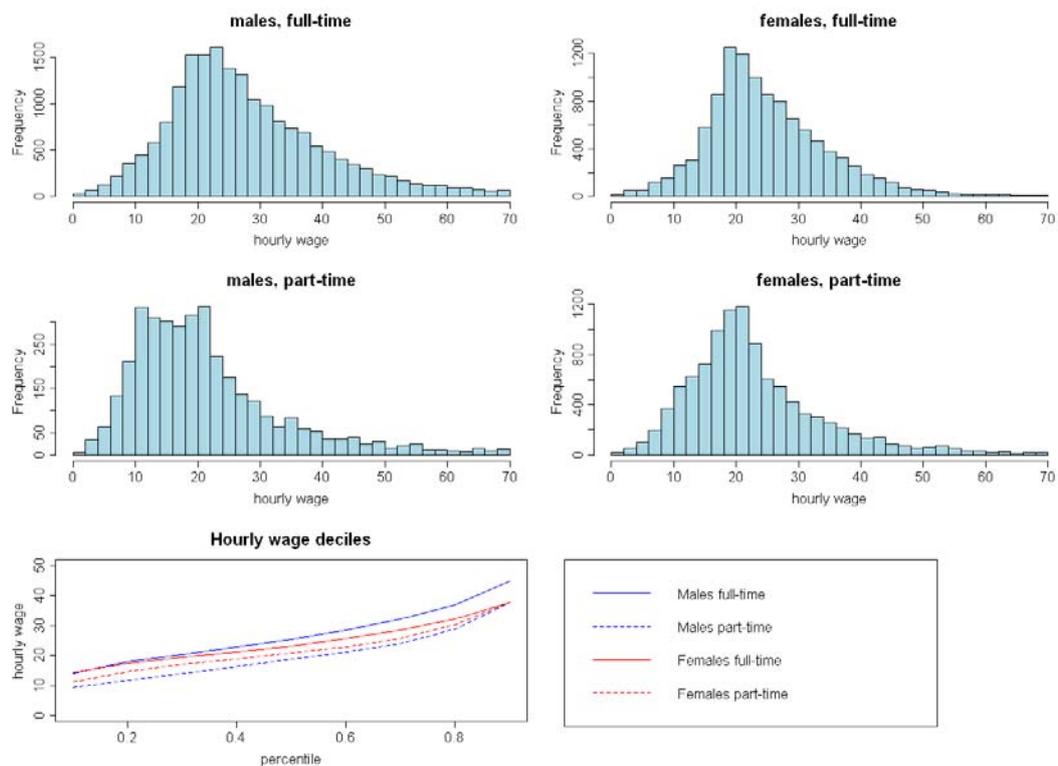
A review of earnings patterns in Australia is given by Keegan and Thurect (2008). Determinants reviewed include gender, age, education, marital status and family composition, immigrant status, industry and occupation, and health status. The authors also note the possible importance of experience, although they acknowledge the difficulty in quantifying this measure. A key conclusion is the dynamic nature of earnings and the changing importance of many of the key correlates. There is also evidence of interactions; Kalb and Scutella (2002) show empirically that those with a university degree have a greater increase in wage rates with age than those without a degree. Additionally, there is evidence of dependence in earnings among couples, with Galler (1996) showing a moderate positive correlation across individuals forming a couple.

The following covariates were considered in the models presented here of hourly wage rate: age, sex, education, marital status, age of youngest child, part-time or full-time employment status, and experience (being the number of years of employment). While the use of these covariates is supported on theoretical grounds

(e.g., see Keegan and Thurecht, 2008), they are also key variables used among developers of microsimulation models (see Appendix A2).

Part-time/full-time employment status as a potential covariate deserves some discussion prior to modelling. It can be seen in Figure 4.15 that the hourly wage for full-time employed is greater than part-time employed for both sexes across the deciles of the wage distribution. This is consistent with the notion of the full-time wage premium whereby higher wages are paid to those working full time¹³³. Explanations for the premium include the possibility that part-time workers are less productive and therefore command lower salaries, or that poorer paying jobs tend to be disproportionately part-time. Lettau (1994) estimates a 16 percent premium for full-time workers, and Harris and Sabelhaus (2003) use 15 percent in their model of hourly wage. An analysis of the first seven waves of HILDA reveals that male full-time wages are 29.5 per cent more than male part-time wages, while female full-time wages are only 7.8 per cent more than female part-time wages. Both mean and decile male part-time wages are less than the corresponding values for part-time females.

FIGURE 4.15 MALE AND FEMALE REAL HOURLY WAGE FROM HILDA WAVES 1-7. FULL-TIME AND PART-TIME.



¹³³ see Lettau (1994) for a discussion of the theory behind the full-time wage premium.

Notably, when we exclude those with youngest ages from the analysis (below age 22), the spread reduces to 11.3 per cent for males and 1.5 per cent for females. This difference can be attributed to lower hourly wage rates among young persons, the majority of whom are employed part-time; Rodgers (2004) finds that after controlling for job type and worker-specific characteristics (such as age, education and occupation), there is no statistically significant difference in hourly wage between part-time and full-time workers in Wave 1 of HILDA. While age and education (and interactions) are controlled for in the wage models that follow, occupation is not; hence, there is the possibility that employment state remains correlated with hourly wage. Consequently, full-time and part-time workers are considered separately when developing models for hourly wage in this chapter.

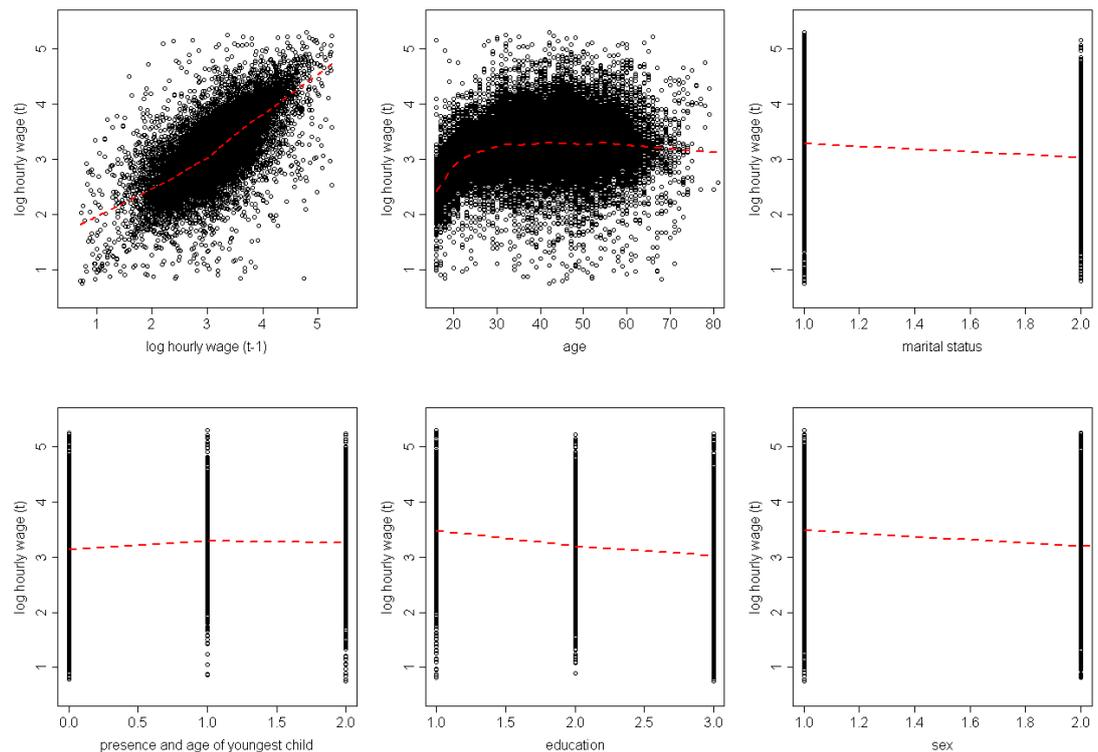
In Figure 4.16 log hourly wage is plotted against the main covariates under consideration. The plot of log hourly wage versus experience appears almost identical to that of log hourly wage versus age, and so has not been included in Figure 4.16; further, strong correlation between age and experience has led to the omission of experience as a covariate from the models considered.¹³⁴

Lagged log hourly wage has been plotted against log hourly wage in Figure 4.16 for illustration. While log hourly wage is clearly a function of lagged log hourly wage this dependency need not necessarily be modelled by including lagged log hourly wage as a regressor. Alternatives to such explicit modelling include first differencing (under the assumption that earnings follow a unit root process), or by capturing the heterogeneity through inclusion of a permanent error component that varies across individuals (profile heterogeneity). As discussed in Section 4.5.2, the assumption of a unit-root for earnings or the assumption of profile heterogeneity need not be exclusive of one another. By imposing a unit-root process on an initial permanent unobserved component, profile heterogeneity can be accommodated while allowing for future variation through temporary and permanent shocks. This is the approach taken by Harris and Sabelhaus (2003) and is the approach followed for the majority of the models subsequently developed in this section.¹³⁵

¹³⁴ The correlation between age and experience is >0.9 . Including experience as a covariate in addition to age (and alternately in place of age) had negligible marginal impact on the explanatory power of the mean fit.

¹³⁵ In contrast to Harris and Sabelhaus (2003) who modelled earnings for all workers and considered iid normal shocks, here hourly wage for part-time and full-time workers are considered separately,

FIGURE 4.16 LOG HOURLY WAGE VERSUS POSSIBLE COVARIATES WITH SMOOTHERS SUPERIMPOSED.



There is considerable theoretical and empirical support for considering both permanent and transitory components in dynamic models for earnings (see Section 4.5). As a result, these features are incorporated into the models developed in this section. For the modelling here, individuals are assumed to start with an existing income based on their observed hourly wage. That is, existing individuals have initial earnings that can be decomposed into a mean component that can be explained by covariates such as age, gender, and education, and an unobserved differential. The differential between actual and mean earnings is assumed to be the result of unobserved covariates¹³⁶, temporary shocks, and the cumulative effect of permanent shocks. It is assumed that subsequent movement in hourly wage from this initial level is the result of changes to the covariates, and unobserved permanent and temporary earnings shocks. Of critical importance are the dynamic processes for earnings, namely, the stochastic processes that determine the shocks to hourly wage.

and in the later parts of this section tests for serial correlation in the transitory component are carried out and models include non-Gaussian errors.

¹³⁶ In the models in this chapter occupation and industry are omitted from the mean effect, and hence are treated as unobserved. Although these are determinants of wage, for the majority of an individual's career they typically remain fixed, and therefore be subsumed into the unobserved permanent component in the earnings model.

As a first step, those observations with missing dependent and independent variables were excluded from the analysis. Next, those individuals receiving less than \$5 per hour or more than \$120 per hour, constituting approximately 2 per cent of the observations, were excluded. As seen in Figure 4.16, hourly wage rates for those aged up to 21 are considerably lower than subsequent ages; these were omitted for the purpose of the analysis and modelling, as were those aged 65 and above. This reduced the sample to 8,931 individuals and 36,299 observations.

4.6.1 *Model W.0: simple mean model*

Prior to specifying a formal earnings dynamics model with variance components, an initial model of hourly wage rates was fitted that ignores the known dependence structure in wages, and thus takes no account of the empirical evidence and literature of Section 4.5. The logarithm of hourly wage is regressed on age, education, part-time or full-time employment status, marital status and presence and age of youngest dependent children. Separate models were fit for male and females. A natural spline component for age is included with 3 degrees of freedom and an interaction was included between age and education. The model can be written:

$$\log(W_{it}) = \beta' \mathbf{x}_{it} + \varepsilon_{it}, \quad (\text{W.0})$$

where W_{it} is the hourly wage for individual i in year t . It is inappropriate to make inferences from model W.0 as the residuals are serially correlated and display heteroscedasticity. Instead, the purpose of this initial model is to allow decomposition of the OLS residuals to ascertain the existence and structure of transitory and permanent variance components. This approach is consistent with those of Moffitt and Gottschalk (1998) and Ramos (2003), among others. By first regressing log hourly wage against observables, their contribution to any permanent and transitory differences in earnings is accounted for. Table 4.7 gives the coefficient estimates and their significance levels.

TABLE 4.7 COEFFICIENTS FOR MODEL W.0. LOG HOURLY WAGE REGRESSIONS FOR MALES AND FEMALES.

Independent variables	Males		Females	
	Estimate	Standard error	Estimate	Standard error
Intercept	3.187***	0.025	3.167***	0.018
Age (df =1)	0.260***	0.029	0.181***	0.024
Age (df =2)	0.836***	0.061	0.620***	0.047
Age (df =3)	0.111***	0.033	0.113***	0.031
Marital status (not married)	-0.082***	0.008	-0.050***	0.007
Dependent children (youngest 5 or under)	-0.006	0.010	-0.008	0.010
Dependent children (youngest 6 or over)	-0.006	0.009	-0.056***	0.008
Education (tafe)	-0.085***	0.031	-0.169***	0.025
Education (<=yr12)	-0.097***	0.029	-0.166***	0.023
Employment status (part-time)	-0.074***	0.011	0.012*	0.006
Age (df = 1) x education (tafe)	-0.103***	0.034	-0.079**	0.033
Age (df = 2) x education (tafe)	-0.450***	0.075	-0.297***	0.066
Age (df = 3) x education (tafe)	-0.040	0.040	-0.088**	0.043
Age (df = 1) x education (<=yr12)	-0.212***	0.037	-0.077***	0.029
Age (df = 2) x education (<=yr12)	-0.582***	0.073	-0.435***	0.060
Age (df = 3) x education (<=yr12)	-0.064	0.041	-0.131***	0.037

*** Significant at the 1% level; ** Significant at the 5% level; * Significant at the 10% level.

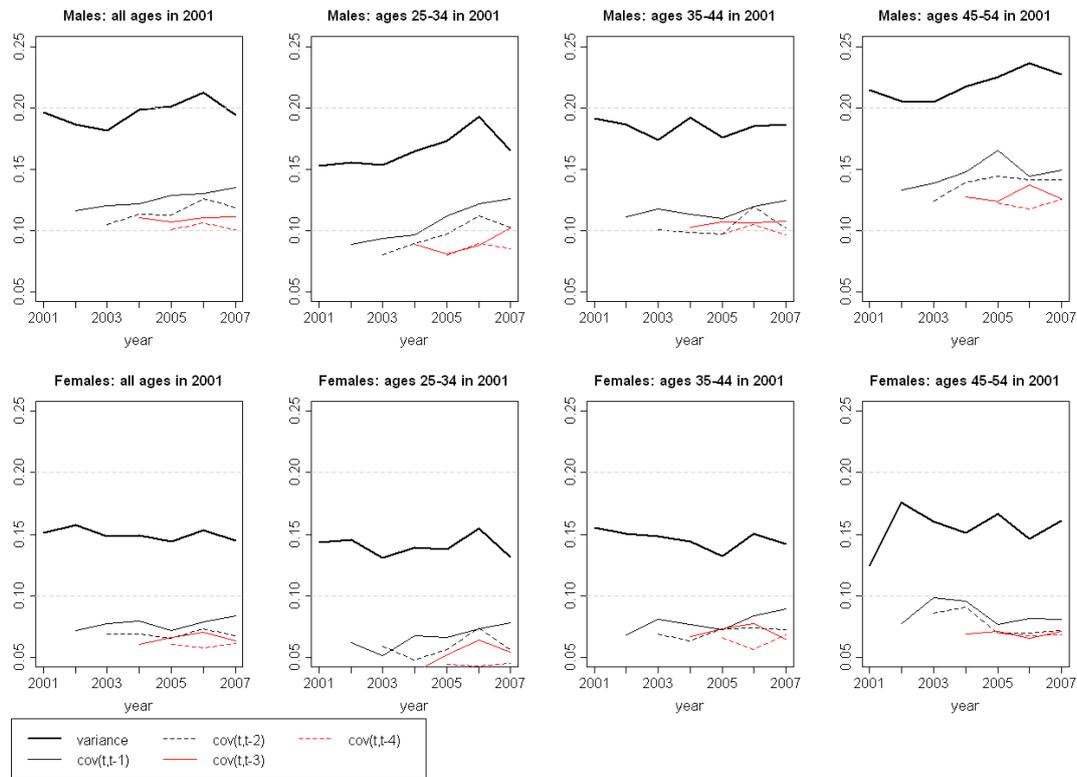
Notably, the explanatory power of the covariates is low, producing R-squared values of 0.135 and 0.148 for males and females respectively.¹³⁷ While full-time/part-time status is only significant for females at the 10% level, it is found subsequently that the between and within person variation in hourly wage differs markedly between full-time and part-time workers. Therefore, employment status is considered as a factor when modelling the variance and covariance of earnings.

While model W.0 is included as an example of a wage model when costing ICLs in Section 4.8, there are obvious deficiencies due to the presence of serial correlation within individuals. The variances and autocovariances for the observed residuals, \hat{r}_i , were calculated along cohorts by sex, and 10-year age group and are shown in Figure 4.17. For example, the second plot in the first row in Figure 4.17 shows residual variances and autocovariances for different lag lengths for males, aged 25 to 34 in 2001 (i.e., born between 1967 and 1976). For ages 25 to 34 there is some evidence of increases for short lags, though the spread between the variance and autocovariances appears static during the survey period. While the increase in variability may indicate a period effect, it may instead be due to age, as those at the

¹³⁷ Adding additional interactions between covariates has only a minor impact on the fitted models, and has a negligible effect on the residual variances and autocovariances.

start of the survey period are seven years older by the end of the period. For ages 35 and above both variances and autocovariances appear almost stationary with respect to year.¹³⁸

FIGURE 4.17 VARIANCES AND AUTOCOVARIANCES OF RESIDUALS $\hat{\epsilon}_{it}$ FROM MODEL W.0



Notes: the plots for all ages include ages 25 to 64.

Corresponding residual variances, autocovariances and standard errors for all ages are given in Table 4.8. Standard errors were generated by using the block bootstrap procedure applied to the observed residuals.¹³⁹ This ensures that heteroscedasticity and serial correlation are accounted for. Variances and standard errors are given in the diagonal, while autocovariances and standard errors are given below the diagonal, and autocorrelations are presented above the diagonal.

¹³⁸ To test whether the residual variances and autocovariances are distorted by period effects, year was included as a factor in model W.0. Including year led to a negligible difference in the variances and autocovariances, and there was an absence of any trend in mean log hourly earnings. Hence, year was excluded from the regression models selected for males and females.

¹³⁹ Bootstrapping was performed via the R function 'tsboot' in the library 'boot' with a fixed block length of seven corresponding to the number of waves of data, and 500 bootstrap resamples.

TABLE 4.8 MALES AND FEMALES, VARIANCES, AUTOCOVARIANCES AND AUTOCORRELATIONS FOR RESIDUALS FROM MODEL W.0, AGES 25-64.

MALES

Year	2001	2002	2003	2004	2005	2006	2007
2001	0.197 (0.009)	0.68	0.63	0.62	0.58	0.58	0.55
2002	0.118 (0.012)	0.187 (0.009)	0.74	0.67	0.63	0.61	0.60
2003	0.106 (0.009)	0.121 (0.012)	0.181 (0.01)	0.72	0.66	0.64	0.60
2004	0.112 (0.004)	0.115 (0.008)	0.122 (0.012)	0.199 (0.01)	0.72	0.69	0.64
2005	0.102 (0.004)	0.108 (0.004)	0.113 (0.008)	0.129 (0.012)	0.201 (0.010)	0.73	0.68
2006	0.106 (0.008)	0.108 (0.004)	0.111 (0.004)	0.128 (0.008)	0.132 (0.012)	0.214 (0.01)	0.74
2007	0.096 (0.013)	0.102 (0.008)	0.102 (0.004)	0.113 (0.004)	0.120 (0.008)	0.137 (0.012)	0.195 (0.01)

FEMALES

Year	2001	2002	2003	2004	2005	2006	2007
2001	0.150 (0.004)	0.53	0.53	0.47	0.47	0.41	0.40
2002	0.070 (0.009)	0.157 (0.004)	0.55	0.52	0.51	0.43	0.37
2003	0.068 (0.008)	0.077 (0.009)	0.148 (0.004)	0.63	0.50	0.53	0.48
2004	0.059 (0.004)	0.068 (0.008)	0.079 (0.009)	0.149 (0.004)	0.56	0.57	0.50
2005	0.060 (0.004)	0.066 (0.004)	0.065 (0.009)	0.072 (0.009)	0.145 (0.004)	0.59	0.54
2006	0.054 (0.008)	0.056 (0.004)	0.069 (0.004)	0.073 (0.008)	0.079 (0.009)	0.153 (0.004)	0.62
2007	0.053 (0.009)	0.047 (0.008)	0.061 (0.004)	0.062 (0.004)	0.067 (0.008)	0.083 (0.009)	0.144 (0.004)

It is clear from Table 4.8 that the autocovariances are significant, even at the longest lags. It is also clear that there is an absence of a definite trend over time, hence it is assumed that the permanent and transitory error components are stationary in the development of earnings model that follow.

Four models of increasing complexity are developed for earnings in the remainder of Section 4.6. Each of the models assumes a mean structure as in W.0 with coefficients as given in Table 4.7. This first stage regression provides an estimate of β' , which remains unbiased in the event of heteroscedasticity or serial correlation in the residuals. The models also have in common the assumption that the unexplained component of earnings can be decomposed into a permanent and transitory component, however, they differ in the assumptions imposed on the residual components. The residual models considered are as follows:

- a fixed permanent component with and without a white noise transitory component (models W.1 and W.2);
- a random walk permanent component with normal shocks, and an iid normal transitory component (W.3);
- a random walk permanent component with normal shocks, and a normal transitory component with serial correlation (W.4);
- a random walk permanent component with non-normal shocks, and a non-normal transitory component (W.5).

4.6.2 *Models W.1 and W.2: fixed permanent effect with and without iid transitory component*

An initial simplified approach to variance decomposition is to assume that the unobserved component of earnings can be decomposed into the canonical permanent-transitory model, consisting of a time-invariant permanent component and a white noise transitory component:

$$r_{it} = u_i + v_{it},$$

where r_{it} is the residual from fit W.0, u_i is the time-invariant individual component with variance σ_u^2 , and v_{it} is the serially uncorrelated transitory component with mean 0 and variance σ_v^2 .

Two variations of this formulation are used in the ICL simulations of Section 4.8. First, it is assumed that the variance in the residuals from W.0 is exclusively due to permanent variation, and that there is zero transitory variance ($\sigma_v^2 = 0$). Second, it is assumed that two levels of variation exist and $\sigma_v^2 \neq 0$. i.e.,

$$r_{it} = u_i + v_{it}, \quad \text{where } \sigma_v^2 = 0, \quad (\text{W.1})$$

$$r_{it} = u_i + v_{it}, \quad \text{where } \sigma_v^2 \neq 0. \quad (\text{W.2})$$

The latter model allows for mobility in earnings, albeit non-persistent mobility.

Values for the components of variance can be found under simplifying assumptions. If it is assumed that $v \perp u$, then the estimated variance of the residuals is $\text{Var}(u_{it} + v_{it}) = \sigma_{u_i}^2 + \sigma_v^2$. Under this formulation σ_u^2 is the covariance between r_{it} and r_{is} , for $s \neq t$. Assuming the canonical interpretation, and ignoring variation with respect to year, total, permanent and transitory variance can be estimated from the variance/covariance matrices for \hat{r}_{it} .¹⁴⁰ The resulting values for males and females for all ages and years are given in Table 4.9.

TABLE 4.9 MALE AND FEMALE VARIANCE COMPONENT ESTIMATES UNDER MODEL W.2.

	Males	Females
Total variance	0.196	0.150
σ_u^2	0.113	0.067
σ_v^2	0.083	0.083

This simple model suggests higher cross-sectional variance in log hourly wage for males than females, yet with an identical transitory component. It is increases in transitory variance, rather than permanent, which boosts mobility. Additional variation in the permanent differential may indeed decrease wage mobility by accentuating the earnings gap between individuals.

¹⁴⁰ By pooling the variances and covariances and regressing them against an indicator variable with level 1 (if the response is a variance) or 0 (if the response is a covariance), the resulting intercept and indicator coefficient will give $\hat{\sigma}_u^2$ and $\hat{\sigma}_v^2$ respectively.

FIGURE 4.18 RESIDUAL VARIANCES AND AUTOCOVARIANCES FOR ALL YEARS, 2001 TO 2007

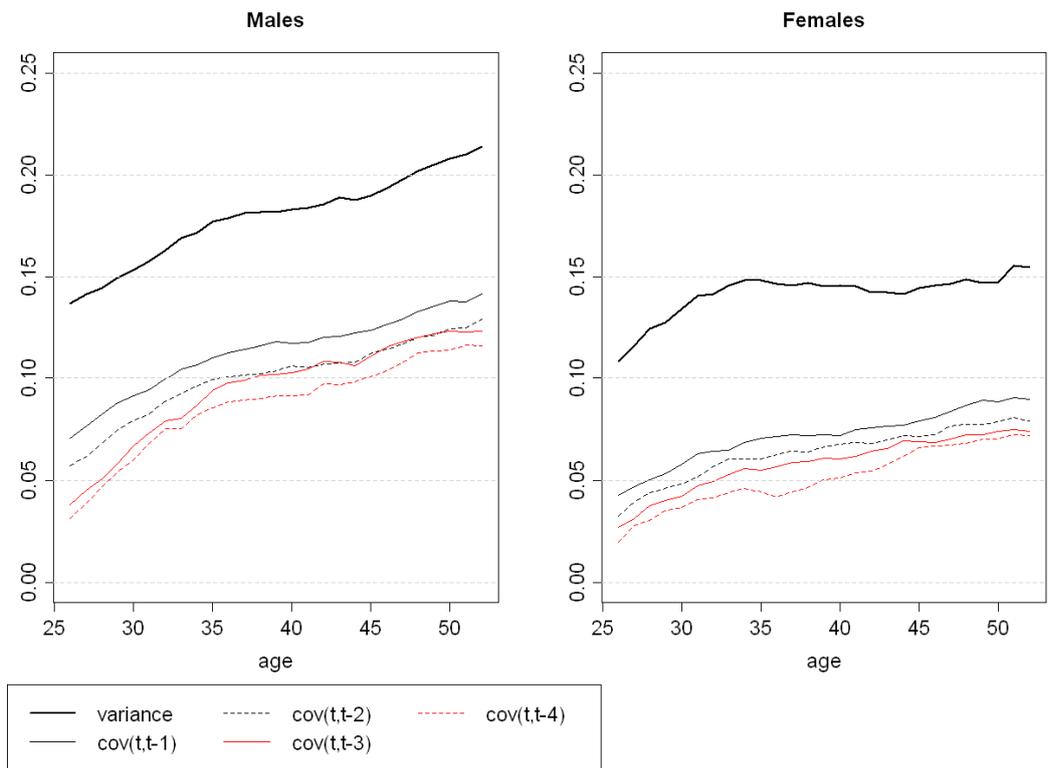
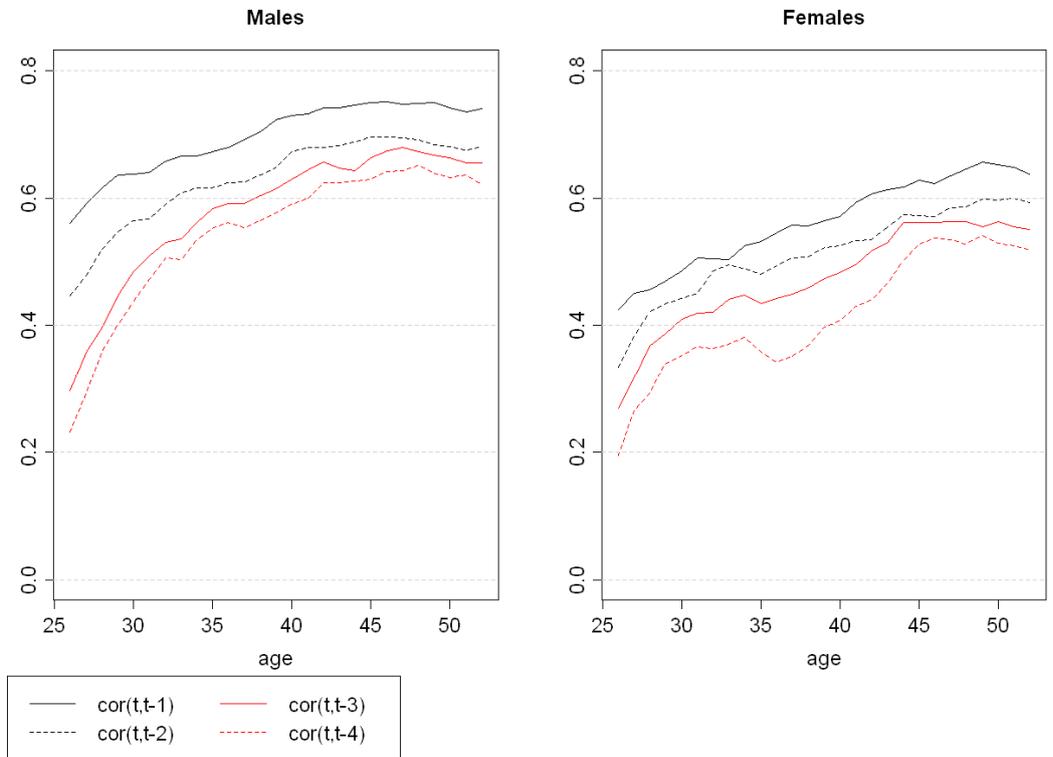
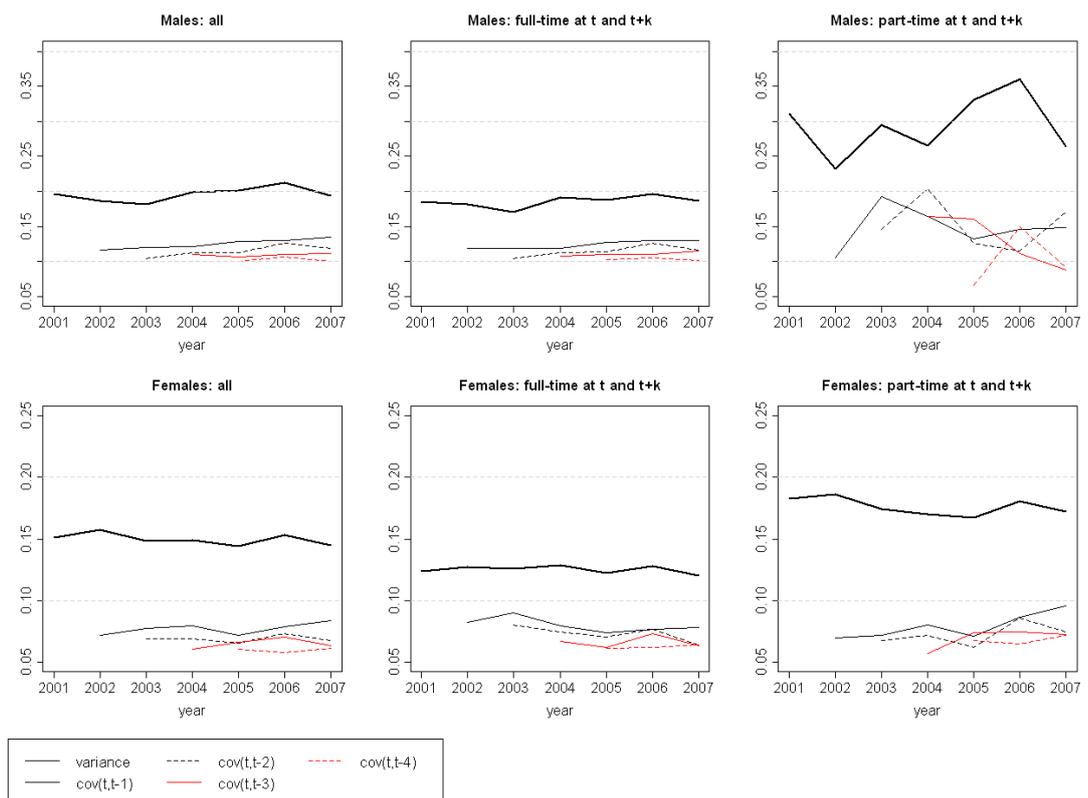


FIGURE 4.19 RESIDUAL AUTOCORRELATIONS FOR ALL YEARS, 2001 TO 2007



Examination of the variances and autocovariances in Table 4.8, and Figure 4.18 and Figure 4.19, clearly leads to rejection of model W.2.¹⁴¹ First, there appears to be age variation in the variance and autocovariance values, particularly for males. The pattern of growth is consistent with a random walk for the permanent effect (discussed below). Second, there may be serial correlation in the transitory component, as it appears that autocovariances reduce with lag duration.¹⁴² A decomposition of the variances and autocovariances by full-time and part-time employment state in Figure 4.21 and Figure 4.22 indicates substantial differences in the variance estimates between part-time and full-time workers.

FIGURE 4.20 RESIDUAL VARIANCES AND AUTOCOVARIANCES FOR YEARS 2001 TO 2007. FULL-TIME AND PART-TIME WORKERS CONSIDERED SEPARATELY.



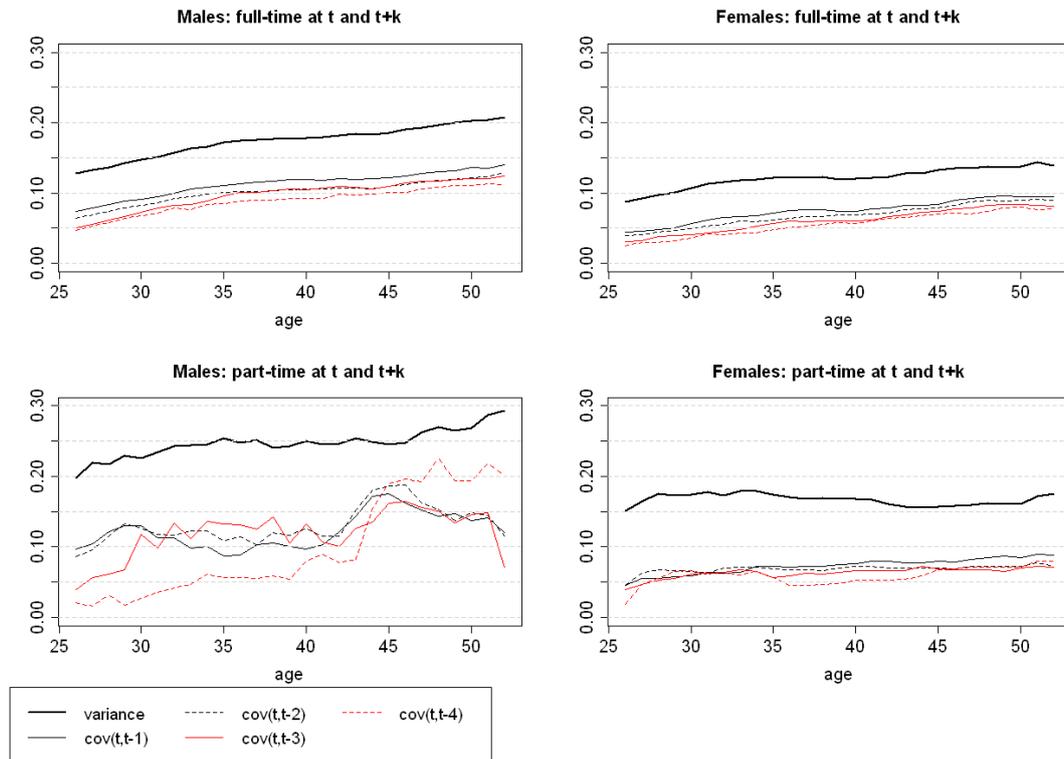
For part-time males there is considerable volatility in the variances and autocovariances, likely due to the small number of part-time male workers in the

¹⁴¹ The variances and covariances were estimated for each 9-year age group starting at 22-30 (average age of 26), 23-31 (average age of 27), and so on up to persons aged in their mid 50s.

¹⁴² In this circumstance the variance of the permanent component would be more closely approximated by the covariance at long duration lags (e.g., $cov(t, t - 4)$ or further lags) at which time persistence in transitory shocks would have presumably been exhausted.

HILDA survey period. For full-time males and females, and part-time females, the values appear generally stable over the survey period. Figure 4.21 presents the same values aggregated over all years.

FIGURE 4.21 RESIDUAL VARIANCES AND AUTOCOVARIANCES FOR ALL YEARS, 2001 TO 2007. FULL-TIME AND PART-TIME WORKERS CONSIDERED SEPARATELY.



It is apparent that the variance for part-time males and females is considerably greater than for full-time males and females. It is also evident that the autocovariances for part-time females are lower than for full-time females, and consequently autocorrelations are also much lower than for full-timers.¹⁴³ These observations pertaining to variance and autocovariances have implications to model development in the next section.

¹⁴³ Variances and autocovariances were also extracted for individuals who transitioned between part-time and full-time states (and vice versa). These are discussed in the next section.

4.6.3 Model W.3: random walk permanent component and iid transitory component, normal shocks

The case where part-time and full-time individuals follow the same variance process, namely that visualised in Figure 4.18, is considered first. This assumption is restrictive, and would only be defensible when projecting a population where the proportion of part-time and full-time earners remains fixed over the projection period.

Because of the pattern of increasing variance, and long lagged autocovariances with age, it is assumed that the permanent component follows a random walk:

$$r_{it} = u_{it} + v_{it}, \quad (\text{W.3})$$

$$u_{i,t+1} = u_{it} + w_{it},$$

where, w_{it} represents a iid random permanent shock with mean 0, and v_{it} is the unobserved transitory component that includes any idiosyncratic error. As before, u_{it} represents unobserved differences in hourly wage due to factors such as IQ, drive and ambition, and occupation and industry, among others. Many of these may have a permanent effect on an individual's hourly wage, while others will be less permanent, though have long persistence (such as occupation and industry of employment). Changes in earnings from year t to year $t+1$ occur due to changes in \mathbf{x}_{it} , but also due to random shocks to both the unobserved permanent and transitory components¹⁴⁴. The random shocks affect the transitory income through v_{it} and the permanent component of earnings through the permanent shock w_{it} .¹⁴⁵

To establish the variance of the shocks, w_{it} and v_{it} , first define the unobserved earnings shock as the first difference of the residuals from the mean fit:

¹⁴⁴ This is the same as the unexplained component of the rate of growth of earnings in Meghir and Pistaferri (2004).

¹⁴⁵ While the term 'permanent' is used for consistency with the earnings literature, it is assumed to vary over time and can thus be considered a non-mean reverting effect as opposed to a strictly permanent effect (e.g., Dickens, 2000).

$$g_{i,t+1} = \Delta r_{i,t+1} = r_{i,t+1} - r_{it} = \Delta u_{i,t+1} + \Delta v_{i,t+1} = w_{i,t+1} + \Delta v_{i,t+1}.$$

The variance is:

$$\text{var}(g_{i,t+1}) = \text{var}(w_{i,t+1} + \Delta v_{i,t+1}) = \sigma_w^2 + 2\sigma_v^2 - 2\text{cov}(v_{it+1}, v_{it}),$$

where it is assumed that w and v are orthogonal (i.e., the transitory and permanent shocks are independent). Extending this to greater lags:

$$r_{i,t+k} - r_{it} = u_{i,t+k} - u_{it} + v_{i,t+k} - v_{it}, \quad \text{and}$$

$$\text{var}(r_{i,t+k} - r_{it}) = \text{var}\left(\sum_{s=t}^{t+k-1} w_{is} + v_{i,t+k} - v_{it}\right) = k\sigma_w^2 + 2\sigma_v^2 - 2\text{cov}(v_{i,t+k}, v_{it}),$$

since $u_{i,t+k} = u_{it} + \sum_{s=t}^{t+k-1} w_{is}$.

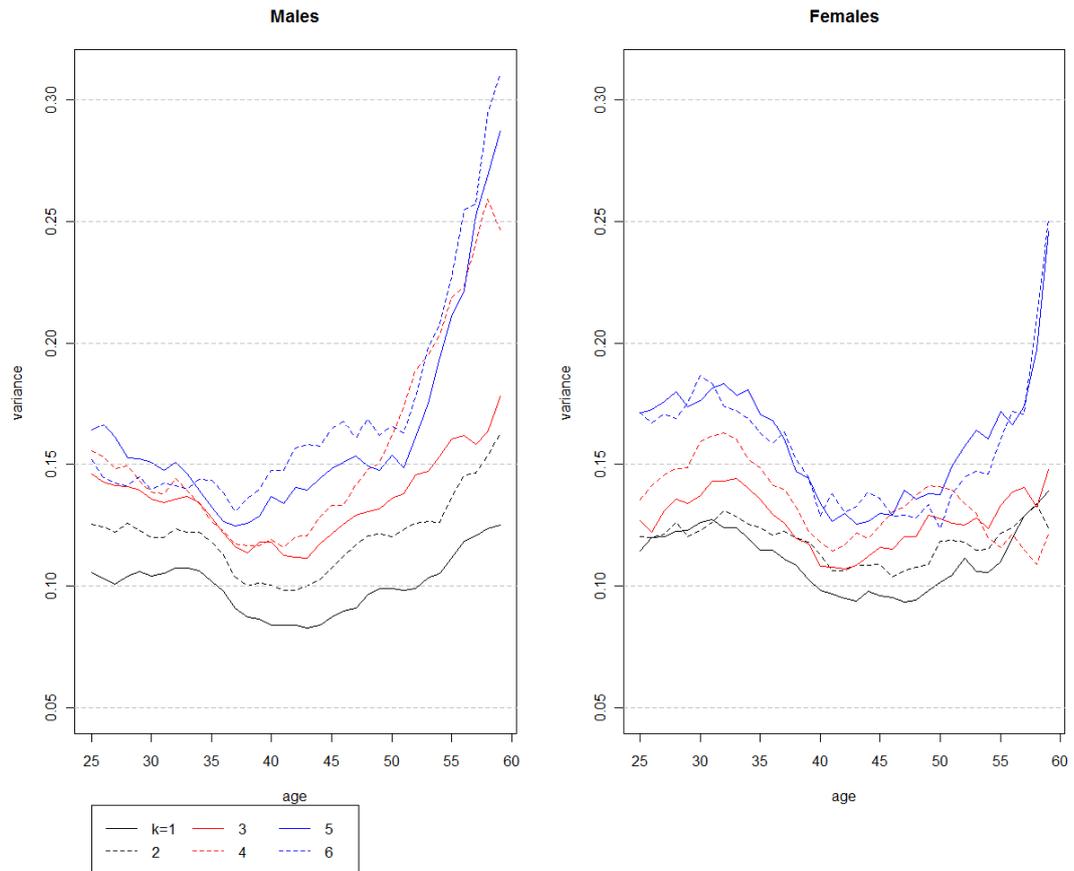
For the analysis the residuals from the regressions (i.e., \hat{r}_{it} and \hat{g}_{it}) are used in place of r_{it} and g_{it} . Figure 4.22 shows the variance of the unexplained earnings innovations (the changes in estimated residuals) for different time gaps. There is greater variance in changes in the earnings equation residuals for larger gaps. This is expected if there are permanent shocks that have a multiplicative effect over time and is further support for a random walk for the permanent component.¹⁴⁶

In the first instance under the simplifying assumption that there is no serial correlation in the transitory shocks, then:

$$\text{var}(r_{i,t+k} - r_{it}) = k\sigma_w^2 + 2\sigma_v^2.$$

¹⁴⁶ Notably this pattern is almost identical to the variances of the differences between log(earnings) over various lags due to the low explanatory power of the observed covariates.

FIGURE 4.22 VARIANCE OF EARNINGS INNOVATIONS ($\hat{r}_{i,t+k} - \hat{r}_{it}$) FOR ALL YEARS, 2001 TO 2007



Therefore, assuming at least three years of panel data, enabling calculations of $\text{var}(r_{i,t+1} - r_{it})$ and $\text{var}(r_{i,t+2} - r_{it})$, a solution for σ_w^2 and σ_v^2 can be found. Conveniently, this approach is still robust if the transitory process is $\text{MA}(q)$ and there are at least $q+3$ time periods. For example, if the transitory shock follows an $\text{MA}(1)$ process, then $\text{cov}(v_{i,t+k}, v_{it}) = 0$, for $k \geq 2$, and the relations $\text{var}(r_{i,t+2} - r_{it}) = 2\sigma_w^2 + 2\sigma_v^2$, and $\text{var}(r_{i,t+3} - r_{it}) = 3\sigma_w^2 + 2\sigma_v^2$ can be used to solve for the variance of the shocks.

First proceed under the assumption that the process in the transitory component is no greater than an $\text{MA}(2)$ and use $\text{var}(r_{i,t+k} - r_{it})$ for $k = 3, 4, 5$ and 6 to find estimates for the variances of the shocks. For both sexes the estimates vary according to the age range considered as seen in Figure 4.22. Table 4.10 gives the estimates for different age ranges for females for illustration of the variability in the estimates.

TABLE 4.10 ESTIMATES OF THE VARIANCE OF PERMANENT AND TRANSITORY SHOCKS FOR MODEL W.3. FEMALES, FULL-TIME AND PART-TIME EMPLOYED COMBINED.

Age range	Females	
	σ_w^2	σ_v^2
22-29	0.020	0.030
30-39	0.010	0.057
40-49	0.007	0.045
50-59	0.010	0.049
30-49	0.009	0.050

Notes: the values for ages 30-49 are used in the subsequent modelling and hence are given in bold.

One other source of variation remains un-estimated. Since the permanent component is assumed to be a random walk, it follows that:

$$\text{var}(u_{i,t+k}) = \text{var}(u_{it}) + \sum_{s=t}^{t+k-1} \text{var}(w_{is}) = \sigma_{u_t}^2 + k\sigma_w^2.$$

It is assumed that at the start of an individual's working life there is an initial or base permanent differential in hourly wage¹⁴⁷. The variance of this component can be estimated by noting that the total residual variance at the start of an individual's working life (prior to permanent shocks) will be equal to the variance of the base permanent differential plus the variance of the transitory component. That is, $\text{var}(r_{it}) = \sigma_{u_b}^2 + \sigma_v^2$, for an individual i at the base age, which in the presence of data that includes duration of work, can be taken as the commencement of working life. For the current exercise, the sample considered for projection commences at age 30, hence a base permanent differential is estimated for this age level.

The residual variance can be obtained from the OLS regression of Y_{it} on $\beta'x_{it}$. For those with average age of 30, the residual variances for females and males are approximately 0.12 and 0.15 respectively. This corresponds with a base differential

¹⁴⁷ To be precise we could drop the notation for time t in the subscripts for the permanent component, and replace this with age a . Correlation and variance structures explored in HILDA appear to essentially display stationarity, yet there is evidence of variation with age. If we consider that a starting permanent differential exists at the commencement of an individual's labour force experience at age b due to persistent unobserved effects, then by age a (where $a > b$), the individual will have experienced $a - b$ potential permanent shocks. While we retain the notation t for the equations in this section, the random walk is intended to capture variation over the life course as an individual ages, rather than period effects.

variance of approximately 0.05 for females assuming a transitory variance of 0.07.¹⁴⁸

Under the assumptions of independence between the permanent differential, permanent shock and transitory shock, it is easy to show that $\text{cov}(r_{it}, r_{i,t+k}) = \sigma_u^2 + \text{cov}(v_{it}, v_{i,t+k})$ for all k . Therefore, for high lags if it is assumed that $\text{cov}(v_{it}, v_{i,t+k}) = 0$, what remains is σ_u^2 . For young ages this is a measure of the variance of the base earnings differential.

Now, proceed by comparing the actual and fitted values over the HILDA data period for Waves 1 to 7 for females aged 30 to 49. Values of 0.009 and 0.05 are assumed for the permanent and transitory shocks, consistent with the estimates from Table 4.10. It is assumed that an unbiased estimate of the unobserved permanent component $u_{i,1}$ is the log of the actual hourly earnings minus the fitted values from $\beta' \mathbf{x}_{i,1}$. These values are weighted to ensure that the variance of $u_{i,1}$ is consistent with the starting variance as determined through the parameter estimates.

Note that the total variance for individual i at time t will be:

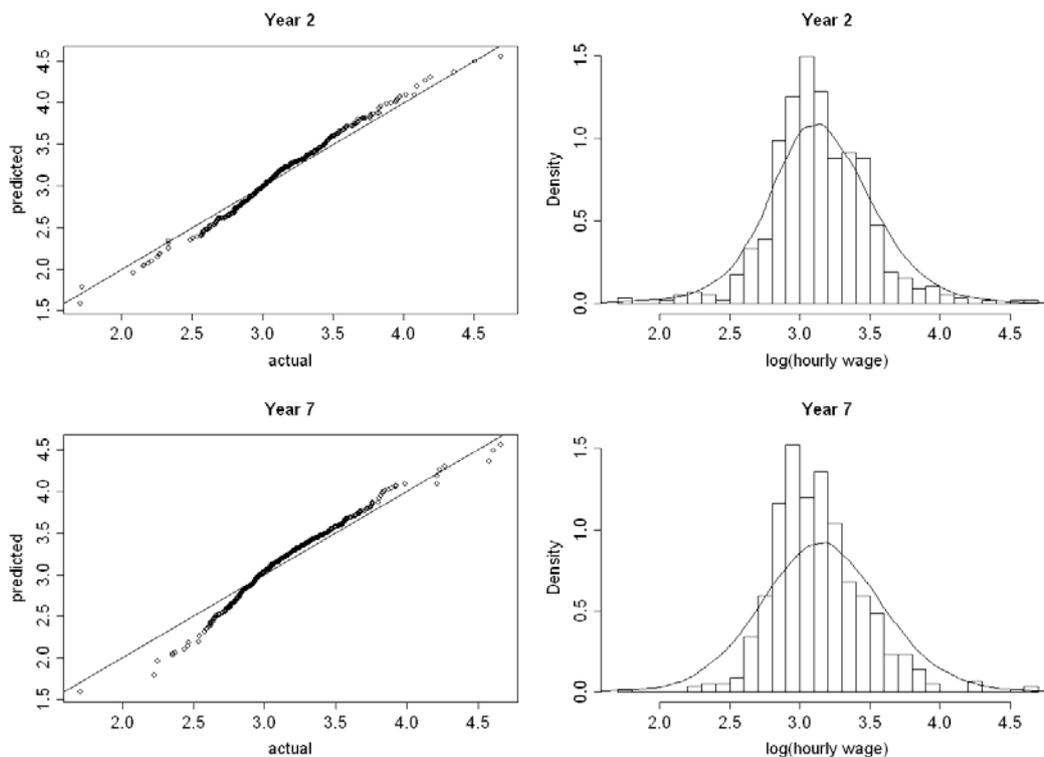
$$\text{var}(r_{it}) = \sigma_{u_b}^2 + k\sigma_w^2 + \sigma_v^2,$$

where k is the difference between age at time t and age at the base.

For each individual in each year of the simulation, $\beta' \mathbf{x}_{it}$ was calculated based on the observed individual characteristics, normal random errors were generated for the permanent and temporary shocks, and a permanent component was generated as the sum of the previous permanent component plus the random permanent shock. The $\beta' \mathbf{x}_{it}$, the new permanent component and the random temporary shock were summed to produce a fitted log hourly wage. This process was repeated for subsequent years over the seven year period. Actual and fitted values are compared in the qq-plots and histograms below for years 2 and year 7 for 100 samples of 596 observations in Figure 4.23.

¹⁴⁸ 0.07 is the approximate transitory variance estimated for 30 year old females.

FIGURE 4.23 FEMALE ACTUAL AND SIMULATED LOG(HOURLY WAGE) FROM MODEL W.3. Q-Q PLOTS AND HISTOGRAMS, FOR COMBINED PART-TIME AND FULL-TIME WORKERS



The simulated distribution of log hourly wage compares poorly with the actual distribution by year 7. Additionally, the variances and autocovariances of the simulated log hourly wage (given in Figure 4.24) display excessive serial dependency and overestimation.

To address this, consider separate variance decomposition models for part-time and full-time earners. The variances of the earnings innovations for full-time and part-time males and females by age are given in Figure 4.25. These can be compared with Figure 4.22. While it is assumed that the same residual functional form (W.3) applies to both part-time and full-time workers, it is clear from Figure 4.25 that there is considerably more variability in log hourly wage among part-time earners, and as such parameter estimates will differ. There is also greater variation in the variance estimates with respect to both age and year, which makes parameter estimation more uncertain.

FIGURE 4.24 VARIANCES AND AUTOCOVARIANCES FOR OBSERVED LOG(HOURLY EARNINGS) AND SIMULATED LOG(HOURLY EARNINGS) BASED ON MODEL W.3. FEMALES AGES 30 TO 49, FULL-TIME AND PART-TIME WORKERS COMBINED.

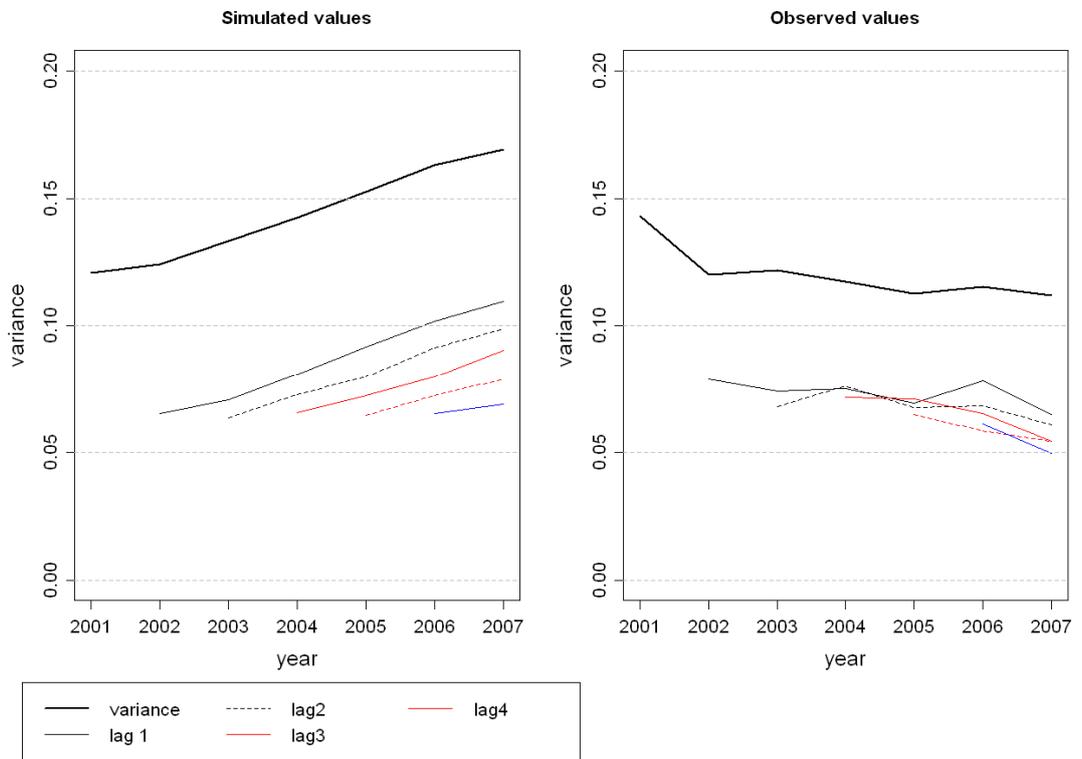
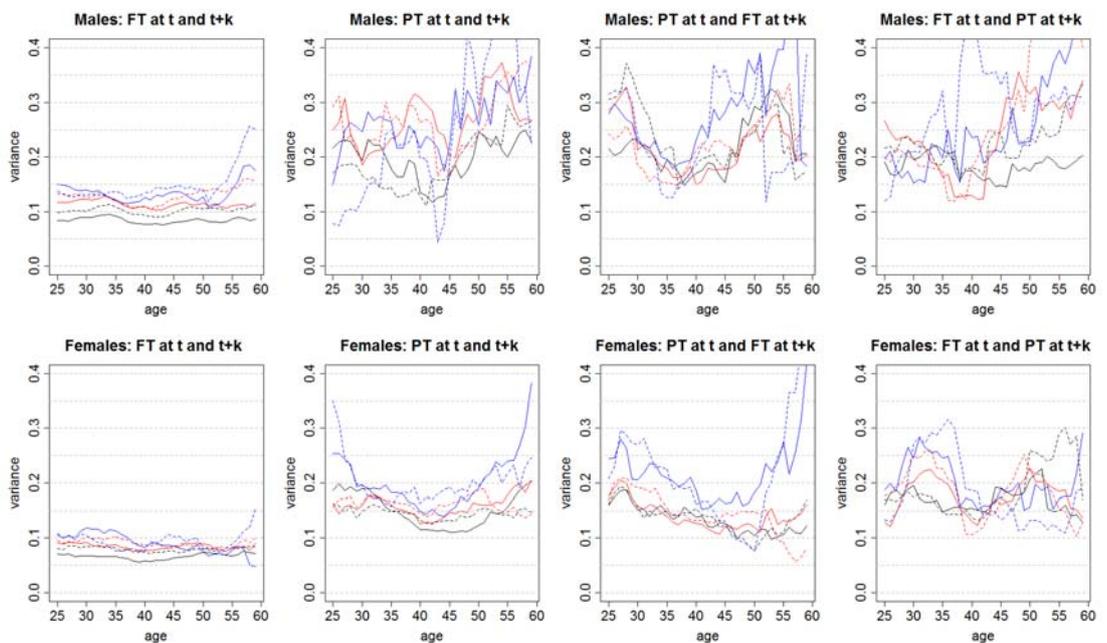


FIGURE 4.25 VARIANCE OF MALE AND FEMALE EARNINGS INNOVATIONS ($\hat{\epsilon}_{i,t+k} - \hat{\epsilon}_{it}$) FOR ALL YEARS, 2001 TO 2007, FOR THOSE IN EITHER PART-TIME OR FULL-TIME STATES AT TIME T AND T+K.



Notes: For legend see Figure 4.22

Following the same approach as above, use $\text{var}(r_{i,t+k} - r_{it})$ for $k = 3, 4, 5$ and 6 to find estimates for the variances of the shocks. The results for each of the four possible full-time/part-time transitions for females are given in Table 4.11.¹⁴⁹

TABLE 4.11 ESTIMATES OF THE VARIANCE OF PERMANENT AND TRANSITORY SHOCKS FOR MODEL W.3. FEMALES, FULL-TIME AND PART-TIME EMPLOYED ARE CONSIDERED SEPARATELY.

Age range	FT at t and $t+k$		PT at t and $t+k$		FT at t and PT at $t+k$		PT at t and FT at $t+k$	
	σ_w^2	σ_v^2	σ_w^2	σ_v^2	σ_w^2	σ_v^2	σ_w^2	σ_v^2
22-29	0.005	0.039	0.086	-0.066	0.006	0.059	0.024	0.046
30-39	0.002	0.043	-0.001	0.088	0.023	0.070	0.024	0.042
40-49	0.005	0.032	0.009	0.054	-0.002	0.085	0.016	0.036
50-59	-0.002	0.043	0.027	0.037	-0.021	0.134	0.027	0.027
30-49	0.004	0.035	0.004	0.065	0.015	0.070	0.02	0.035
30-55	0.002	0.040	0.007	0.065	0.004	0.090	0.018	0.040

Notes: the values for ages 30-49 and 30-55 are used in the subsequent modelling and hence are given in bold.

The higher variance of permanent shocks for women transitioning between full-time and part-time work is expected. Such transitions are more likely to be associated with a change in role, occupation or industry, than for women who remain in full-time or part-time employment.

An implication of assuming constant variance of earnings innovations with respect of log hourly wage is that higher levels of hourly wage will be subject to larger wage shocks than lower levels. To ascertain whether this is a realistic assumption, the variances of the one-step earnings innovations were extracted for full-time males, and both full-time and part-time females, for different log hourly wage deciles. The empirical variances across different deciles show no discernable pattern or trend, supporting the assumption of constant variances with respect to log hourly wage innovations.

For illustration of the proposed model, the approach described above is followed for all females, and project log hourly wage is projected over the period 2001 to 2007 for females aged 30 to 55, where the parameters vary according to employment state, and compare the results with the observed data. Values from Table 4.11 are used as the basis for the parameter assumptions for the model. For women remaining

¹⁴⁹ Because of the small number of males with part-time employment status in the HILDA sample, the analysis and subsequent model building is confined to females.

in full-time employment, the variances for the transitory and permanent shock are taken as 0.04 and 0.002 respectively. For women remaining in part-time employment, variances for the transitory and permanent shock are taken as 0.065 and 0.004 respectively¹⁵⁰. For women transitioning to or from part-time or full-time employment, it is assumed that the variance component estimates are 0.065 and 0.01 for the transitory and permanent shocks, being the approximate weighted average of the parameter estimates for full-time to part-time and part-time to full-time 30 to 55 year olds.

The initial permanent differential was estimated from the residuals of the OLS fit, weighted to ensure that the starting variance was consistent with the expected variance as determined from the selected model parameters.

The distributions, variances and autocovariances of the simulated log hourly wage levels are compared with those of the observed values in Figure 4.26 and Figure 4.27. While there is some overestimation of both variances and autocovariances, the predicted values provide a much closer fit than those for females where employment states were not differentiated.

Chamberlain and Hirano (1999), and Geweke and Keane (2000) noted earnings shocks in the PSID appear non-Gaussian, and proposed models to accommodate this. By incorporating non-Gaussian shocks, it is hypothesised that the shape of the distribution of predicted log wage will conform more closely to the observed values. This is explored in Section 4.6.5 below.

There is also the possibility of the existence of serial correlation in the transitory component that is not accommodated in the models considered to date. This is taken up in Section 4.6.4.

¹⁵⁰ The values for 30-49 year old women were used rather than 30-55 year olds; there is considerable volatility in the variance estimates for women approaching age 55 for part-time to part-time women, hence the decision to use the estimates from the more stable age ranges.

FIGURE 4.26 FEMALE ACTUAL AND SIMULATED LOG(HOURLY WAGE) FROM MODEL W.3. Q-Q PLOTS AND HISTOGRAMS. SIMULATIONS BASED ON SEPARATE VARIANCE COMPONENTS FOR FULL-TIME AND PART-TIME FEMALES.

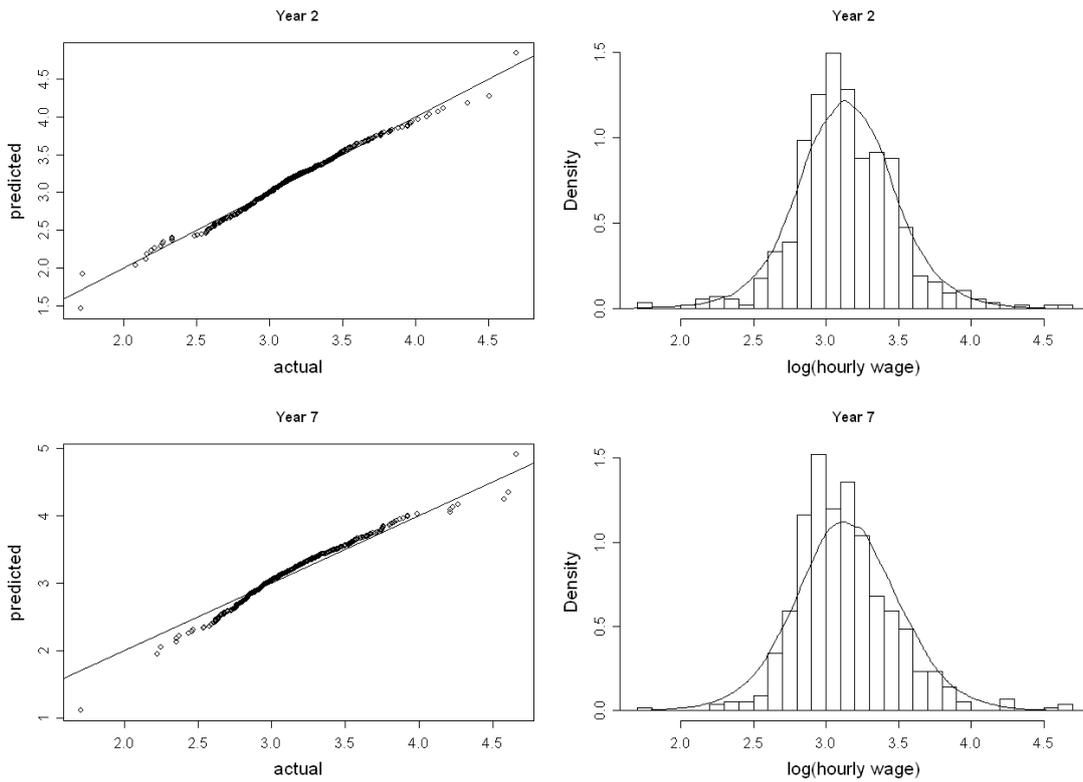
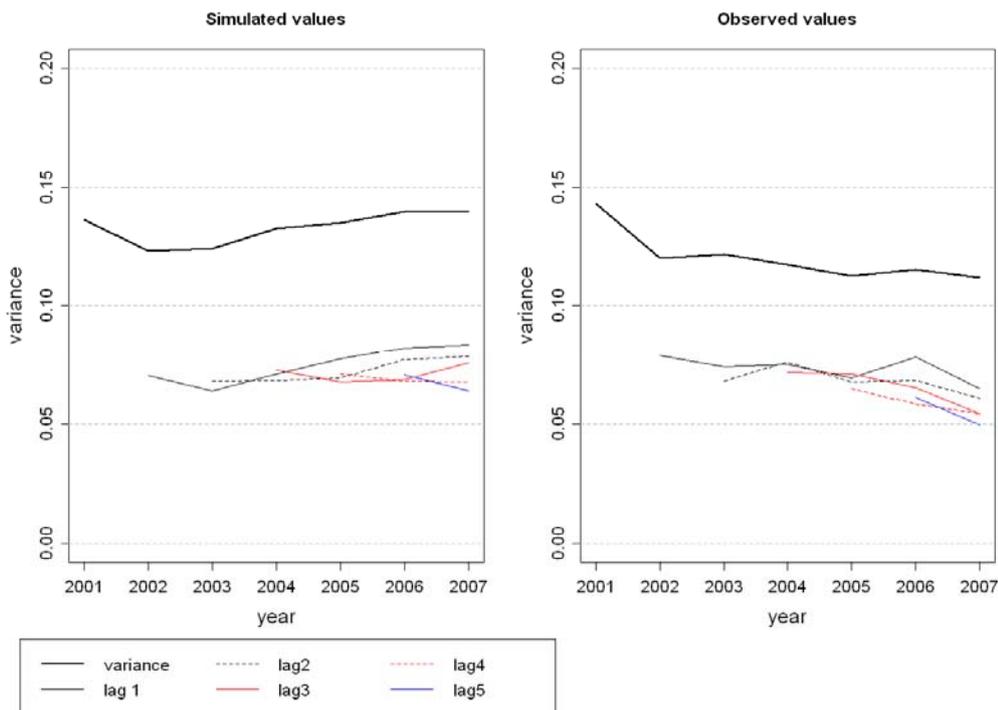


FIGURE 4.27 FEMALE ACTUAL AND SIMULATED LOG(HOURLY WAGE) FROM MODEL W.3. VARIANCE AND COVARIANCE ESTIMATES. SIMULATIONS BASED ON SEPARATE VARIANCE COMPONENTS FOR FULL-TIME AND PART-TIME FEMALES.



4.6.4 Model W.4: random walk permanent component, transitory component with serial correlation, normal shocks

The models of the previous section can be extended to allow for serial correlation in the transitory component. The transitory component is written as either an AR(1) or MA(1) process:

$$r_{it} = u_{it} + v_{it}, \quad (\text{W.4})$$

$$u_{i,t+1} = u_{it} + w_{it},$$

$$v_{it} = \rho v_{i,t-1} + \varepsilon_{it}, \text{ or } v_{it} = \varepsilon_{it} + \theta \varepsilon_{i,t-1}.$$

While higher-level processes may be more suitable for the transitory component, there are currently insufficient HILDA waves to allow for processes that would require additional parameter estimates.

An indication of the presence of serial correlation in the transitory component can be achieved by inspection of the autocovariances for the earnings innovations, g_{it} . Under the assumption of no serial correlation in the permanent shock (w_{it}), and if it is assumed $w \perp v$ and stationarity, then

$$\begin{aligned} \text{cov}(g_{it}, g_{i,t+1}) &= \text{cov}(w_{it} + v_{i,t+1} - v_{it}, w_{i,t+1} + v_{i,t+2} - v_{i,t+1}) \\ &= \text{cov}(v_{i,t+1}, v_{i,t+2}) - \text{var}(v_{i,t+1}) - \text{cov}(v_{it}, v_{i,t+2}) + \text{cov}(v_{it}, v_{i,t+1}) \\ &= 2 \text{cov}(v_{it}, v_{i,t+1}) - \sigma_v^2 - \text{cov}(v_{it}, v_{i,t+2}) \end{aligned}$$

For the second lag:

$$\begin{aligned} \text{cov}(g_{it}, g_{i,t+2}) &= \text{cov}(w_{it} + v_{i,t+1} - v_{it}, w_{i,t+2} + v_{i,t+3} - v_{i,t+2}) \\ &= \text{cov}(v_{i,t+1}, v_{i,t+3}) - \text{cov}(v_{i,t+1}, v_{i,t+2}) - \text{cov}(v_{it}, v_{i,t+3}) + \text{cov}(v_{it}, v_{i,t+2}) \\ &= 2 \text{cov}(v_{it}, v_{i,t+2}) - \text{cov}(v_{it}, v_{i,t+1}) - \text{cov}(v_{it}, v_{i,t+3}) \end{aligned}$$

If there is no serial correlation in the transitory component, these reduce to

$$\text{cov}(g_{it}, g_{i,t+1}) = -\sigma_v^2, \text{ and } \text{cov}(g_{it}, g_{i,t+2}) = 0.$$

Under an AR(1) process, $\text{cov}(v_{i,t+k}, v_{it}) = \rho^k \frac{\sigma_\varepsilon^2}{1-\rho^2}$, and $\text{var}(v_{it}) = \frac{\sigma_\varepsilon^2}{1-\rho^2}$, and:

$$\text{cov}(g_{it}, g_{i,t+1}) = \left(\frac{2\rho - \rho^2 - 1}{1-\rho^2} \right) \sigma_\varepsilon^2, \text{ and } \text{cov}(g_{it}, g_{i,t+2}) = \rho \left(\frac{2\rho - \rho^2 - 1}{1-\rho^2} \right) \sigma_\varepsilon^2. \text{ }^{151}$$

While under an MA(1) process,

$$\begin{aligned} \text{cov}(v_{i,t+1}, v_{it}) &= \theta \sigma_\varepsilon^2, \\ \text{cov}(v_{i,t+k}, v_{it}) &= 0, k = 2, \dots \\ \text{var}(v_{it}) &= (1 + \theta^2) \sigma_\varepsilon^2, \end{aligned}$$

it follows that, $\text{cov}(g_{it}, g_{i,t+1}) = (2\theta - \theta^2 - 1) \sigma_\varepsilon^2$, and $\text{cov}(g_{it}, g_{i,t+2}) = -\theta \sigma_\varepsilon^2$.

The variances of the earnings innovations for full-time and part-time females, and the autocovariances and autocorrelations for females who are at both the full-time or part-time states at time $t+k$ and time t , for $k=1, 2, 3$ and 4 , are given in Table 4.12. Variances and standard errors are given in the diagonal, while autocovariances and standard errors are below the diagonal, and autocorrelations are above the diagonal.

¹⁵¹ For example, for the AR(1) process with $\rho=0.5$, $\text{cov}(g_{it}, g_{i,t+1}) = -\frac{\sigma_\varepsilon^2}{3}$ and $\text{cov}(g_{it}, g_{i,t+2}) = -\frac{\sigma_\varepsilon^2}{6}$. For $\rho=0.2$, $\text{cov}(g_{it}, g_{i,t+1}) \approx -\frac{\sigma_\varepsilon^2}{1.5}$ and $\text{cov}(g_{it}, g_{i,t+2}) \approx -\frac{\sigma_\varepsilon^2}{7.5}$. For the MA(1) process with $\theta=0.5$, $\text{cov}(g_{it}, g_{i,t+1}) = -\frac{\sigma_\varepsilon^2}{4}$ and $\text{cov}(g_{it}, g_{i,t+2}) = -\frac{\sigma_\varepsilon^2}{2}$. For $\theta=0.2$, $\text{cov}(g_{it}, g_{i,t+1}) = -0.64\sigma_\varepsilon^2$ and $\text{cov}(g_{it}, g_{i,t+2}) = -\frac{\sigma_\varepsilon^2}{5}$.

TABLE 4.12 FEMALES, VARIANCES, AUTOCOVARIANCES AND AUTOCORRELATIONS FOR EARNINGS INNOVATIONS (\hat{g}_{it}) FROM FIT W.3, AGES 25-60.

FEMALES, FULL-TIME AT TIME T AND TIME T+K

Year	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
2001-02	0.070 (0.007)	-0.50	0.16	-0.16	-0.04	0.04
2002-03	-0.029 (0.012)	0.063 (0.008)	-0.46	-0.02	0.07	-0.07
2003-04	0.008 (0.005)	-0.026 (0.011)	0.059 (0.005)	-0.33	0.03	-0.04
2004-05	-0.007 (0.006)	-0.001 (0.003)	-0.018 (0.011)	0.062 (0.008)	-0.43	-0.02
2005-06	-0.002 (0.004)	0.004 (0.006)	0.002 (0.003)	-0.028 (0.011)	0.076 (0.004)	-0.41
2006-07	0.002 (0.010)	-0.004 (0.003)	-0.002 (0.004)	-0.001 (0.003)	-0.026 (0.012)	0.062 (0.010)

FEMALES, PART-TIME AT TIME T AND TIME T+K

Year	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
2001-02	0.160 (0.026)	-0.56	-0.10	0.00	-0.02	-0.03
2002-03	-0.085 (0.022)	0.177 (0.036)	-0.47	-0.07	0.05	0.00
2003-04	-0.012 (0.009)	-0.056 (0.014)	0.119 (0.018)	-0.39	-0.06	0.00
2004-05	0.000 (0.004)	-0.008 (0.009)	-0.046 (0.013)	0.148 (0.013)	-0.51	0.12
2005-06	-0.003 (0.007)	0.006 (0.004)	-0.006 (0.008)	-0.065 (0.021)	0.130 (0.014)	-0.50
2006-07	-0.004 (0.020)	0.000 (0.007)	0.000 (0.003)	0.014 (0.009)	-0.060 (0.021)	0.123 (0.014)

Table 4.12 indicates that for both part-time and full-time females who are in the same state after k periods, the only significant covariance is $\text{cov}(g_{it}, g_{i,t+1})$.¹⁵² From the reasoning above, these results may indicate the presence of either no serial correlation, or possibly a weak AR(1) or MA(1) process (i.e., with small values for ρ or θ) such that the effect is not noticeable in the empirical covariances. This process was repeated for full-time males and a similar result was found to hold.

The presence of serial correlation is formally tested by fitting both an AR(1) and MA(1) process to the transitory components. Both males and females persisting with full-time wage are considered, as are females persisting with part-time wages. First, consider an AR(1) process, such that:

¹⁵² The same conclusions are reached when we consider females who transition from full-time to part-time, or vice versa.

$$v_{it} = \rho v_{i,t-1} + \varepsilon_{it}.$$

This has been the preferred process for the transitory component in the earnings literature¹⁵³, with mixed empirical support from analysis of the PSID. Unlike the literature, here modelling log hourly wage, not log earnings is preferred, hence similar processes would not necessarily be expected to hold. As before, the variance of the earnings innovations (the differenced residuals) can be used to solve for the parameters. In contrast to Section 4.6.3, the covariance term for the transitory components is non-zero. It follows from an AR(1) process that:

$$\text{var}(r_{i,t+k} - r_{it}) = k\sigma_w^2 + 2\sigma_v^2 - 2\text{cov}(v_{i,t+k}, v_{it}) = k\sigma_w^2 + 2\sigma_\varepsilon^2 \left(\frac{1 - \rho^k}{1 - \rho^2} \right).$$

This can be considered a non-linear regression model with unknown parameters σ_w^2 , σ_ε^2 and ρ , with $k = 1, \dots, 6$. This is solved for ages 25 to 60. For both males and females remaining in full-time employment the estimates for ρ are statistically significant though low, being 0.218 and 0.172 respectively for females and males, indicating little persistence; the covariance between the current and lagged transitory error is only approximately 1/5th the transitory variance, and the covariance for lags beyond the first are essentially zero. For females persisting in the part-time state, ρ is not significant. The parameter estimates for full-time females are given in Table 4.13.

TABLE 4.13 FEMALES, FULL-TIME AT T AND T+K, AR(1) PROCESS

	estimate	standard error
σ_w^2	0.0024*	0.0006
σ_ε^2	0.038***	0.001
ρ	0.218**	0.032

* p<0.05; ** p<0.01; *** p<0.001

Unsurprisingly, the AR(1) pattern can also be accommodated via an MA(1) process. An MA(1) process for the transitory error is consistent with Meghir and Pistaferri (2004). It follows from an MA(1) process that:

¹⁵³ e.g., see Lillard and Willis (1978), Chamberlain and Hirano (1999), Ulrick (2000), Geweke and Keane (2000), Ramos (2003), Baker and Solon (2003).

$$\text{var}(r_{i,t+1} - r_{it}) = \sigma_w^2 + 2\sigma_v^2 - 2\text{cov}(v_{i,t+1}, v_{it}) = \sigma_w^2 + 2\sigma_\varepsilon^2(1 - \theta + \theta^2),$$

$$\text{var}(r_{i,t+k} - r_{it}) = k\sigma_w^2 + 2\sigma_\varepsilon^2(1 + \theta^2) \text{ for } k=2, \dots$$

The parameters are solved for this system of equations via non-linear regression, and θ is deemed statistically, but not practically, significant, with an estimate of 0.176. As with the AR(1) process, the MA(1) process was not found to be significant for part-time females remaining in the part-time state (see Table 4.14).

TABLE 4.14 FEMALES, FULL-TIME AT T AND T+K, MA(1) PROCESS

	estimate	standard error
σ_w^2	0.0032*	0.0007
σ_ε^2	0.037***	0.001
θ	0.176*	0.039

* p<0.05; ** p<0.01; *** p<0.001

The estimated parameters are consistent with expectation that, at most, very weak autocorrelation exists in the transitory shock. Based on the available data and the assumptions made, while there is evidence of autocorrelation in the transitory component for full-time workers, the effect is very weak and is expected to have negligible impact on the costs for which these models are being developed. It appears that by assuming a random walk for the permanent component, the serial dependency in earnings identified in Figure 4.18 is sufficiently captured.¹⁵⁴

As a consequence of the findings in this section, serial correlation in the transitory component is henceforth ignored in the model developed in the next section.

¹⁵⁴ Indeed, a comparison of observed and simulated variances and covariances for females aged 25 to 50 based on model W.3 which excludes serial correlation, points to the possibility that the random walk may in fact overestimate the serial dependency in earnings (see Figure 4.27). An alternative modelling approach is offered by Alvarez *et al.* (2002), who consider separate ARMA processes for each individual, such that the parameters are permitted to vary from person to person. While this approach may be possible for panel data with long duration, such as the PSID, HILDA has insufficient waves to enable such detailed modelling.

4.6.5 *Model W.5: random walk permanent component, iid transitory component, non-Gaussian shocks*

Histograms and qq-plots are produced for the unexplained earnings innovations, with normal distributions superimposed for full-time and part-time females. It is clear from Figure 4.28 that normally distributed shocks are inappropriate for females remaining in either the full-time or part-time states. The earnings innovations for those transitioning to either part-time or full-time states, from full-time or part-time respectively, are closer to normal, yet still display kurtosis.

As an alternative to Gaussian shocks, smoothed density curves were fit to the observed one-step earnings innovations for each of the three cases (full-time to full-time, part-time to part-time, and part-time/full-time to full-time/part-time). It was assumed that the distributions of the earnings innovations in Figure 4.28 were consistent in shape for both the permanent and transitory shocks; the density curves for transitory and permanent innovations were extracted for each of the three cases by weighting the observations for total innovations for each case by a constant factor such that the variances of the weighted densities were identical to the permanent and transitory variances assumed in Section 4.6.3.¹⁵⁵

The simulation of Section 4.6.3 was repeated using the parameter values from Model W.3, and the distribution of log hourly wage for years 2 and 7 are displayed below in Figure 4.29. The red line in the histograms shows the density of the predicted values under the assumption of non-Gaussian errors, while the dotted black line gives the density of the original predictions from Figure 4.26 assuming normal errors. There is clear improvement in capturing the distribution of log hourly wage when non-Gaussian errors are applied, however, there remains scope for improvement.

¹⁵⁵ This approach is reasonable under the assumption that the transitory and permanent innovations are independent.

FIGURE 4.28 FEMALES. ONE-STEP EARNINGS INNOVATIONS FOR AGES 22 TO 64.

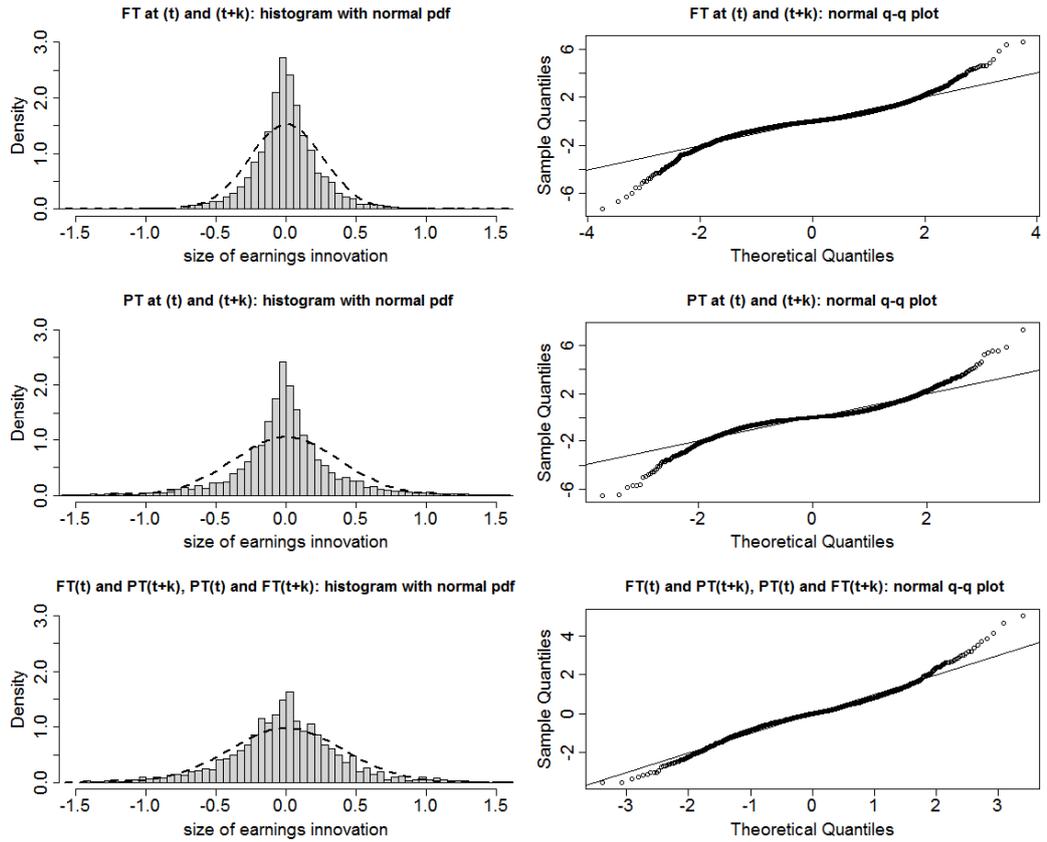
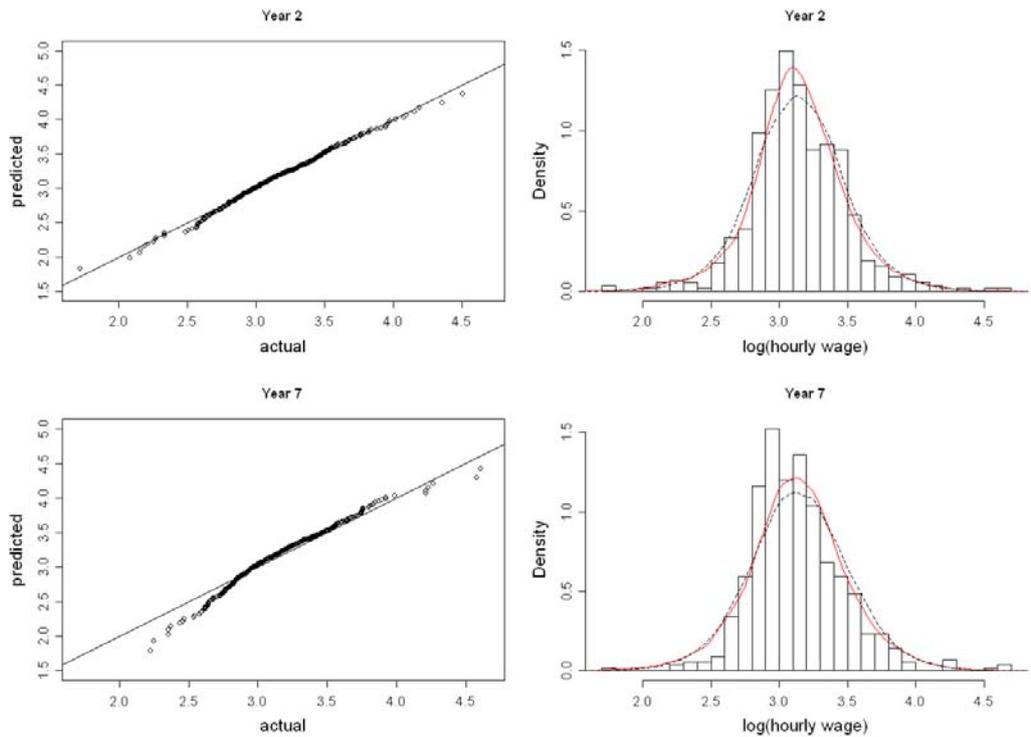


FIGURE 4.29 FEMALE ACTUAL AND SIMULATED LOG(HOURLY WAGE) FROM MODEL W.5. Q-Q PLOTS AND HISTOGRAMS. SIMULATIONS BASED ON SEPARATE VARIANCE COMPONENTS FOR FULL-TIME AND PART-TIME FEMALES, AND NON-GAUSSIAN ERRORS.



The implications of the models throughout Section 4.6, and in particular the inclusion or exclusion of serial dependency are explored in Section 4.8 where repayments are simulated for a hypothetical ICL. Models W.0, W.1, W.2 and W.5 are applied to simulate hourly wage. In order to derive estimates of total earnings, estimates for the number of hours worked are also required. The following section details the processes taken in model development for hours worked.

4.7 Developing models of earnings - hours per week worked

While specific temporary events may affect earnings by altering the number of weeks worked per year (e.g., through illness or periods of unemployment), other events may affect the number of hours worked per week temporarily (e.g., overtime, higher duties), or permanently (e.g., retirement, unemployment, changing from full-time to part-time duties). Permanent changes in hours worked are assumed to predominantly manifest through changes in labour force state, and hence are accommodated through the models of labour force transitions (see Section 4.4). However, both non-persistent transitory and persistent transitory (or semi-permanent) changes in hours worked can be accommodated through model development for hours per week worked.

Hours per week worked were extracted from HILDA for males and females and aggregated across all waves. The simplest model of hours per week worked, H_{it} , is one that ignores variability and assigns the mean number of hours based on employment state¹⁵⁶:

$$H_{it} = \begin{cases} 23 & \text{if } L_{it} = \text{part-time} \\ 40 & \text{if } L_{it} = \text{full-time} \end{cases} \quad (\text{H.0})$$

An alternative, yet still simple model, is one that allows for variation in hours worked between different individuals by assuming the previous number of hours worked is maintained over time (conditional on remaining in the same employment

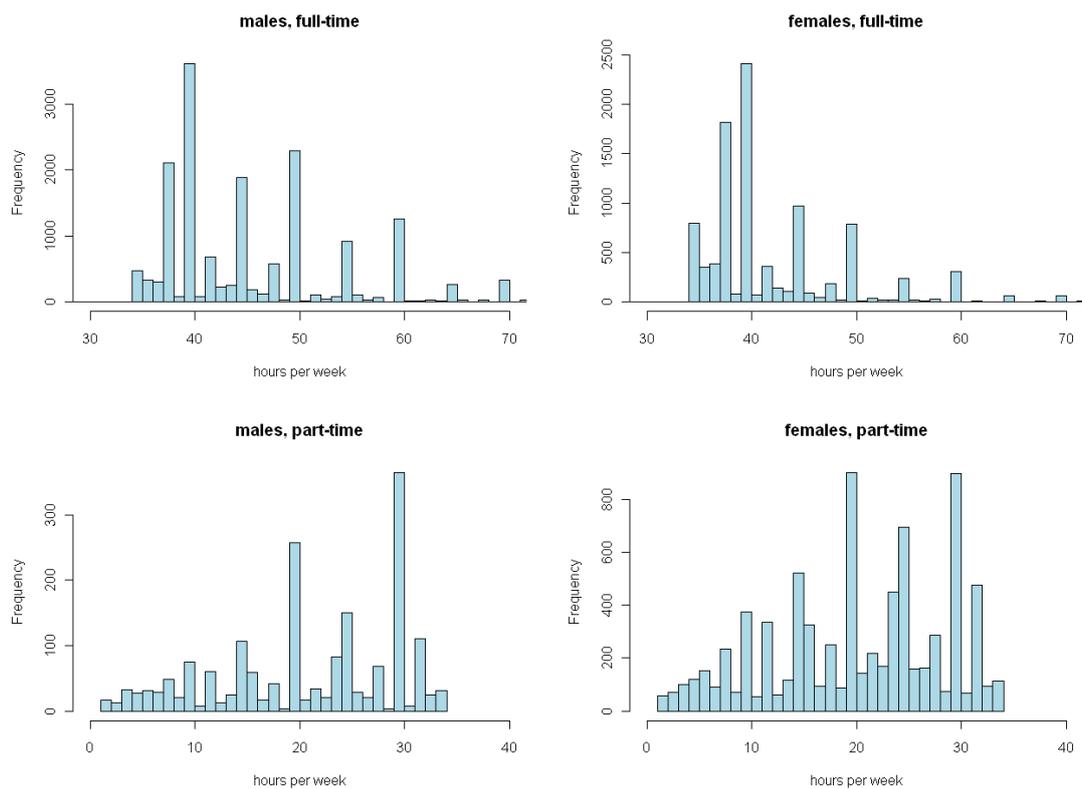
¹⁵⁶ There was minimal variation in the mean number of hours across the seven available waves of HILDA.

state) (akin to fixed permanent variation in hourly wage as in hourly wage models W.1 and W.2):

$$H_{it} = \begin{cases} 23 & \text{if } L_{it} \neq L_{i,t-1} \text{ and } L_{it} = \text{part-time} \\ 40 & \text{if } L_{it} \neq L_{i,t-1} \text{ and } L_{it} = \text{full-time} \\ H_{i,t-1} & \text{if } L_{it} = L_{i,t-1} \end{cases} \quad (\text{H.1})$$

A more realistic model is one that allows for variation both between individuals, and across time for the same individual. The remainder of this section details the development of a stochastic model (H.2) that allows for these sources of variation. Figure 4.30 displays histograms by sex and employment state for the number of hours per week worked.

FIGURE 4.30 HISTOGRAM OF HOURS PER WEEK WORKED FOR MALES AND FEMALES.



It is clear from Figure 4.30 that hours worked have discrete distributions, with greater frequency in general for multiples of 5 hourly blocks; with few exceptions there are more cases at 15, 20, 25, 30, 40, 45 and 50 hours than at intermediate levels. A consequence is that modelling mean hours and decomposing residuals

using a variance components approach, as was done for hourly wage, is not the preferred approach. Instead, the probabilities of being at each discrete level, and transitioning between levels, are modelled discretely via transition matrices. This is performed for females only, as it is females who are the subject of the hypothetical ICL estimates that follow in Section 4.8.

For the current exercise transition matrices are estimated for all females, however, an alternative approach would be to model the mean level of hours per week as a function of age, gender, marital status, education, age of youngest child, etc, and then model the residuals of the mean fit via transition matrices. When a regression model was fit with the same socio-economic covariates as had been considered for the hourly wage model W.0, the explanatory power for the fit was very low (R-squared < 3%). The fitted hours varied by an immaterial amount for predictive purposes under a range of covariate values.

As an alternative test of the explanatory power of the covariates, a dummy variable was generated that recorded whether or not an individual changed the number of hours of work between time t and $t + 1$ within either the part-time or full-time employment states. This was regressed on the covariates, however, it was found that none of the covariates (including age, hourly wage, education and dependent children) had a significant effect on the probability of staying with the same hours, or transitioning to a different number of hours.

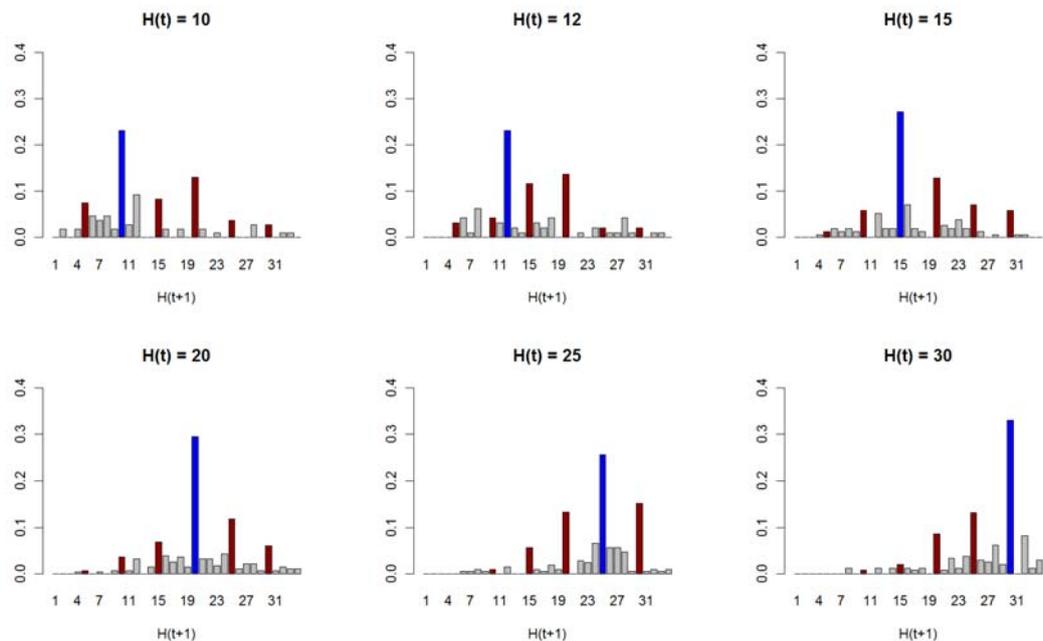
In practice, one might expect the transition probabilities to change when specific life events occur. For example, the number of hours of work for a mother may increase when a child enters primary school for the first time. While changing work patterns in the presence of life events may be captured predominantly through labour force transitions, it is plausible that such events also have an impact on hours worked within a particular labour state. In order to test whether such events changed the probabilities of transition, two additional dummy variables were generated that recorded whether or not an individual changed their education level, or dependent child status (e.g., from level 0 to 1 (no children to a child under the age of 6), from level 1 to 2 (a dependent child aged 6 or over), or level 2 to 0, etc.) between time t and $t+1$. Again it was found that neither of these dummy variables was significant in

explaining the probability of staying with or changing the number of hours worked for individuals remaining either part-time or full-time.

As a consequence of the regression results described above, it was decided to ignore all covariates in development of the probability transition models for hours worked from part-time to part-time, and full-time to full-time states.

The propensity for specific discrete hours worked is apparent when one considers the transition probabilities between hours worked at time t and $t+1$. Figure 4.31 displays these probabilities for part-time females aged 22 to 65 at time t who remain part-time at time $t+1$. In this figure the bars in blue indicate the probability of persisting with the same number of hours at time $t+1$ as at time t , while the bars in red highlight the probabilities corresponding with hours that are multiples of five hourly blocks (i.e., 5, 10, 15, 20, 25 and 30). It is clear that, for those who change hours, there is generally a greater chance of moving to one of the five hourly blocks than to an intermediate level. This is not only apparent for those commencing on a five hourly block, but also for those commencing on other levels (as evidenced by the bar plot for $H_t = 12$ in Figure 4.31).

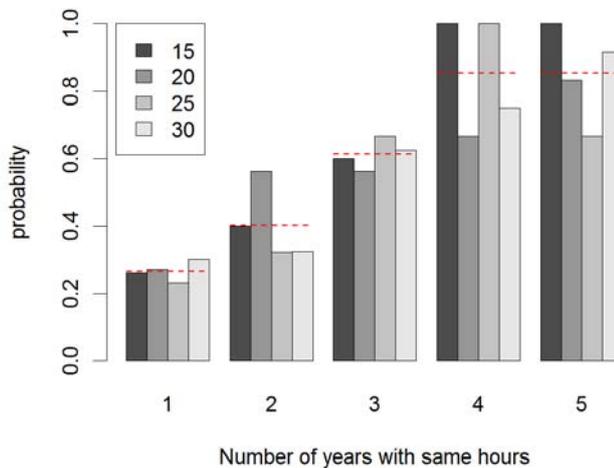
FIGURE 4.31 BAR PLOTS OF ONE-YEAR TRANSITION PROBABILITIES FOR PART-TIME FEMALES, AGED 22 TO 65.



What is also apparent is that the probability of persisting with the same number of hours worked increases markedly if the individual has remained at that level for multiple years. The probability of persisting with H hours at time $t+1$, given H hours for 1, 2, 3, 4 and 5 years, for various values of H , is given in Figure 4.32. The dotted red line in Figure 4.32 marks the average probability across the four levels considered. It is apparent from the figure that relatively consistent probabilities of persistency exist for different levels of hours worked per week.

The increase in the probability of persistency between the number of years (m) with the same hours for $m = 1$ and $m = 2, 3$, and 4 , is 14 per cent, 35 per cent and 59 per cent respectively. i.e., there is a 35 per cent greater chance of working the same number of hours H per week, if the individual had worked H hours per week for the previous three years as opposed to just the previous year.

FIGURE 4.32 PART-TIME FEMALES. PROBABILITIES OF WORKING H HOURS GIVEN H HOURS WORKED FOR PREVIOUS YEARS.



A model was developed using transition matrices for the number of hours worked between time t and time $t+1$. If we denote $p(H_{t+1} | H_t)$ as the probability of an individual working H_{t+1} hours per week at time $t+1$ given the individual had worked H_t hours at time t , then the transition matrix for individuals remaining in the part-time (pt) state can be written:

$$\mathbf{P}(H_{t+1} | H_t, L_{t+1} = L_t = \text{pt}) = \begin{Bmatrix} p(H_{t+1} = 1 | H_t = 1) & p(2 | 1) & \dots & p(34 | 1) \\ p(1 | 2) & p(2 | 2) & \dots & p(34 | 2) \\ \dots & \dots & \dots & \dots \\ p(1 | 34) & p(2 | 34) & \dots & p(34 | 34) \end{Bmatrix}$$

A ‘lag one’ matrix was derived empirically from the data, to be applied for projecting the number of hours at time $t+1$ for an individual with variable hours in the previous two years (t and $t-1$):

$$\mathbf{P}(H_{t+1} | H_t, H_t \neq H_{t-1}, L_{t+1}=L_t = \text{pt}) = \left\{ \begin{array}{cccc} p(H_{t+1} = 1 | H_t = 1, H_{t-1} \neq 1) & p(2 | 1, H_{t-1} \neq 1) & \dots & p(34 | 1, H_{t-1} \neq 1) \\ p(1 | 2, H_{t-1} \neq 2) & p(2 | 2, H_{t-1} \neq 2) & \dots & p(34 | 2, H_{t-1} \neq 2) \\ \dots & \dots & \dots & \dots \\ p(1 | 34, H_{t-1} \neq 34) & p(2 | 34, H_{t-1} \neq 34) & \dots & p(34 | 34, H_{t-1} \neq 34) \end{array} \right\}$$

While it would have been attractive to impose a constant transition probability of 27 percent for the diagonal (corresponding to the average for the first set of bar plots in Figure 4.32), the probabilities of one-year persistency for hours intermediate to the five hourly blocks (i.e., outside of 10, 15, 20, 25 and 30) are lower and display greater variability. It was, therefore, decided to apply the empirical transition probabilities in place of the constant amount.

Other matrices were generated for lags two to four¹⁵⁷. These were based on the ‘lag one’ matrix, where the diagonal entries were increased by a constant amount (according to the average increased probabilities of persistency derived from Figure 4.32):

$$\begin{aligned} & \text{diag}(\mathbf{P}(H_{t+1} | H_t = H_{t-1}, H_{t-1} \neq H_{t-2}, L_{t+1}=L_t = \text{pt})) \\ & = \text{diag}(\mathbf{P}(H_{t+1} | H_t, H_{t-1} \neq H_t, L_{t+1}=L_t = \text{pt})) + 0.14, \end{aligned}$$

$$\begin{aligned} & \text{diag}(\mathbf{P}(H_{t+1} | H_t = H_{t-1} = H_{t-2}, H_{t-2} \neq H_{t-3}, L_{t+1}=L_t = \text{pt})) \\ & = \text{diag}(\mathbf{P}(H_{t+1} | H_t, H_{t-1} \neq H_t, L_{t+1}=L_t = \text{pt})) + 0.35, \end{aligned}$$

$$\begin{aligned} & \text{diag}(\mathbf{P}(H_{t+1} | H_t = H_{t-1} = H_{t-2} = H_{t-3}, L_{t+1}=L_t = \text{pt})) \\ & = \text{diag}(\mathbf{P}(H_{t+1} | H_t, H_{t-1} \neq H_t, L_{t+1}=L_t = \text{pt})) + 0.59. \end{aligned}$$

¹⁵⁷ In the subsequent simulations it is assumed that the lag four transition matrix holds for cases where the number of hours worked persists for four or more years.

The off-diagonals were reduced proportionately to ensure that each row in the transition matrices summed to one.

Following this approach, full-time to full-time states were extracted and transition probabilities between the numbers of full-time hours were considered. As for part-time females, there is a general propensity for greater probabilities of transition to five hourly blocks (i.e., 35, 40, 45 and 50). In addition, as seen in Figure 4.33, there is also a relatively large likelihood of 38 hours worked. As for part-time females, Figure 4.34 gives the probability of persisting with H hours at time $t+1$, given H hours for 1, 2, 3, 4 and 5 years, and various values of H , for full-time females. The increase in the probability of persistency between the number of years (m) with the same hours for $m=1$ and $m=2, 3$, and 4 , is 28 per cent, 35 per cent and 45 per cent respectively.

FIGURE 4.33 BAR PLOTS OF ONE-YEAR TRANSITION PROBABILITIES FOR FULL-TIME FEMALES, AGED 22 TO 65.

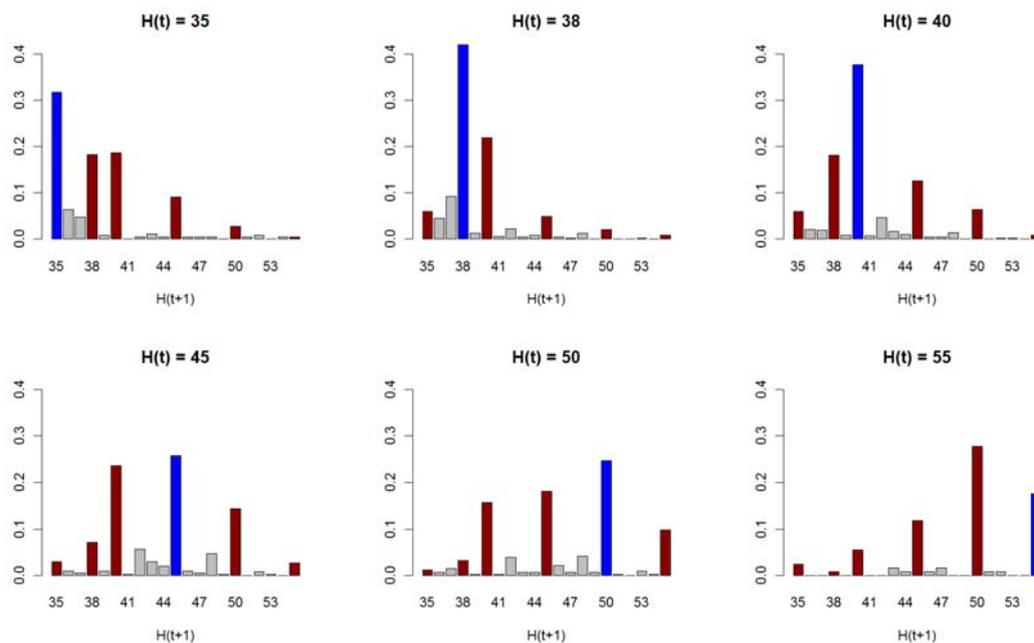
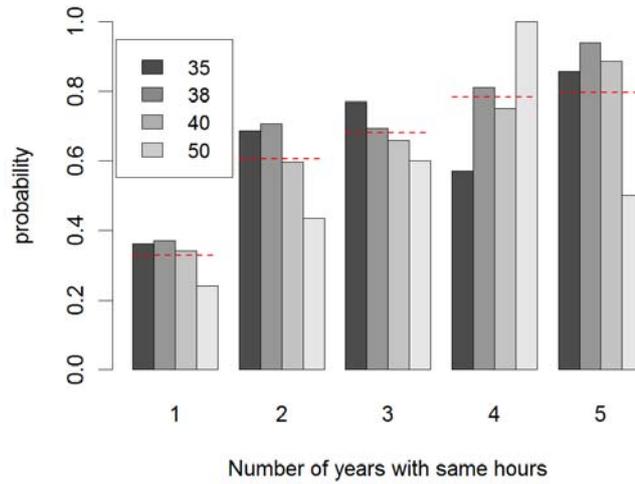


FIGURE 4.34 FULL-TIME FEMALES. PROBABILITIES OF WORKING H HOURS GIVEN H HOURS WORKED FOR PREVIOUS YEARS.



The corresponding ‘lag one’ transition matrix, $\mathbf{P}(H_{t+1} | H_t, H_t \neq H_{t-1}, L_{t+1} = L_t = \text{ft})$, was derived empirically, with:

$$\mathbf{P}(H_{t+1} | H_t, H_t \neq H_{t-1}, L_{t+1} = L_t = \text{ft}) = \begin{pmatrix} p(H_{t+1} = 35 | H_t = 35, H_{t-1} \neq 35) & p(36 | 35, H_{t-1} \neq 35) & \dots & p(60 | 35, H_{t-1} \neq 35) \\ p(35 | 36, H_{t-1} \neq 36) & p(36 | 36, H_{t-1} \neq 36) & \dots & p(60 | 36, H_{t-1} \neq 36) \\ \dots & \dots & \dots & \dots \\ p(35 | 60, H_{t-1} \neq 60) & p(36 | 60, H_{t-1} \neq 60) & \dots & p(60 | 60, H_{t-1} \neq 60) \end{pmatrix}$$

Transition matrices for lags two to four were derived similarly as for part-time females.¹⁵⁸

For females transitioning to part-time employment from another state (full-time, not in the labour force, or unemployed), probabilities were derived for hours worked from 1 hour to 35 hours. The serial correlation between hours worked for individuals transitioning between labour states is either not significant (between full-time and part-time)¹⁵⁹, or not relevant (between the other states, with zero hours worked, and part-time), so estimates for hours worked ignored previous levels.

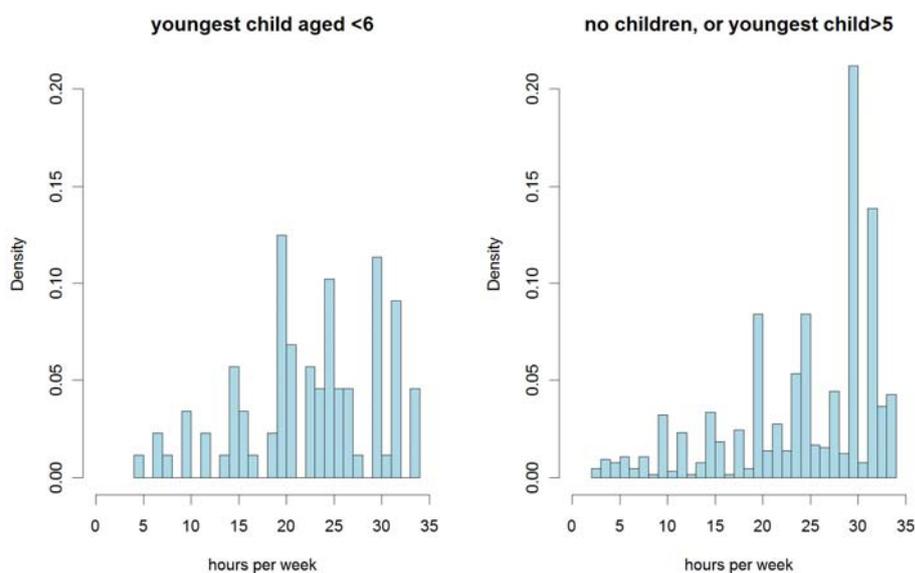
¹⁵⁸ It was assumed that individuals with over 60 hours of work performed 60 hours. As seen in Figure 4.30 this corresponds with a very small fraction of the full-time female population.

¹⁵⁹ Correlation between FT and PT, and PT to FT, were 14% and -15% respectively for females. This compares with approximately 65% for FT to FT and PT to PT.

To test if individual socio-economic characteristics were significantly correlated with hours worked for individuals *changing* labour state, a regression of female part-time hours worked was fit against age, marital status, presence and age of youngest child, education and hourly wage. Age of worker, age of youngest child, and hourly wage were statistically¹⁶⁰ significant. Despite the statistical significance, the explanatory power for the regression fit was very low (R-squared < 5%) and the predicted mean hours under realistic covariate ranges for age and hours worked varied by an immaterial amount for the purposes of the models developed here. In contrast, there was a noticeable difference in the pattern and magnitude of hours per week worked for part-time women with children under the age of six, and part-time women with older children (or no children) (see Figure 4.35).

Consequently, two sets of probability vectors were extracted for the model for part-time women who were not part-time in the previous period; the simulated hours worked for those with children under the age of six were assumed to follow the distribution in the first plot in Figure 4.35, while hours worked for all other part-time women were assumed to follow the second distribution.

FIGURE 4.35 PART-TIME FEMALES. HISTOGRAMS OF HOURS PER WEEK WORKED AT $T+1$ FOR FEMALES WHO WERE NOT PART-TIME AT TIME T .



¹⁶⁰ Age and log hourly wage were significant at the 1% level, and age of youngest child was significant at the 0.1% level.

The two probability vectors can be expressed as:

$$\mathbf{P}(H_{t+1} | chi_{t+1} = \text{age 0 to 5}, L_{t+1} = \text{pt}, L_t \neq \text{pt}) = \left\{ \begin{array}{l} p(H_{t+1} = 1 | chi_{t+1} = \text{age 0 to 5}) \\ p(H_{t+1} = 2 | chi_{t+1} = \text{age 0 to 5}) \\ \dots \\ p(H_{t+1} = 34 | chi_{t+1} = \text{age 0 to 5}) \end{array} \right\}$$

$$\mathbf{P}(H_{t+1} | chi_{t+1} \neq \text{age 0 to 5}, L_{t+1} = \text{pt}, L_t \neq \text{pt}) = \left\{ \begin{array}{l} p(H_{t+1} = 1 | chi_{t+1} \neq \text{age 0 to 5}) \\ p(H_{t+1} = 2 | chi_{t+1} \neq \text{age 0 to 5}) \\ \dots \\ p(H_{t+1} = 34 | chi_{t+1} \neq \text{age 0 to 5}) \end{array} \right\}$$

This process was repeated for females transitioning to full-time employment from another state. In contrast to part-timers, the presence or age of children was not a significant determinant of full-time hours worked. Statistically significant variables included age, education, and log hours worked. While allowing for variation according to these characteristics could be the subject of a more complete model, for the present exercise a single set of probabilities was extracted for all full-time females who were not full-time in the previous period, which can be expressed as:

$$\mathbf{P}(H_{t+1} | L_{t+1} = \text{ft}, L_t \neq \text{ft}) = \left\{ \begin{array}{l} p(H_{t+1} = 35) \\ p(H_{t+1} = 36) \\ \dots \\ p(H_{t+1} = 60) \end{array} \right\}$$

Models H.0, H.1, and the stochastic model, H.2, based on transition matrices and vectors as described in this section, are used in the simulation of annual earnings so as to explore the implications of model complexity to ICL costs. This is taken up in the next section.

4.8 Implications of earnings models to ICL costs

To assess the impact of the alternative labour force state and earnings models on ICL costs, ICL debt and compulsory repayments were calculated over a 30-year projection period for the subpopulation of females aged 30 to 49 as at the start of the HILDA survey (Wave 1). The models considered in the simulations are summarised in Table 4.15.

TABLE 4.15 MODELS USED IN THE ICL SIMULATIONS

Variable	Model	Model description
Labour force state	L.0	Multinomial fit with socio-economic covariates
	L.1	L.0 + labour force state at time $t-1$ as covariate
	L.2	L.0 + labour force states at time $t-1$ and $t-2$ as covariates
	L.5	L.0 + labour force states from time $t-1$ to $t-5$ as covariates
Hourly wage	W.0	mean earnings rate from regression fit
	W.1	W.0 + fixed permanent component
	W.2	W.0 + fixed permanent component + normal transitory shocks
	W.3	W.0 + random walk permanent component (with normal errors) + normal transitory shocks
	W.5	W.0 + random walk permanent component (with non-normal errors) + non-normal transitory shocks
Hours worked	H.0	median hours worked for FT and PT employment states
	H.1	Previous hours worked if at same employment state. Otherwise, median hours worked as per H.0
	H.2	Non-parametric dynamic stochastic model

The parameters of the ICL considered in this section include an initial debt of \$6,500, and thresholds and rates as per Chapter 2 (i.e., with a minimum threshold below that of HECS). Additionally, it is assumed that projected incomes and income thresholds are increased with average growth in earnings at 4 per cent per annum, and outstanding debt is indexed at 2.5 per cent per annum. For some of the examples in this section HECS thresholds and rates were also applied for comparison. It was assumed that education and marital status remained constant for each individual for the duration of the projection. Dependent children were treated differently¹⁶¹.

¹⁶¹ For the first seven years, it was assumed that the child status followed the actual HILDA data. For the projection period beyond the first seven years, assumptions were made as follows. For individuals with a youngest child 5 years or under by year 7, it was assumed that this persisted for three years of the projection period, after which the child remained dependent but moved to the next factor level. For individuals with a dependent child greater than age 5, it was assumed that the child remained

In Section 4.8.1 ICL costs are simulated in the presence of both deterministic and stochastic earnings models. In these first simulations labour state is assumed to remain static for the 30-year period projection period. Combinations of simple and complex models of hourly wage (W.0 to W.5) and hours worked (H.0 to H.2) are applied to generate simulated earnings and the corresponding ICL costs are calculated. In these simulations differences in costs are associated with variation in the earnings models, and are not due to mobility in labour force state. It is shown that the models that incorporate mobility through permanent and transitory shocks lead to very different patterns of repayment than static models, and this appears to be the case for HECS thresholds and rates, as well as for the lower thresholds of Chapter 2.

In Section 4.8.2 labour force is permitted to vary according to models L.0 to L.5. ICL costs are investigated under variable labour force models with both deterministic and stochastic earnings projections. It is shown that the models that include lagged labour force state materially alter predictions relative to model L.0, and that allowing for dynamic labour force mobility is critical when estimating default risk and aggregate ICL costs.

Finally, in Section 4.8.3 the models are applied to representative starting income levels for consistency with the paid parental leave ICL scheme examples in Chapter 2. Part-time single females with three starting income levels (lower quartile, median and upper quartile) have their incomes projected under static assumptions (consistent with model W.1-H.1) and under stochastic assumptions (W.5-H.2), and the implications of the models to ICL repayments and subsidies are explored.

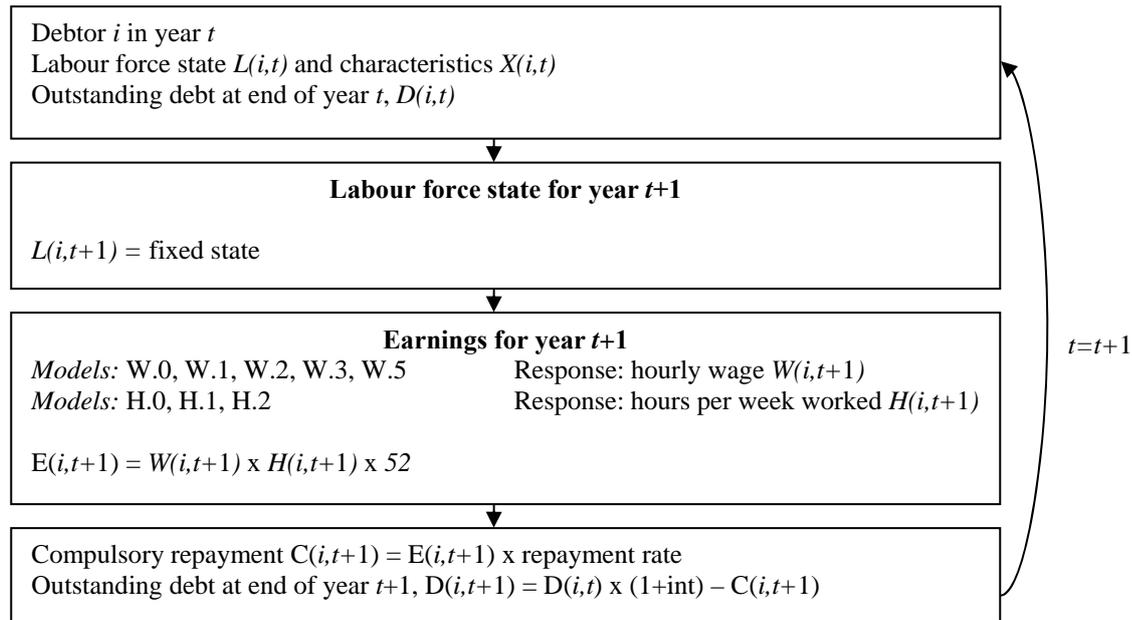
4.8.1 Simulating ICL costs with deterministic and stochastic earnings

In this section ICL debt and repayments are simulated for a 30-year period assuming all debtors have static employment. Earnings follow models W.0 to W.5 and H.0 to

dependent for the next 10 years. It was assumed that individuals with no dependants would remain without dependants for the duration of the projection period.

H.2, and were iteratively predicted via Monte Carlo simulation¹⁶². Compulsory repayments and outstanding debt were calculated based on the estimated earnings. A summary of the simulation process is given in Figure 4.36. One simulation involved repeating this process for $t = 1$ to 30, for all individuals $i = 1, \dots, N$ within the subpopulation, and 100 simulations were performed for each earnings model considered.

FIGURE 4.36 ICL SIMULATION PROCESS FOR STATIC LABOUR FORCE STATE AND VARIABLE EARNINGS



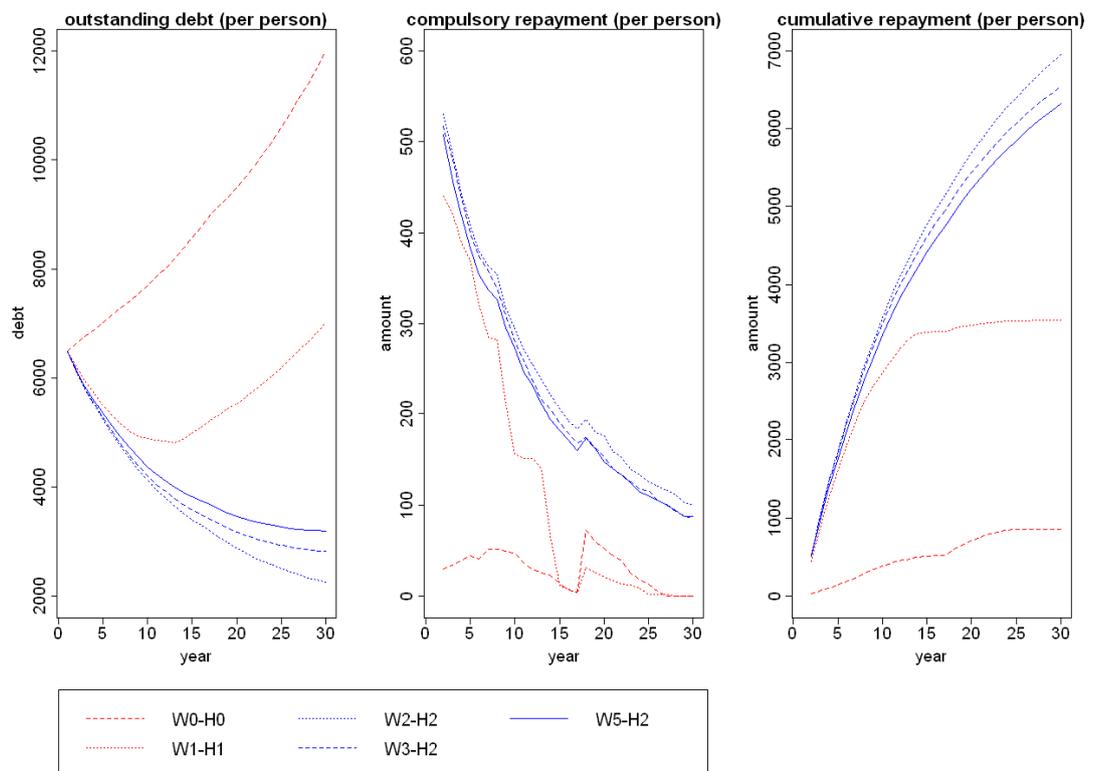
First, earnings are projected where both hourly wage and hours worked are treated as deterministic (models W.0 and H.0); i.e., permanent variation in hourly wage is ignored, and hours worked is the median level for part-time and full-time workers. This is followed by another set of deterministic assumptions, but where residual variation in hourly wage at year 1 is assumed to represent individual permanent effects (model W.1) and hours worked at time $t+1$ are assumed to be identical to hours worked at time t (model H.1). Model W.1-H.1 is analogous to static earning percentiles, in that individual variation is assumed to persist and earnings mobility is absent.

Next, it is assumed that hourly wage is permitted to vary stochastically following model W.2 whereby earnings mobility is accommodated through Gaussian transitory

¹⁶² The Monte Carlo approach involved generating a uniform random number and comparing this with the values of the cumulative distribution for the predicted earnings functions. This process is described in more detail in Section 4.2.4.

shocks, and hours worked follows model H.2. In the next combined model (W.3-H.2) the permanent component for hourly wage is permitted to vary as a random walk with Gaussian errors, such that earnings mobility manifests via both permanent and transitory shocks. Finally, in the last combined model (W.5-H.2), Gaussian shocks to hourly wage are replaced with non-parametric shocks. In these first simulations labour force state is assumed to be part-time for all debtors. The results of the average ICL calculations for 100 simulations are presented in Figure 4.37.

FIGURE 4.37 ICL ESTIMATES. FEMALES, AGED 30-49, PART-TIME LABOUR FORCE STATE. PROJECTIONS FOR 30 YEAR PERIOD BASED ON EARNINGS MODELS.



The differences between earnings models are immediately apparent. Compulsory repayments are greater and there is a correspondingly lower outstanding debt for the models that incorporate stochastic variability in earnings.

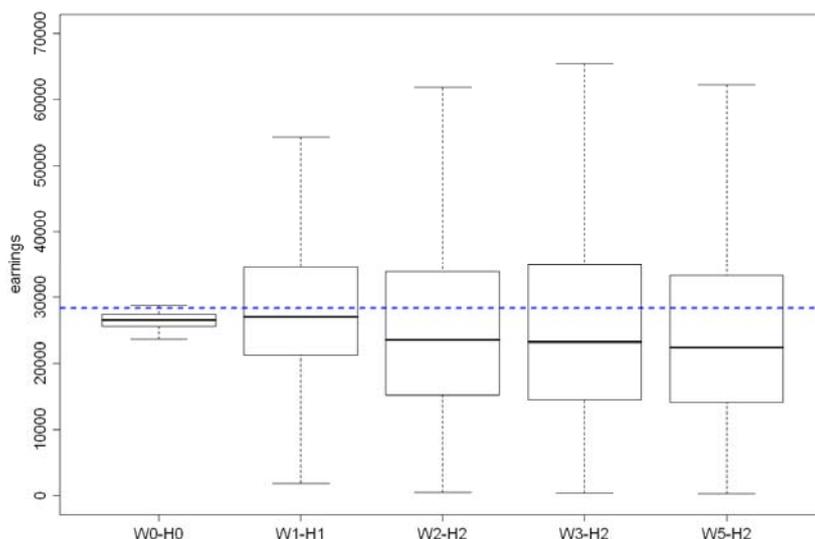
The deterministic models (in red in Figure 4.37) perpetuate the level of earnings of individuals. Under model W.0-H.0 there is no allowance for permanent differences between individuals, and the mean earnings are below the minimum threshold for almost all debtors, resulting in less than \$1,000 of debt repaid on average over the 30 year projection period. Under model W.1-H.1, permanent earnings variation between individuals is incorporated, and as a consequence a much greater proportion

of debtors have earnings above the minimum threshold. While those above the minimum repay their debt, those below are projected to remain below - by year 15, debtors who can repay, have repaid, while the debt of those under the minimum threshold continues to grow with accrued interest.

In contrast, under stochastic earnings models, earnings mobility enables movement across the minimum threshold. While transitions can occur in both directions (i.e., those with lower earnings transition to higher earnings, and vice versa), the simulations suggest that the inclusion of stochastic variability increases the average repayment relative to deterministic earnings models, and thus reduces projected outstanding debt. While the stochastic models all lead to greater repayments and less debt, there is variation; as hourly wage model complexity increases, repayments fall, yet remain markedly higher than those produced under deterministic assumptions.

Differences in the simulated earnings are explored in Figure 4.38. Real earnings are given at year 20 for a selection of models, with the minimum ICL threshold of \$28,259 superimposed.

FIGURE 4.38 BOXPLOTS OF REAL PART-TIME EARNINGS AT YEAR 20. MINIMUM THRESHOLD (\$28,259) SUPERIMPOSED

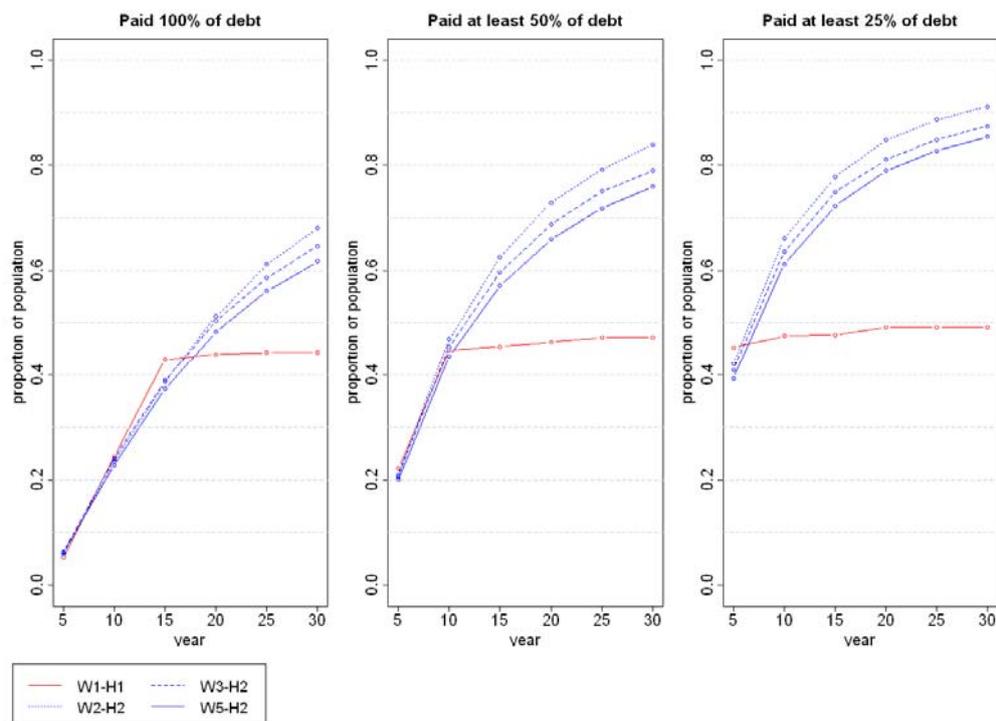


It is clear from Figure 4.38 that a large proportion of part-time females have earnings below the minimum income threshold under the stochastic models. Indeed, it appears that a greater proportion of females have earnings above the threshold under the deterministic model W.1-H.1. While this may seem inconsistent with the

results of Figure 4.37 where lower repayments are made under the deterministic models, the cross-sectional density plots mask the earnings mobility that is captured in the stochastic models.

The inconsistency between the cross-sectional distributional plots and ICL results can be better understood through inspection of Figure 4.39. In this figure, the proportions of females who have paid off all debt, at least half their debt, or at least one quarter of their debt, are given under various earnings models. For the static model W.1-H.1 (in red), the proportion of debtors to have paid off 25 per cent, 50 per cent, or 100 per cent of their debt, changes very little after year 15. This is expected given mobility is not accommodated in these models; those with earnings above the minimum threshold pay off their debt within 15 years, while the remaining debtors make few if any repayments thereafter (as evidenced by the unchanging proportions for the three plots). In contrast, for the stochastic models mobility in earnings is such that the proportion paying some, and all, debt increases over the prediction period as more individuals have the opportunity to exceed the threshold.

FIGURE 4.39 PROPORTION OF FEMALES WHO HAVE REPAID ALL, AT LEAST HALF, OR AT LEAST ONE QUARTER OF DEBT.



At risk of generalising from the above example, the ICL simulations were repeated where the labour force state of debtors was assumed to be full-time, rather than part-

time, and where HECS thresholds and rates applied, rather than those from Chapter 2. The results for projected outstanding debt are given in Figure 4.40. As expected, under the thresholds of Chapter 2 when employment is assumed to be full-time (indicated by the bold lines), all debtors repay quickly regardless of the earnings models.

The differences between stochastic and deterministic earnings models that were apparent in Figure 4.37 for part-time employment are also evident under HECS thresholds. Even with a relatively high minimum threshold ($> \$41,594$), under part-time earnings there are significant additional repayments when mobility is accommodated into earnings.

Under HECS thresholds and full-time employment, repayments are greater and debt lower. In contrast to the results with PPICL thresholds, with HECS thresholds there are clear differences between W.1-H.1 and the stochastic models. This can be explained by noting that approximately 30 per cent of full-time debtors under W.1-H.1 in Figure 4.40 have earnings below the minimum HECS threshold ($\$41,594$). While these individuals stay in debt during the projection period (and thus average debt remains above $\$2,000$), those subject to stochastic variation have opportunities for earnings to exceed the threshold. Although mobility under the stochastic models results in some full-time individuals falling below the minimum threshold, the same mobility leads to an increase in repayments and reduction in debt for others. Figure 4.40 suggests that, on balance, this mobility has a positive influence on repayments.

To quantify the implication of incorporating stochastic earnings mobility, subsidies are produced for model W.1-H.1 and W.5-H.2. The discount rate used in the calculations is 5.5 per cent, consistent with that used in Chapters 2 and 3. Results are given in Table 4.16.

FIGURE 4.40 AVERAGE OUTSTANDING DEBT ESTIMATES. FEMALES, AGED 30-49, PROJECTIONS FOR 30 YEAR PERIOD BASED ON EARNINGS MODELS.

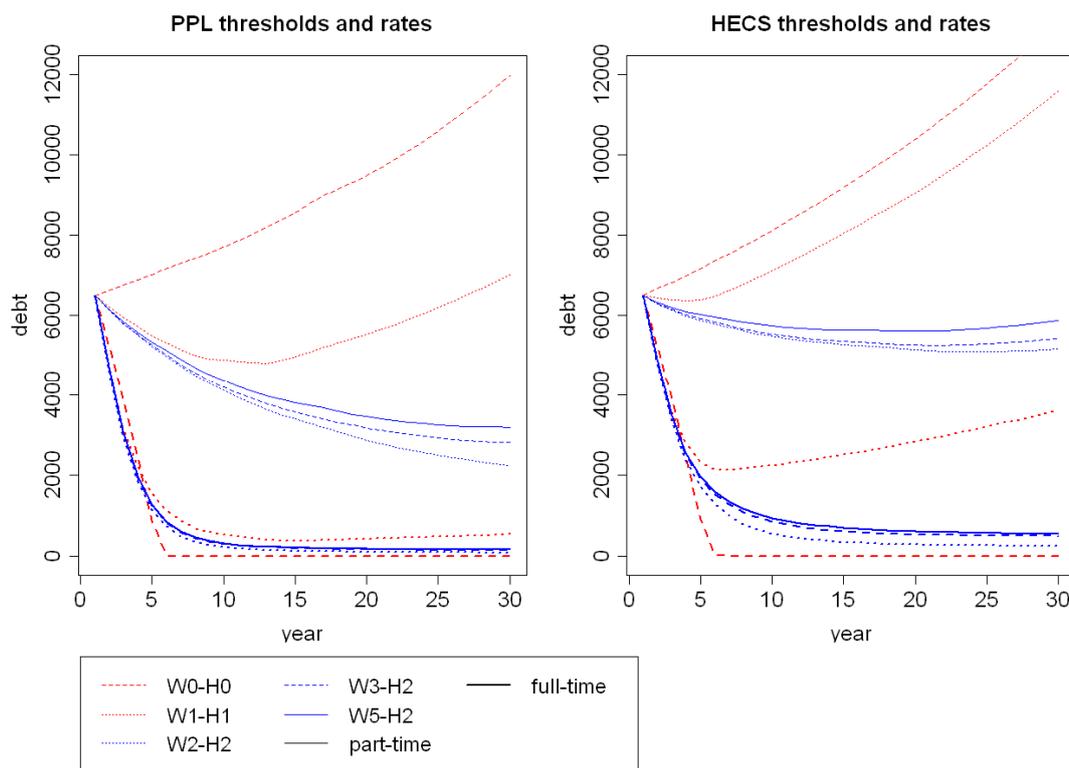


TABLE 4.16 ICL SUBSIDIES (%) CORRESPONDING WITH MODELS W.1-H.1 AND W.5-H.2 FOR FEMALES. OUTSTANDING DEBT = \$6,500 (LOAN = ~\$5,400)¹⁶³

Thresholds and rates	PPICL		HECS	
Employment state	Part-time	Full-time	Part-time	Full-time
Model W.1-H.1	51	-6	86	18
Model W.5-H.2	29	-9	50	-4

The key result of this section is that ICL cost estimates can differ significantly if earnings mobility is included or excluded, even when employment state is assumed to be static. In all cases considered here subsidy proportions are lower under the preferred stochastic earnings model (W.5-H.2), and this is particularly the case for debtors employed part-time.¹⁶⁴ In conclusion, repayments appear to be greater and debt may diminish more quickly under stochastic models that allow for earnings mobility than under static earnings assumptions.

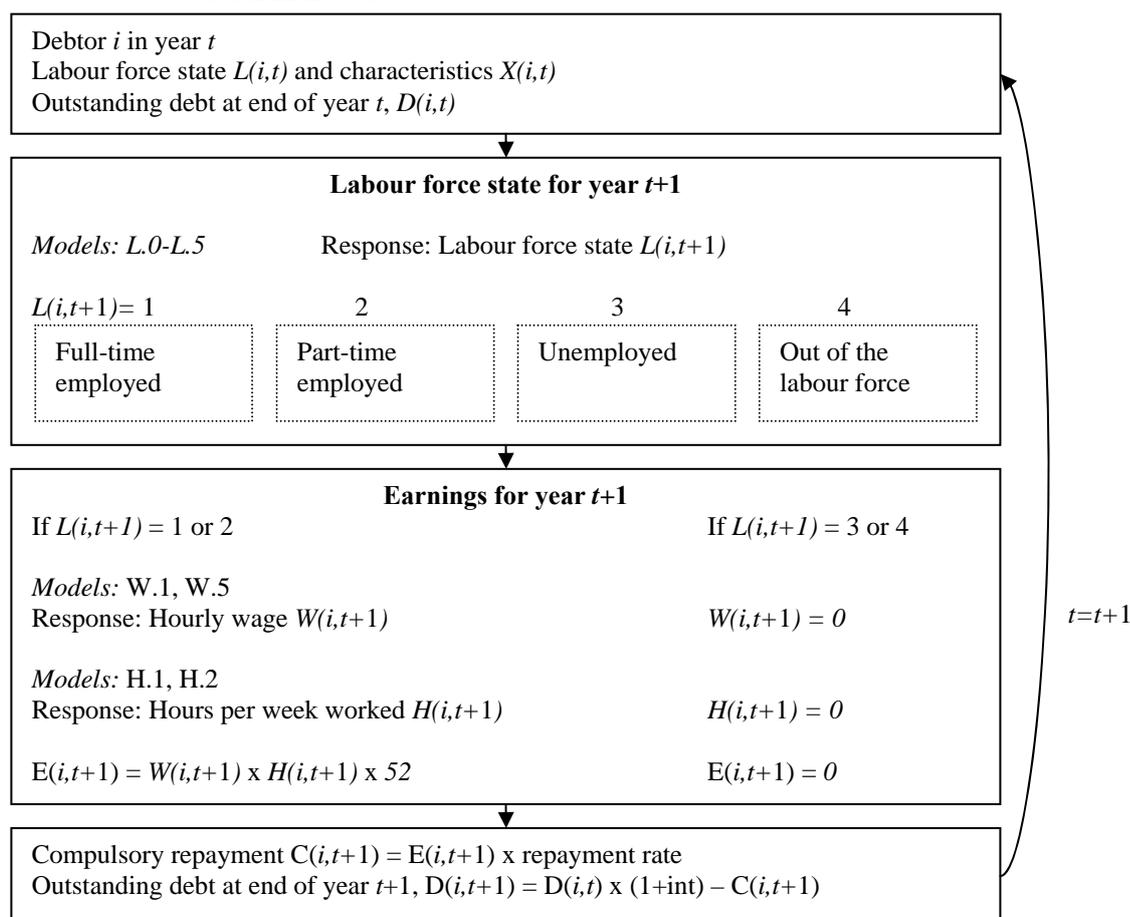
¹⁶³ It is assumed that a 20 per cent surcharge applies to the loan.

¹⁶⁴ Consequently, it may be that static earnings assumptions provide a conservative lower bound for projected ICL repayments, and an upper bound for costs.

4.8.2 Simulating ICL costs with dynamic labour force states and earnings

In this section, the impact of labour force state on ICL predictions is assessed. Incorporating labour force mobility is essential if one is attempting to accurately model costs of default (doubtful debt). The expected probabilities of labour force transition between states for each year were derived from the models L.0-L.5, and labour force state was predicted for the 30 year projection period through Monte Carlo simulation, with initial labour force state taken as the actual state from Wave 1 of the sample data of full-time and part-time females aged 30-49.¹⁶⁵ 100 simulations were run for each model. The process for one simulation for one debtor i is displayed graphically in Figure 4.41.

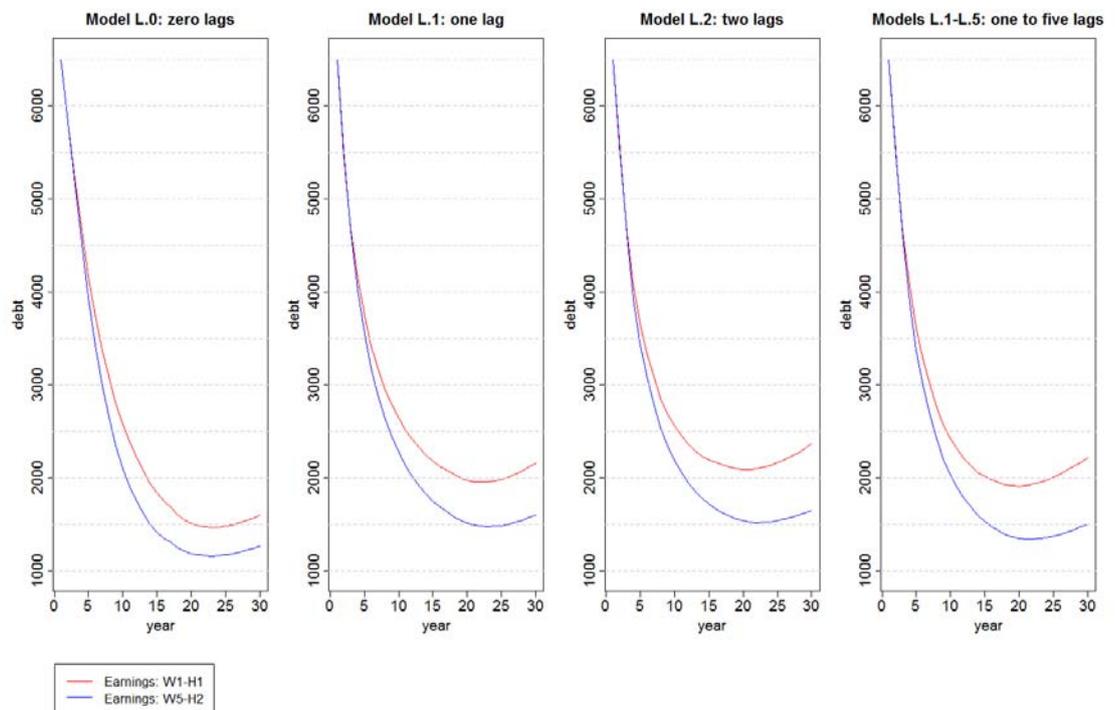
FIGURE 4.41 ICL SIMULATION PROCESS FOR VARIABLE LABOUR FORCE STATE AND VARIABLE EARNINGS



¹⁶⁵ While it is acknowledged that labour force transitions can occur continuously, due to data limitations the labour force model developed uses annual discrete time units so that individuals can only transition between states at one time in each year.

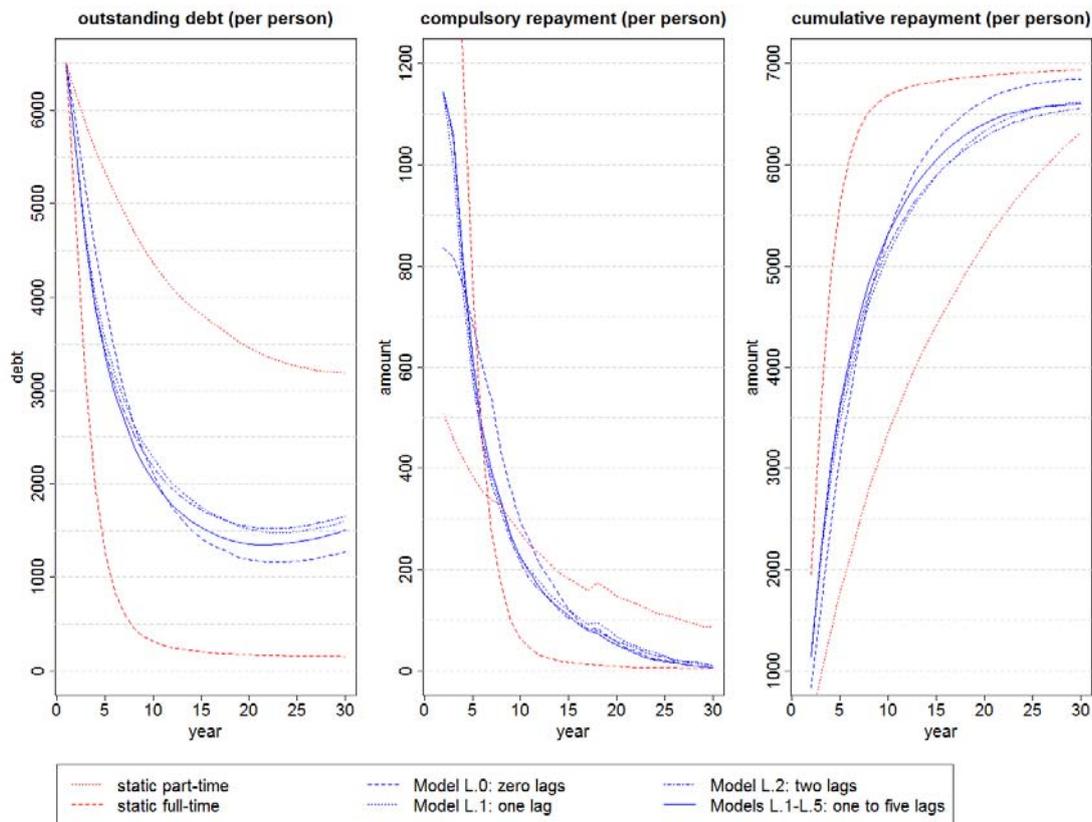
Average outstanding debt estimates for four labour force models (with interactions), and the earnings models W.1-H.1 and W.5-H.2, are compared in Figure 4.42. As in the previous section, repayments are greater and average projected debt is lower under stochastic earnings assumptions than under static earnings. While there is clearly a difference in results between model L.0 and the models that incorporate lagged labour state, there is little variation in results under the model L.2 relative to L.1. In contrast, there is a more noticeable difference in the projections under L.5 and model W.5-H.2.

FIGURE 4.42 OUTSTANDING DEBT ESTIMATES. FEMALES, AGED 30-49, SIMULATED LABOUR FORCE AND EARNINGS FOR 30 YEAR PERIOD. EARNINGS MODELS W.1-H.1 AND W.5-H.2.



The results for the stochastic earnings model W.5-H.2 are shown in more detail in Figure 4.43. ICL outputs assuming static part-time and static full-time employment are given in the figure for comparison.

FIGURE 4.43 ICL ESTIMATES. FEMALES, AGED 30-49, PROJECTIONS FOR 30 YEAR PERIOD BASED ON MODELS L.0, L.1-L.5 (WITH INTERACTIONS), AND EARNINGS MODEL W.5-H.2.



The economic and statistical justification for including lagged state, and the practical significance, as illustrated in the different projections in Figure 4.43, are sufficient grounds for applying at least one lag when choosing the form of the labour force model to use in ICL estimation. As shown earlier in Table 4.5, greater lags beyond one are statistically significant and are clearly superior in capturing persistence in labour force state. Interestingly, the model that includes one to five lags leads to long-term debt and repayment projections that lie between models L.0 and L.1-L.2. The choice of appropriate model may become clearer in the future as additional waves of HILDA are collected and analysed. Regardless, there is little doubt that a labour force model with at least one lag, and ideally more, is necessary when projecting labour force state for the purposes of ICL modelling.

While not plotted here, the results under the labour force models that exclude interactions differ only marginally from those in Figure 4.43.

The implications of ignoring labour force mobility are further explored by producing subsidies under the various labour force models (see Table 4.17).

TABLE 4.17 ICL SUBSIDIES (%). MODELS W.1-H.1 AND W.5-H.2 UNDER DIFFERENT LABOUR FORCE MODELS (WITH INTERACTIONS). FEMALES. OUTSTANDING DEBT = \$6,500 (LOAN = ~\$5,400)

Labour force model	L.0	L.1	L.2	L.5	Static full-time	Static part-time
Model W.1-H.1	11.1	13.7	14.5	13.1	-5.9	51.2
Model W.5-H.2	7.5	9.2	9.0	7.5	-9.0	28.8

Subsidies were also produced for model W.5-H.2 under the labour force models excluding interactions, and were found to be very similar to those in Table 4.17; the subsidy for model W.5-H.2 under L.0, L.1, L.2 and L.5 excluding interactions were 8.0, 8.9, 8.2 and 7.0 per cent respectively.

A possible approach to aggregate costing, and one that is used in Section 2.6.3 of Chapter 2, is to take the subsidies under static employment assumptions and multiply these by the proportions of debtors expected to be in each state. For example, in the data underlying the ICL estimates of this section, there were 288 full-time and 308 part-time women at the start of the projection period. If we were to assume that labour force states remained static for the projection period then an aggregate subsidy for model W.5-H.2 could be estimated as:

$$((28.8\% \times 308) + (-9.0\% \times 288)) / (308 + 288) = 10.5\%$$

As seen in Table 4.17, under model L.5 the subsidy is only 7.5%, which suggests that the 'rough' approach over-estimates costs. The potential for over-estimating cost is particularly discernible if one is limited to both static earnings (i.e., W.1-H.1) and static labour force assumptions. In this case a rough aggregate subsidy would be 23.6%.¹⁶⁶ Again, the most realistic estimate for aggregate costs for this sample is 7.5%, being the subsidy estimate under the preferred stochastic models for earnings and labour force state (models W.5-H.2 and L.5).

The results from this section point to the importance of allowing for both labour force and earnings mobility through the development of stochastic models. While

¹⁶⁶ $((51.2\% \times 308) + (-5.9\% \times 288)) / (308 + 288) = 23.6\%$

static assumptions may be justifiable when considering idealised hypothetical scenarios, they are clearly not appropriate for aggregate cost estimates.

4.8.3 *Simulating PPICL costs for single females*

In this final section, the implications of earnings model complexity on the repayments and subsidies under the individual hypothetical scenarios for the paid parental leave ICL in Chapter 2 are considered. For this section, the re-analysis of ICL costs is confined to single females, as it is this group that is most likely to fall below the minimum income threshold.

Following Scenarios 3 and 4 of Table 2.3 of Chapter 2, hypothetical single women are considered with three starting income levels; the lower quartile, median and upper quartile as extracted from ABS data for 31 year olds. Starting income levels under both full-time and part-time assumptions as used in Chapter 2 are listed in Table 4.18. The corresponding assumed hourly wage and weekly number of hours worked that are used in models in this section are also given in the table. In each case the hourly wage multiplied by the hours worked and 52 weeks result in the approximate annual earnings.

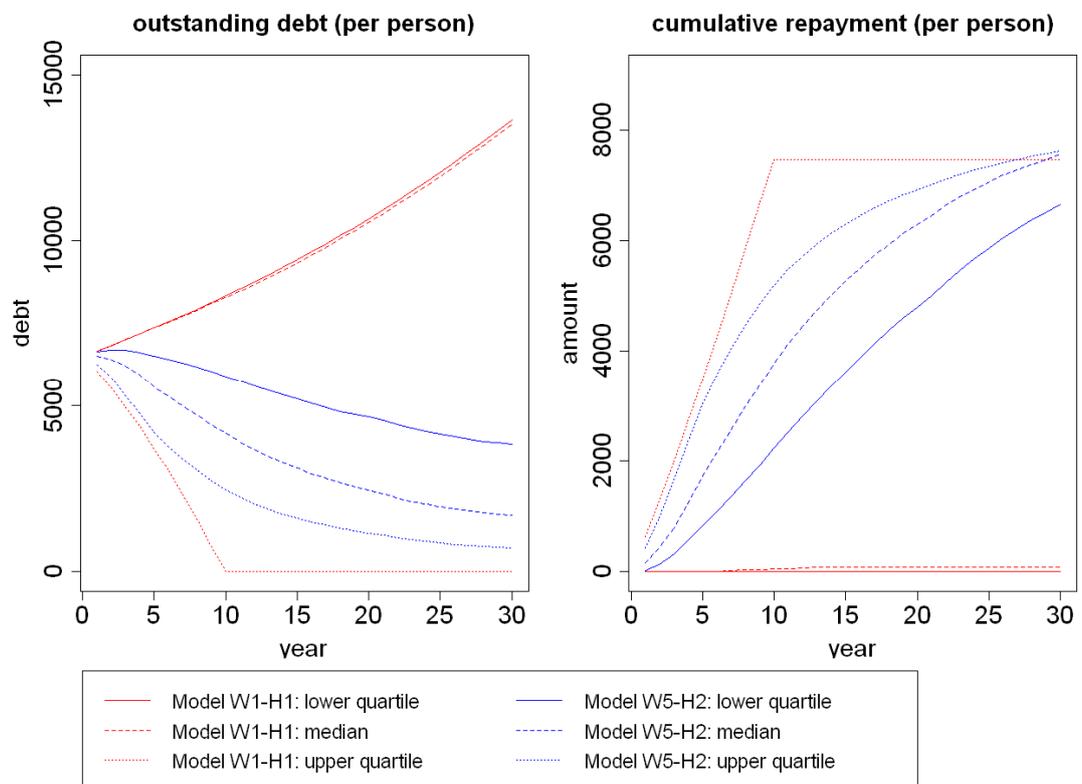
Two models were compared to illustrate the effect of incorporating realistic earnings mobility into ICL projections. As stated earlier, W.1-H.1 perpetuates earnings along a static path for each individual and is akin to using static earnings percentiles. This serves as an appropriate substitute to the static earnings profiles applied in Chapter 2. W.5-H.2 is the most realistic of the earnings models developed in this chapter, incorporating stochastic dynamic processes for both hourly wage and hours worked.

TABLE 4.18 STARTING INCOME LEVELS. LOWER, MEDIAN AND UPPER INCOME QUARTILES FOR FULL-TIME AND PART-TIME SINGLE WOMEN. CONSISTENT WITH CHAPTER 2 ASSUMPTIONS, WITH CORRESPONDING ASSUMED HOURLY WAGE AND WEEKLY HOURS WORKED

	Full-time	Hourly wage	Hours worked
Lower quartile	\$39,000	20	38
Median	\$52,000	25	40
Upper quartile	\$65,000	28	45
Part-time			
Lower quartile	\$15,600	20	15
Median	\$24,700	25	19
Upper quartile	\$31,200	30	20

Future part-time earnings were simulated for a 30 year period for each starting income under models W.1-H.1 and W.5-H.2, and the ICL results were calculated. Figure 4.44 presents the results for females with static part-time employment. For both median and lower quartile earners current and projected part-time earnings under W.1-H.1 are (for the most part) below the minimum threshold and consequently there is close to zero future repayment. In contrast, upper quartile earners are above the minimum threshold and quickly repay their debt. The static nature of model W.1-H.1 is apparent; individuals above the threshold at time 0 remain above the threshold for the future projection period, and vice versa.

FIGURE 4.44 ICL DEBT AND REPAYMENTS UNDER MODELS W.1-H.1 AND W.5-H.2, PART-TIME EARNINGS FOR PROJECTION PERIOD. STARTING INCOMES FROM TABLE 4.18



Earnings mobility in model W.5-H.2 leads to debt repayment for some individuals despite starting income being below the minimum threshold. For those starting on upper quartile incomes, mobility results in delayed repayment, such that some debt still persists on average after 30 years.

The resulting subsidies under the two earnings assumptions are given in Table 4.19. The discount rate used in the calculations is 5.5 per cent, consistent with that used in Chapter 2.¹⁶⁷

TABLE 4.19 ICL SUBSIDIES (%) CORRESPONDING WITH MODELS W.1-H.1 AND W.5-H.2 FOR PART-TIME FEMALES. OUTSTANDING DEBT = \$6,500 (LOAN = ~\$5,400)

Starting income percentile	25%	50%	75%
Model W.1-H.1	100	99	-3
Model W.5-H.2	40	21	8

While the subsidies for lower and median earners fall under model W.5-H.2, the same mobility leads to increased subsidy for higher initial earners.

Following the aggregate cost example of Section 4.8.2, if we assume that the sample of females is distributed equally among the three income percentiles, then an aggregate subsidy estimate under the static model (W.1-H.1) is 65%, whereas under the stochastic model (W.5-H.2) the aggregate subsidy is 23%. In this instance, the increase in subsidy for higher earners is swamped by the falls in subsidies for the median and lower earners.

While the results of Figure 4.44 and Table 4.19 allow for mobility in earnings, it is assumed that the debtors remain employed part-time for the duration of the projection period. When labour force state is permitted to vary (as per model L.5), the repayments for each starting income quartile are considerably greater and consequently debt is repaid more quickly. This is due to projected transitions from part-time to full-time employment states far exceeding transitions to unemployment or exits from the labour force. When the modelling is repeated under the assumption of static full-time employment, under both deterministic and stochastic earnings models debt is repaid quickly due to high incomes relative to the minimum threshold.

As conclusion, while little variation in results is apparent for debtors with full-time salaries under the ICL parameters considered, the same cannot be said for part-timers, where repayments and subsidies vary substantially depending on the realism

¹⁶⁷ The subsidies under W.1-H.1 differ from those under Scenario 4 for the 10 week loan in Table 2.3 due to different income assumptions used in Chapter 2.

of the applied earnings model; allowing for realistic earnings mobility has a material bearing on aggregate ICL cost estimates.

4.9 Discussion

In this section the findings from this chapter are summarised, and some brief discussion is given as to possible extensions of the models developed. Greater coverage of extensions to costing ICLs more generally, and limitations of the models developed, are given in Chapter 5.

In Section 4.3 it was shown that there is clear mobility in earnings and labour force participation across the first seven waves of HILDA, and indications were given that ICL estimates may not be accurate if this mobility is not accommodated in costing. In Sections 4.4, 4.6 and 4.7 models for labour force state and earnings were developed using HILDA data in order to quantify the implications of model complexity on ICL costs. Nested bivariate logistic models for labour force transitions were fit in Section 4.4. The modelling justified the importance of incorporating multiple lags as covariates, in contrast to the majority of labour force models used in the microsimulation literature. Areas for possible extension include the fitting of fixed or random effects models in place of lagged states. Models of hourly wage were then developed in Section 4.6, starting with a simple mean fit. A review of the literature in Section 4.5, coupled with exploratory analysis of the residuals from the mean fit, justified a variance components approach to modelling. The residuals were decomposed into permanent and transitory components. The permanent component was modelled as a random walk, and non-Gaussian permanent and transitory shocks improved the quality of the fit. The choice of variance components differed for part-time and full-time employees. Areas for possible future model extension include allowing for heterogeneity in the error processes across individuals.¹⁶⁸ In Section 4.7, a non-parametric model for hours per

¹⁶⁸ The short duration of HILDA restricts model complexity, however, certain issues are worthy of mention for future analysis. While mean wage was a function of education, wage growth rates were invariant with respect to educational attainment in the models developed in this chapter. Allowing for this variation would be critical in an accurate model for HECS debtors. Further, while age of youngest child and mother have been incorporated in the models developed in this chapter, further modelling could more closely consider labour force transitions in the years following childbirth; one could experiment with approaches to modelling women of child-bearing age; e.g., DYNACAN

week was developed that incorporated transition probabilities between hours worked, conditional on the duration at the same level.

The models developed were then combined. In Section 4.8, labour force state and annual earnings were simulated through a Monte Carlo process, and outstanding debt and compulsory repayments were estimated for a hypothetical ICL.¹⁶⁹ It was found that under HECS and PPICL income thresholds, and both full-time and part-time static employment states, stochastic earnings models led to greater repayments, lower projected debt, and significantly lower subsidies than under static earnings models. Next, labour force state was projected according to models L.0 to L.5, and subsidies under different labour models and static earnings profiles were compared with those under the fitted stochastic earnings model. It was shown that estimating aggregate cost by applying subsidies derived from static labour force cases may lead to poor estimates. In particular, aggregate subsidies can be substantially over-estimated if derived from static earnings profiles within static employment states. In the next sub-section a number of hypothetical scenarios from Chapter 2 were re-costed, and again it was concluded that aggregate costs may be overstated when earnings mobility is excluded.

The data analysis and modelling in this chapter substantiates that deterministic or static labour force and earnings models are unrealistic; although high serial correlation in earnings levels exist, there are significant transitions between labour force states, hours worked and transitory and permanent shocks to wage rates. It was shown that, in addition to static models being unrepresentative of reality, they can substantially over-estimate aggregate ICL costs when compared with dynamic stochastic models.

assumes that women who turn 21 face a probability of being permanently excluded from labour force participation (Morrison, 2000).

¹⁶⁹ An area for further analysis would be to utilise the stochastic structure of the labour force and earnings models and quantify the variability in the ICL costs as a consequence of the uncertainty in model selection and sampling variability.

5 Conclusion

In this final chapter, a summary of the thesis findings is first presented, followed by a discussion of the limitations and possible extensions to this research.

5.1 Summary of findings

In Chapter 2, an ICL was motivated and developed as an extension to the recently announced Australian statutory paid parental leave (PPL) scheme. It was argued that the duration of the government PPL scheme fails to optimise the social and private benefits of parental leave, yet a lack of liquidity and market failure prevents families from financing an extension of leave. An ICL was proposed to provide a source of funds for parents to extend their leave beyond the 18 weeks currently available.

The ICL provides a source of funds, enables consumption smoothing, and encourages participation through the provision of default insurance and contingent payments. Moreover, the policy instrument is flexible so that scheme parameters can be selected in order to suit the required level of cross-subsidisation and taxpayer subsidies.

Key design features for the ICL were proposed to mitigate adverse selection and moral hazard. First, eligibility is confined to persons with previous workforce attachment. This reduces the prospect of adverse selection from parents with no workforce attachment, and is in keeping with the motivation for the policy as a source of temporary income replacement. Second, the minimum repayment threshold is set lower than that of HECS in order to guard against non-retrieval of debt from low income earners in the scheme, noting that scheme participants have, on average, lower income earning potential than university completers. Third, repayments are the obligation of both parents – not just the mother – a feature that significantly lowers the risk of adverse selection.

Loan durations of 26 weeks and 10 weeks in excess of the 18-week statutory scheme were modelled. In addition, the models considered various loan amounts, including minimum wage, reduced amounts to reflect interactions with existing family

benefits, and replacement wages. For the majority of cases modelled it was assumed that the loan is subject to a 20 per cent surcharge. Four representative scenarios were selected, and six cases representing combinations of scheme design parameters were tested against the scenarios. Taxpayer subsidies were estimated, reflecting the costs of both default and interest rate risk.

The results of the cases highlight key features of the scheme. The scheme is apparently progressive, in that debtors with low future incomes tend to take the longest time to repay or do not repay the loan at all, benefiting most from the fixed 20 per cent surcharge and nil real indexation. It is low-income single mothers who benefit most from the scheme; this is an intended outcome, as it is this group that is least likely to be able to finance a period of extended maternity leave by other means.

Cross-subsidisation arises from higher income earners who repay quickly and generate negative taxpayer subsidies. Cross-subsidisation among participating families implies greater equity, but also reduces taxpayer costs. The attractiveness of the scheme to potential participants, however, will not depend on taxpayer subsidies. Instead, it is the subsidies to participants at their individual discount rate (which in turn will be a function of their level of risk tolerance, the availability or lack thereof of alternative funding instruments, and the interest rate associated with alternative funding instruments). It was shown that despite negative taxpayer subsidies, the scheme might be attractive to median and higher income earners if they were faced with moderate borrowing costs. A key conclusion was that an appropriately designed scheme could be attractive financially to both government and parents, even without consideration of externalities.

It was shown through modelling that a real indexation rate could reduce adverse selection further by both encouraging greater participation from higher earning families, while dampening the attraction to families with lower income earning potential. However, the consequence of this action is reduced equity when compared with a surcharge and zero real indexation. Further considerations were made, including: the addition of a HECS debt; and, replacing the stepped repayment schedule with a smooth schedule such that rates are applied to additional income, as opposed to total income.

In summary, it was shown that a carefully designed ICL for extending paid parental leave could be a cost effective and equitable means of providing parents with the necessary leave so as to optimise both private and public returns.

In Chapter 3, an ICL was motivated and developed for the shortfall in student income support for higher education. First, it was argued that there is a significant shortfall in existing student income support arrangements, resulting in sub-optimal educational achievement among enrolled students and reduced university participation. In light of clear returns to society from university education, and evidence that skilled labour shortages are restricting economic growth and innovation, the Bradley Review of Australian Higher Education found a need for greater participation in higher education (Commonwealth of Australia, 2008b).

Evidence from a number of sources suggests that inadequacies in income support are a major concern for tertiary students, and are perhaps the most significant barrier to participation for many. While the federal government has recently improved student income support policy, it was shown that government benefits remain insufficient to cover student costs of living without supplementation from other sources.

To achieve the estimated level of income required for a university student (excluding tuition), after allowing for existing income support arrangements, it was argued that students would be required to engage in 20 or more weeks of paid work. In contrast, only a maximum of 15 weeks employment per annum is possible during university breaks. It was shown that the duration of employment that would be required to provide sufficient income on top of government income support would, in many instances, adversely affect educational outcomes. Under the assumption that employment during the university year should be confined to study breaks, it was argued that an amount of \$2,000 or \$3,000 per annum could make up the shortfall for many financially independent students without dependants.

As with the costs of university tuition, existing commercial loans have restrictive terms and require collateral or a credit-worthy co-signatory as a consequence of uncertain returns on human capital investments. This market failure implies that funding mechanisms distinct from commercial loans are necessary to allow students to meet their living costs while studying. Arguments against government guaranteed

commercial loans are the same as for HECS, and it was proposed that an ICL could be used in this context.

While Australia's first foray into extending HECS to living costs through the SFSS was discontinued after 10 years, there are strong arguments for considering an appropriately restructured ICL in this context. It would provide a source of funds, allowing students to be less reliant on paid employment than currently, and the income contingent feature reduces the risk of financial hardship and removes the threat of loan-associated bankruptcy.

As an ICL for student living costs would exist on top of HECS, understanding the possible interactions of a new ICL with HECS are crucial. It was shown that an income support ICL can lead to a lengthening of the time until HECS is repaid, and consequently net taxpayer subsidies can potentially be significant even when a real interest rate is imposed on the income support ICL. While real indexation arrangements were considered that can lead to essentially nil interest rate subsidies for the income support ICL, it was shown that such arrangements could potentially result in large accumulated debts for low-income earners due to compounding interest. It was speculated that a loan surcharge and nil real indexation could lead to greater take-up and less opposition than real interest rates, and increase equity through greater cross-subsidisation.

Finally, the case of mature aged students was considered, and it was shown that while an ICL of \$2,000 may increase educational participation and outcomes for some, the opportunity costs of further training are considerable and will restrict participation, exacerbating skill shortages. A novel ICL was proposed targeted at mature aged students for further education, where the funds are sourced from an individual's superannuation and are paid back into superannuation via an ICL mechanism. This could be structured to almost eliminate moral hazard and default risk, yet would increase individual utility and could help address the skill shortage crisis.

The subsidy estimates for the scenarios considered for the ICLs developed in Chapters 2 and 3 are based on static earnings assumptions. While these assumptions may be reasonable for idealised scenarios, they do not replicate the true mobility in

employment and earnings. Although subsidy estimates from individuals with static earnings are combined in Chapter 2 to produce a rough estimate of aggregate cost, there is uncertainty as to whether this approach over- or under-estimates the true aggregate cost. While the ICLs developed in Chapters 2 and 3 are presented as viable policy instruments, viability will depend on the aggregate taxpayer costs across all scheme participants. This rationale was motivation for Chapter 4.

In Chapter 4, a range of simple and complex labour force and earnings models were developed for use in costing ICLs. The key purpose of this chapter was to explore the extent to which estimates of ICL debt and repayments are affected by the models underlying the cost estimates. First it was shown from exploration of HILDA data that there is clear mobility in earnings and labour force participation, and ICL estimates may not be accurate if this mobility is not accommodated in costing.

Modelling ICL compulsory repayments requires models for labour force state, hourly wage, and the number of hours worked per week. First, nested bivariate logistic models for labour force transitions were developed. In the simplest model, previous labour force state was ignored. Additional models were fit using lagged labour states. It was found that incorporating multiple lags as covariates substantially improved the fit, justifying the inclusion of multiple lags, a result contrasting with the majority of labour force models used in the microsimulation literature.

Models of hourly wage were then developed, starting with a simple mean fit. A review of the literature on modelling earnings, coupled with exploratory analysis of the residuals from the mean fit, suggested that a variance components approach to modelling was appropriate. The residuals were decomposed into permanent and transitory components. Separate models were fit for part-time and full-time employees due to differing patterns in the variance components. In each model, the permanent component was modelled as a random walk, and it was shown that the quality of the fit in each case improved when non-Gaussian permanent and transitory shocks were used in place of normal shocks. A non-parametric model for hours per week was then developed that incorporated transition probabilities between hours worked, conditional on the duration at the same level.

The models were then combined. First, annual earnings were simulated using a Monte Carlo process, and outstanding debt and compulsory repayments were estimated for a hypothetical ICL while keeping labour force state fixed. It was found that under both the HECS and the PPICL income thresholds, and under both full-time and part-time static employment states, stochastic earnings models led to greater repayments, lower projected debt, and significantly lower subsidies than under static earnings models.

Next, labour force state was permitted to vary according to the nested logistic models developed. Subsidies under different labour force models and static earnings profiles were compared with those under the stochastic earnings model. It was shown that estimating aggregate cost by applying subsidies derived from static labour force cases could lead to poor estimates. In particular, it was shown that aggregate subsidies could be substantially over-estimated if derived from static earnings profiles within static employment states.

In conclusion, the results suggest that static models can substantially over-estimate aggregate ICL costs when compared with dynamic stochastic models. Consequently, when estimating the aggregate interest rate and default costs for an ICL scheme, it is imperative that stochastic models are used which incorporate realistic labour force and earnings mobility.

5.2 Limitations and future research

While the stochastic models in Chapter 4 were primarily developed to explore the implications of model complexity to ICL costs, the models could also be applied to estimate aggregate costs for the ICL schemes proposed.

Although the stochastic models were developed with consideration given to theoretical as well as empirical issues, adjustments to the models could be explored, and the modelling made more flexible. Areas for possible extension include the fitting of fixed or random effects models in place of lagged states for the labour force model. For the models of hourly wage, heterogeneity in the error processes across individuals could be considered. Depending on the area of application, greater attention could be given to parameter estimation for specific groups in the

population. For example, in the case of paid parental leave, a more thorough exploration of patterns of labour force transitions for new mothers would be warranted.

A reason for estimating costs and benefits of ICLs is to enable both provider and debtor to evaluate the viability and attractiveness of a particular policy and set of parameters. A further rationale is based on the recognition that ICLs, while currently restricted to the domain of government, could conceivably be extended to private investors.¹⁷⁰ Lleras (2004) explores the practicality of integrating investment in human capital into the financial system through the use of human capital contracts. He speculates on the use of human capital contracts for valuing ICLs, however, the types of ICLs considered and the mathematical exposition given is limited. As an alternative to costing through microsimulation, one could consider the feasibility of decomposing and valuing existing and hypothetical ICLs through their embedded instruments, being standard loans and option contracts. By expressing an ICL in terms of standard financial instruments, the risks associated with participating in ICLs (as either investor or debtor) may be more readily quantifiable.

A deficiency in the models considered in this thesis is that they have essentially ignored attempts to allow for moral hazard. This is a limitation of Chapter 4, yet dealing with this issue is complex, as it requires information about the potential impact of different magnitudes of debt on income earning behaviour under a complex policy arrangement.

While behavioural responses may be difficult to quantify, a precedent exists for microsimulation model structures that incorporate behavioural feedback. For example, in the context of taxation policy, the Melbourne Institute tax and transfer microsimulation model (MITTS) incorporates behavioural feedback to model individual reactions to taxation policy (Creedy *et al.*, 2002). Some other microsimulation models also attempt to incorporate labour force behaviour (e.g., SESIM) based on the economic theory of consumer demand, whereby individuals maximise their utility based on preferences for consumption and leisure subject to budget constraints and the available weekly hours of work. Determination of the

¹⁷⁰ However, as discussed by Lleras (2004), legal issues such as debt collection and other logistic matters are non-trivial.

utility curve is made complicated due to tax and transfer systems. A similar approach can be applied to the decision to retire, based on the financial benefits of retiring early versus continuing to work.

For specific policy initiatives, such as paid parental leave, the introduction of the policy may affect labour force participation. Indeed, labour force change is an intended consequence of the policy; an intention of paid parental leave policy is to discourage women from quitting employment and to encourage a return to their employer following cessation of leave. Regardless of the specific policy application, ICLs may affect behaviour as a consequence of their inherent design features. As discussed in earlier chapters, the fact that loan repayments are contingent on income can lead to moral hazard through intentional misstatement of earnings, or reduced participation in employment.

A future extension of the earnings models developed in this thesis is one that incorporates behavioural feedback into the decision to participate in the labour force. Classically, the decision to participate can be considered a trade-off between achieving wellbeing from consumption (assumed to be equal to net income) and leisure activities (Ehrenberg and Smith, 2006). Both consumption and leisure increase utility. For a household, utility can be maximised conditional on the time available to adults within the household and household income. Labour supply models are developed for MITTS that incorporate the household utility function in the model (Kalb and Scutella, 2002), and predicted hours of work change in response to changes in the tax and transfer systems. Modifying labour force and earnings models that underlie ICL cost estimates to allow for behavioural feedback is necessary to properly quantify the potential costs associated with new ICL proposals. A starting point is to learn from MITTS and consider individual and household utility in the presence of both the existing tax and transfer systems as well as the hypothetical ICL policy arrangements.

An important final consideration is the broader role of ICLs as policy mechanisms to provide funding for human capital development during periods of deferred or interrupted employment. In addition to paid parental leave and education, there are a number of subsidised activities that would compromise human capital development if they were not taken and which rely on financial support. These activities include

job searching while unemployed, apprenticeships, and child care services (allowing parents to seek employment or education). Due to externalities, taxpayers subsidise these activities (to a greater or lesser extent), yet it is likely that such public funding yields private benefits. In each of these cases, the recipients of the support who achieve high lifetime earnings (partly as a consequence of this support) are not asked to repay any of the funds provided. While an ICL replacing existing support may be seen by some as a movement away from the welfare state to user-pays, income contingency and in particular, default insurance through a minimum threshold, ensure that equity is promoted. Indeed, ICLs can be flexibly designed to suit the particular policy circumstances. As discussed in Chapter 3, novel ICL structures could be proposed to address the concern about sourcing of funds and costs when the expected repayment period is reduced. Consideration could be further extended to debt retrieval from assets in addition to income. In an economic climate of pressures on expenditure due to demographic change (Commonwealth of Australia, 2010a), there is a need for debate on the sustainability of welfare arrangements, and ICLs could play a role in this debate as equitable and cost effective alternatives to traditional subsidy arrangements.

$$\kappa(I_t) = \begin{cases} 0.000 & \text{for } I_t \leq 41594 \\ 0.040 & \text{for } 41594 < I_t \leq 46333 \\ 0.045 & \text{for } 46333 < I_t \leq 51070 \\ 0.050 & \text{for } 51070 < I_t \leq 53754 \\ 0.055 & \text{for } 53754 < I_t \leq 57782 \\ 0.060 & \text{for } 57782 < I_t \leq 62579 \\ 0.065 & \text{for } 62579 < I_t \leq 65873 \\ 0.070 & \text{for } 65873 < I_t \leq 72492 \\ 0.075 & \text{for } 72492 < I_t \leq 77247 \\ 0.080 & \text{for } I_t > 77248 \end{cases}$$

For example, if income was \$48,000, the compulsory payment would be:

$$\Lambda = (48,000)(0.045) = \$2,160$$

Repayment calculations

The technical description here assumes debt and interest accrue annually and repayments are made at the end of each year. We will let R_t be the repayment on the loan at time t , let OD_t be the outstanding debt at time t , and D_t be the new loan amounts borrowed at time t , where the first new debt is borrowed at the end of the first year at time 1. The outstanding loan at the beginning of the first year is OD_0 . This is increased with the indexation rate i_1 , and repayments of R_1 are assumed to be made at the end of the first year (at time 1). New debt of D_1 is then added to the outstanding balance, giving an outstanding debt at the beginning of the second year of $OD_1 = OD_0(1+i_1) - R_1 + D_1$.

For many of the design cases in Chapter 2 it has been assumed that initial debt and the values of D_t are inflated with a 20 per cent loan surcharge.

A repayment is only made if the borrower's income exceeds the minimum repayment threshold. The compulsory repayment contingent on the income received during the first year is $\Lambda(I_1)$, where Λ is defined above. However, the repayment

actually made, R_1 , is limited to the amount of debt outstanding at the end of that year, or $OD_0(1+i_1)$. Therefore, $R_1 = \min(OD_0(1+i_1), \Lambda(I_1))$.

Using the debtor's income and the indexation rate, we obtain the repayment schedule recursively:

$$R_{t+1} = \min(OD_t(1+i_{t+1}), \Lambda(I_{t+1}))$$

$$OD_{t+1} = OD_t(1+i_{t+1}) - R_{t+1} + D_{t+1}.$$

For couples where repayment is calculated based on both parent's incomes individually, total repayment at time $t+1$ would be:

$$R_{t+1} = \min(OD_t(1+i_{t+1}), \Lambda(I_{mother,t+1}) + \Lambda(I_{father,t+1}))$$

where $I_{x,t+1}$ is the income received between time t and $t+1$ for person x .

Interest Rate Subsidy

If we denote the discount rate for valuation as d , then the present value of the repayments for a loan with n repayments is:

$$PV(\text{repayments}) = \sum_{t=1}^n \frac{R_t}{(1+d)^t}.$$

Similarly, the present value of the amount outlaid by the government is:

$$PV(\text{outlays}) = OD_0 + \sum_{t=1}^n \frac{D_t}{(1+d)^t}$$

where the initial debt and new debt amounts exclude a loan surcharge (if present) for the purpose of this calculation. We have the subsidy amount:

$$PV(\text{outlays}) - PV(\text{repayments})$$

We define the subsidy proportion as:

$$\frac{PV(\text{outlays}) - PV(\text{repayments})}{PV(\text{outlays})}.$$

A.2 Labour force and earnings models in microsimulation – a selected review

While each of the microsimulation models below has multiple components, the review that follows is limited to the events and basic processes used in modelling labour force participation and earnings. The references listed throughout this section can be referred to for specific model details.¹⁷¹ The models discussed here include the US models DYNASIM, PENSIM, CORSIM, PRISM, and MINT, the UK model SAGE, the Canadian models DYNACAN and LifePaths, the Swedish model SVERIGE, the Norwegian model MOSART, and the Irish Dynamic Microsimulation Model. An early adopter of microsimulation modelling in Australia was the National Centre for Social and Economic Modelling (NATSEM). Australian models developed by NATSEM are summarised at the end of this section, including the HARDING model, DYNAMOD, and their latest large scale model currently under development, APPSIM. A list of the key labour force and earnings events and the variables used to determine the events in the models are given in Table A1.

TABLE A1 MICROSIMULATION MODEL KEY LABOUR FORCE AND EARNINGS EVENTS

Model	Event	Variables used to determine event
DYNASIM (Source: Anderson, 1997; Favreault and Smith, 2004)	Labour force participation	Age, race, sex, education, region, disability, marital status, geographic region (south or not), student, children, spouse earnings
	Hourly wage	Race, sex, age, region, disability, marital status, education, student
	Hours in labour force	Age, transfer income, expected wage rate, disability, marital status, children
	Unemployment	Age, sex, race, education, marital status, region, disability, children
PENSIM (Source: Holmer <i>et al.</i> , 2010)	Job duration (first and subsequent)	Age, sex, educational attainment, industry type, unionised job status, part-time flag, employer size, earnings at start of job, employer pension plan flag.
	Duration non-employment	Age, sex, educational attainment
	Hours worked	age, sex, attending college flag, educational attainment, industry type, unionised job status.
	Earnings	age, sex, educational attainment, industry type, unionised job status, part-time flag.

¹⁷¹ Keegan (2007), Keegan and Thurect (2008), and O'Donoghue *et al.* (2009) present a summary of the labour force and earnings features of some of these models.

Model	Event	Variables used to determine event
CORSIM (Source: Anderson, 1997; O'Donoghue, 2001)	Work status (FT/PT, or not working)	Age, race, sex, education, presence and number of children, age of youngest child, current and lagged marital status, unemployment rate, previous number of weeks worked (0, 1-47, >47)
	Weeks worked per annum	Age, race, sex, marital status, lagged weeks worked (0,1-47, >47), education, presence and number of children, age of youngest child, unemployment rate
	Weekly earnings rate	Previous earnings, age, race, sex, current and previous marital status, current and previous weeks worked, education, presence and number of children, age of youngest child, unemployment rate.
PRISM (Source: Anderson, 1997)	Annual hours worked	Age, sex, marital status, children, hours worked in each of previous three years, education, child-bearing during year (if female), divorced during year (if female), widowed during year (if female), receipt of social security or pension income, labour force participation of age-sex group. This information is used to determine transition probabilities between five hours worked classes from one year to the next.
	Entry wage rate	Age, race, sex, education, wage in initial data base (if employed)
	Wage growth	Age, sex, education, whether changed jobs during year, employment status
	Job change	Age, full-time/part-time status, job tenure, hours worked in current and previous years, proximity to retirement eligibility
MINT (Source: Anderson, 1997)	Lifetime age-earnings profiles	(earnings relative to average earnings) sex, education (5 classes), age (13 classes)
	Post-retirement earnings group	Age, age, race, marital status, sex, education, wealth, pension benefits, retirement wealth, past earnings, social security exempt amount
	Post-retirement earnings	Drawn randomly from earnings distributions from SIPP.
SAGE (Source: Zaidi <i>et al.</i> , 2009)	Employment status (FT employed, PT employed, unemployed, NILF)	Sex, educational attainment, age, age squared, number of children (for females), age of youngest child (for females), partner employment status, health restriction (dummy), employment status change in previous year (dummy), duration of non-employment (for non-employed), employment sector, occupation, industry
	Type of employment, sector, industry and occupation	These were determined at the time of completion of education in the model and were taken as time-invariant.
	Earnings	Sex, educational attainment, age, age squared, previous employment status, FT/PT status, occupation, industry, partnership status, partner employment status, health restriction, public/private sector, number of children (for females), age of youngest child (for females) (Interactions between many of these variables were incorporated in the earnings equations).

Model	Event	Variables used to determine event
DYNACAN (Source: Anderson, 1997)	Employment status	Age, sex, marital status, presence of children, disability status, retirement status, worked in previous year (full-time, part-time, none)
	Annual weeks worked (3 levels: 0, 1-47, 48 or more)	Age, sex, marital status, lagged weeks worked class, education, presence of children (women), number of children (women), age of children (women), unemployment rate.
	Weekly wage	Age, sex, marital status (women), presence of children (women), education, unemployment rate, previous year earnings, employment status, lagged employment status.
LIFEPATHS (Source: Statistics Canada, 2010; Gribble, 2000)	FT potential annual earnings and hours worked	Work experience, education level, field of study, sex, province of residence, immigration status.
	Employment status	Duration of current job, duration of not working, age, sex, province of residence, education level, presence and ages of children, presence of a spouse and spouse's employment status.
SVERIGE (Source: Holm <i>et al.</i> , 2003)	Employment status (work or not work)	sex, age, civil status, education level, whether the individual studied or had a job the year before, immigrant status, and years since immigration
	FT/PT status (workers)	age, sex, education level, number of children and if the youngest child is younger than six years, the rate of unemployment in the region, distance to the region centre, immigrant status, and years since immigration.
	Number of weeks worked (PT)	the number of weeks worked is assigned randomly to part-time workers
	Wage for FT and PT earners	Relative wage rate in previous year, age, sex, education level, whether the person was in education the year before, and unemployment rate for the region
MOSART (Source: Andreassen and Texmon, 2000)	Labour force participation and labour market earnings	Age, sex, education, student status, disability status, labour force status in preceding years, marital status, number of children (women), age of youngest child (women).
Irish Dynamic Microsimulation Model (Source: O'Donoghue, 2001)	Working (as employee or self-employed)	Occupational group, age, sex, marital status, years in education, years in work, years in unemployment, years ill, years at home, father's education level, lone parent status, number of children, spouse employment and labour force status, pension member status, civil servant status, previous working status, disposable income
	Part-time work status	Occupational group, age, sex, marital status, years in education, years in work, years in unemployment, number of children, spouse employment and labour force status, previous employment status, disposable income
	Hourly earnings	Occupational group, age, sex, marital status, years in education, years in work, years in unemployment, years ill, years at home, father's education level, lone parent status, number of children, spouse employment and labour force status, pension member status, civil servant status, previous employment status, manager status, part-time status, educational level

Model	Event	Variables used to determine event
Harding (Source: Harding, 1993)	Labour force participation	Sex, age, education status, employment status in previous year, marital status and age of youngest child (women).
	Self-employed or employee	Self-employed status in previous year, sex, age, education, husband flag (women)
	Full-time or part-time status	Self-employed status, sex, age, full-time/part-time status in previous year, education, new baby (women), marital status (women)
	Hours in labour force	Education, age, employment status, self-employment status, age of youngest child (women).
	Unemployment and proportion of year unemployed	Age, unemployment status in previous year, duration of previous unemployment, education, sex, proportion of year in labour force.
DYNAMOD (Source: King <i>et al.</i> , 1999; O'Donoghue, 2001; Keegan, 2007; Keegan and Thurecht, 2008)	Labour force state	Separate equations for three age groups (15-24, 25-44 and 45+) and sexes. Monthly transition rates are also dependent on state in previous month, marital status, presence and ages of children, industry or occupation, education level, season, and macro variables such as unemployment rates and proportion of part-time workers.
	Weekly earnings	Human capital variables – education, experience (age minus five years minus time spent in education) Demographic and family variables – age, sex, marital status, number of children, country of birth, spouse earnings (correlation between partners' earnings incorporated). Employment variables - previous and current employment and labour force status, earnings in previous period, public or private sector, industry (for self-employed)
APPSIM (Source: Keegan, 2007; Keegan and Thurecht, 2008)	Labour force state (FT employed, PT employed, unemployed, NILF)	Age, sex, current education, education level, marital status, presence and age of children, disability in previous period, labour force status in previous two periods.
	Weekly Earnings	Age (and age-squared), sex, age of youngest child for children 2 or under (women), number of dependent children, education level (bachelor degree or higher, trade or diploma, year 12 only, less than year 12), employment status (wage or salary earner, self employed, employee of own incorporated business), marital status, spouse earnings, full-time/part-time status, number of hours worked (for part-time), earnings in previous year(s).

DYNASIM

The Dynamic Simulation of Income Model (DYNASIM) was the first large scale dynamic microsimulation model targeting individual socioeconomic status and

behaviour. Work on DYNASIM began under the direction of Guy Orcutt at the Urban Institute in 1969. A second version DYNASIM 2 was developed in the early 1980s (Anderson, 1997), and the latest version is DYNASIM 3 (Favreault and Smith, 2004). The labour and earnings sector component of the model first simulates labour force participation, then hourly wage rate, and next annual hours in the labour force. Each of these three equations includes permanent and transitory error components. A permanent error for each individual is calculated from PSID historic data. The transitory error is drawn each year and is based on an autoregressive process (Favreault and Smith, 2004). Hourly wage rates are estimated using a random-effects model of the log of hourly wages. The resulting coefficients are used to calculate an expected wage rate for each individual. Annual hours are then estimated using a tobit model where the expected wage rate is included as an explanatory variable. Labour force participation is estimated using a random-effect probit model (Favreault and Smith, 2004).

PENSIM

PENSIM was developed as a private pension model for DYNASIM, but was never fully integrated due to the model complexity (Anderson, 1999). As the model's focus is on pensions, job pathways are an essential component of the simulation. Each job has six characteristics which are simulated recursively: employer industry, job unionization, hours of employment, initial job earnings, employer firm size, and employer pension sponsorship. A range of hazard function models are used to simulate waiting time until start of first job, duration of first job, waiting time between jobs, and duration of subsequent jobs. While the original earnings equations in the PENSIM model omitted education due to lack of data (O'Donoghue, 2001), earnings equations in the current version have been redesigned and include education among other factors (Holmer *et al.*, 2010). Earnings are simulated using a stochastic process with two normally distributed error terms - a temporary and permanent deviation. The parameters of the model have been calibrated so that individual earnings histories have similar features to observed longitudinal data (Holmer *et al.*, 2010)

CORSIM

The Cornell Microsimulation Model (CORSIM) was first developed by Cornell University in 1986, though later versions have since been developed (Caldwell, 1996). Income from employment is estimated by multiplying the simulated weekly earnings rate with the annual weeks worked. Labour force participation, unemployment and employment are not explicitly modelled. Instead, an estimate of zero weeks worked indicates unemployment or non-participation in the labour force.

PRISM

The Pension and Retirement Income Simulation Model (PRISM) is a dynamic microsimulation model developed in 1980 to simulate retirement income and elderly long term care use in the United States. Since that date, it has been extended and revised to simulate the outcomes of social security and pension policy. Income from employment is estimated by multiplying the simulated wage rate with the annual hours worked. Like CORSIM, an estimate of zero annual hours worked indicates unemployment or non-participation in the labour force.

MINT

The Modelling Income in the Near Term model (MINT) was developed in the Office of Research, Evaluation and Statistics of the U.S. Social Security Administration, for the purpose of analysing social security policy proposals (Anderson, 1997). Lifetime age-earnings profiles for each individual are modelled relative to average earnings as a step-function of age. For each age-earnings profile, separate equations are modelled for each of the combinations of sex and education, and a person-specific fixed effect is added that persists for each individual over the course of the projections (akin to a permanent error component). A transient random error term is also added to conform with actual earnings patterns. For earnings after retirement, individuals are assigned to an earnings group (either zero earnings, or one of three positive earnings groups), and then earnings are assigned based on a random draw from 1990-1992 Survey of Income and Program Participation (SIPP) data.

SAGE

SAGE is a British dynamic microsimulation model (Zaidi *et al.*, 2009). Employment transitions are estimated to occur quarterly. Labour dynamics include employment status (employed, unemployed or out of the labour force), and for those categorised as employed, level of employment, type of employment, sector, industry, and occupation. Once labour state is simulated, earnings are estimated through random-effect linear regression models. The earnings models incorporate both permanent and transitory errors.

DYNACAN

DYNACAN was developed under the direction of the Office of the Chief Actuary in Canada in the mid to late 1990s for the purpose of valuing policy proposals relating to the Canadian public pension system (Morrison, 2000). Each individual is first simulated broadly into whether or not they work (and whether they are an employee or self-employed), followed by the number of weeks worked during the year, and lastly weekly wage. Income from employment is estimated by multiplying the simulated weekly wage rate with the annual weeks worked. Alignment with exogenous variables ensures that the aggregate wages and labour force participation levels coincide with Canadian experience (see Anderson (1997), Morrison (2000), and Neufeld (2000) for more detail on the alignment process used). Weekly wage includes a random variable akin to a permanent error component (labelled permanent luck) assigned as a constant wage deviation for each individual. Rather than allowing for reduced labour force participation for women via labour force transition rates, DYNACAN assumes that women who turn 21 in the model face a probability of being permanently excluded from future labour force participation. Keegan (2007) notes that DYNACAN is unique in the manner it deals with women.

LifePaths

LifePaths is a Canadian microsimulation model of individuals and families. It operates in continuous time such that state changes can occur sub-annually, thus being more representative of reality (Gribble, 2000). In the labour force module three categories of employment status are considered: not employed, employed as a

paid employee and self-employed. Each individual is assigned a potential earnings rate. Actual earnings are estimated by combining full-time potential annual earnings with hours worked and employment status (Gribble, 2000). Earnings (for non-students) are generated from separate equations for wages and salaries, and two equations governing earnings for self-employed (Statistics Canada, 2010). Pregnant women in LifePaths are separately assigned labour force participation decisions depending on their labour force status mid-way through their pregnancy.

SVERIGE

SVERIGE is a Swedish spatial microsimulation model which had its roots in CORSIM (Holm *et al.*, 2003). The original employment and earnings module consisted of four sub-modules. An equation first determines whether or not an individual is employed during the year. For those estimated to work, an equation simulates whether they will work full-time or part-time. If part-time, an equation determines the number of weeks the individual will work. Finally, wages are simulated. Wages for both full-time earners and part-time earners are modelled by regressing the logarithm of the ratio of lagged monthly earnings over total population average earnings against a series of person specific demographic variables. A new employment and earnings module has been developed since the original model to improve the match between simulated and actual data. In the new module the population is separated into seven groups (e.g., unemployed, emigrants, high salary earners, etc.) and earnings development equations are estimated for each group. (Holm *et al.*, 2003).

MOSART

MOSART is a dynamic stochastic microsimulation model first developed by Statistics Norway in the late 1980s. A logistic relationship is used for labour force participation in the model. Labour supply is simulated as two levels: whether a person has labour income or not during each year (Andreassen and Texmon, 2000). An adjustment term is included to ensure that the overall income distribution is consistent with an exogenous measure of total labour income (Andreassen, Fredriksen and Ljones, 1996).

The Irish Dynamic Microsimulation Model

This dynamic model was constructed by O'Donoghue (2001) to study inter-temporal issues relating to redistribution in the Irish tax-benefit system. Transitions take place annually. The equations pertaining to labour force participation and earnings are determined by numerous variables, and different equations govern specific transitions. For example, the equations that govern transitions to employment and transitions to unemployment, from periods of schooling, employment, or unemployment, all differ with respect to the determining variables. O'Donoghue (2001) includes comprehensive coverage of the labour force events, a sample of which is provided in Table A1. A number of the variables listed are included as quadratics in the equations used.

Harding model

Harding (1993) developed a dynamic cohort model based on a hypothetical sample of 2,000 males and females to investigate lifetime income distributions in Australia. Separate labour force modules were included for males and females. The first stage of both labour force modules involved determining labour force participation, followed by self-employment/employee status for those participating, and part-time or full-time status. Numbers of hours were simulated, along with the chance of unemployment, and proportion of time in employment. Earnings were estimated by multiplying the number of hours worked by hourly wage. Log hourly wage was modelled from regression equations with explanatory variables listed as in Table A1. Due to the lack of Australian panel data sources at the time, Harding relied on international findings to select permanent and transitory error terms which she applied to the simulations of hourly wage rates.

DYNAMOD

DYNAMOD is a dynamic microsimulation model of the Australian population based on a 1% sample. The original application of DYNAMOD was for costing income-contingent student loans for the Commonwealth Government, and consequently emphasis was placed on simulation of student education processes and earnings (King *et al.*, 1999). The latest version is DYNAMOD 3 (Keegan, 2007).

While labour force activity in DYNAMOD 3 is simulated with a monthly time unit, earnings are based on annual units. Labour force transitions between three main labour force states (employed, unemployed, and out of the labour force) are modelled for three age group and sex combinations. The transition rates depend on a number of personal characteristics as well as labour state. Those estimated as employed are further classified into full-time or part-time employment states (for wage and salary earners), where the chance of being full-time or part-time is based on state in the previous month. Employed individuals are then classified according to sector of employment, industry, occupation and employment status (e.g., wage/salary earner, self employed, etc) when they enter the labour force. Employment participation is estimated separately for full-time students. Simulated labour states are aligned to exogenous aggregates (participation rates and unemployment rates for males and females).

Weekly earnings are estimated separately for current full-time employment (wage or salary), part-time employment (wage or salary), and self-employment status, as well as labour force status in the previous period. Annual earnings are the product of weekly earnings and the number of weeks in employment. As with labour state, earnings are aligned to maintain consistency with exogenous mean earning measures. The earnings equations have the feature of optional autocorrelation for the error process, whereby the user can specify parameters based on their assumptions of the permanent and transient levels of variation.

APPSIM

APPSIM is a NATSEM dynamic microsimulation model based on a 1% sample (~188,000 persons) of the Australian population taken from the 2001 Census. Although the model is currently in development, a number of working papers have been released that summarise the intended approaches to be used for modelling labour force and earnings (Keegan, 2007; Keegan and Thurecht, 2008). Labour force transitions will be based on HILDA data, and aligned with labour force participation rates and unemployment rates from the most recent Intergenerational Report (Keegan, 2007). While Keegan suggests that APPSIM will ultimately include a behavioural component, she outlines an initial labour force module where the primary concern is adequate, as opposed to full, functionality. The time period used

for labour force transitions will be quarterly. Once quarterly labour force state is determined, if an individual is simulated as being employed (either full-time or part-time), the weekly number of hours they work will be estimated, followed by simulated earnings.

Keegan and Thurecht (2008) propose inputs for the APPSIM earnings module based on statistically significant variables from an analysis of HILDA data. Table A1 lists the proposed variables for the initial model as discussed by Keegan (2007), and Keegan and Thurecht (2008). While a person's industry of employment appears to be correlated with earnings, Keegan and Thurecht (2008) recommend against including either industry or occupation in the first version of APPSIM due to the difficulty in predicting the future distributions of occupations and industries. For the first version of APPSIM, Keegan and Thurecht (2008) suggest that separate earnings equations be specified by the levels of the following categories: sex, full-time/part-time, full-time students/non students, employee/self-employed, normal/high earners, and Australian-born/immigrants. While they recognise that indicator variables and interactions between explanatory variables could achieve the required results, they note the conceivably large number of interactions required. Additionally, it may be that earnings for different sub-groups can be modelled with different sets of predictors.

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