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What Do Microsimulations Tell Us about Fiscal Costs of the Newly Launched Income Contingent Loans in Japan?

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Abstract

This study estimates the fiscal costs incurred by the income contingent loans launched in April 2017 using a microsimulation approach. The study identifies three factors to understand how costly the loan scheme is: discount rate, female working conditions, and income mobility. The largest costs include about 40% of the mean loan outstanding at the time of graduation that would not be repaid in present discount value terms. This amount may be reduced as the discount rate falls from 2%, as more married females continue working at higher wages, and as more income dynamics are introduced, such as changes in the percentiles of income distributions during individuals' lives. The costs would be, on average, 20 percentage points higher than their fixed repayment counterparts.

Keywords: microsimulation, income contingent loan, higher education, fiscal costs
JEL classifications: D14, I22, I23, I28, J22

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1. Introduction

The working-age population in Japan has started to decline. This reflects the progress of an ageing society. While this quantitative aspect of the labor force is a drag on the growth of the Japanese economy, its qualitative aspect proves to be a major source of the growth, according to various growth accounting exercises. The Japan Industrial Productivity (JIP) database[1] shows that much of the growth rate from 2000 to 2012 (0.5 out of 0.7 percentage points) has been attributable to the qualitative increase in the labor force. This result shows how important investment in human capital is in the current situation and gives a hint on why policies to fully utilize human resources attract so much attention. One of the top priorities is placed on a reform on financing higher education. Various reforms have been undertaken over the last a few years, but more are likely to come.

One of the reform was to introduce an income contingent loan (ICL, hereafter) scheme. After discussions with an expert group set up by the Ministry of Education, Culture, Sports, Science and Technology (MEXT),[2] the Japan Student Service Organization (JASSO) launched a new ICL scheme in April 2017 as a part of free-of-interest loans.[3]

This study tries to answer basic questions, such as who will benefit and to what extent, by calculating the amounts of debts the borrowers fail to repay in terms of present discount values (PDV). The other side of the same coin is the fiscal costs of such a scheme because the government stands by the JASSO.

Calculating fiscal costs for ICLs is much more difficult than calculating for fixed repayment loans. Repayment patterns are different for each of the borrowers, and therefore, it is necessary to simulate individual earnings and repayments over their entire working lives. Microsimulation is an essential tool using which the Parliamentary Budget Office of Australia calculated fiscal costs of Australian ICL schemes to be about 28% of tuition costs incurred in PDV terms. Another Australian study by Higgins and Sinning (2013) estimated that 20% of the government claims were not repaid on a PDV basis.

This paper is structured as follows. The next section will explain what the ICL is, and Section 3 will provide an overview of financing higher education in Japan. Section 4 will explain the data and methodology used and Section 5 will provide the simulation results. Section 6 will conclude the paper by summarizing major findings and suggesting future tasks to be tackled.

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1 The JIP 2015 version is available at http://www.rieti.go.jp/jp/database/JIP2015/index.html.

2 The final report of the expert group is available at http://www.mext.go.jp/b_menu/shingi/chousa/koutou/069/gaiyou/1378312.htm.

3 Furthermore, the Interim Report of the Council for Designing 100-Year Life Society, which was released in December, 2017, lists items to be examined until next summer. One of them is to ensure equal access of middle-income class to higher education by referring to "the HECS in Australia and other countries' experiences." The HECS was an Australian ICL scheme, and renamed as HELP.

2. What is the ICL?

This study deals with a particular kind of student loan, the ICL. This originally comes from Friedman (1962), who advocated ICLs as a financing scheme for vocational training and/or higher education to overcome capital market imperfections. A lack of physical collateral usually prevented an individual from borrowing money from financial institutions: a promise to repay debts from future increase in income was of no value to these institutions.[4] However, the argument for ICLs is not based on the assumption that education has externalities. While the externality assumption may hold true for primary and secondary education, it seems dubious for tertiary education because its benefits are likely to be realized as higher wages. A merit of the ICL is to provide the borrowers with an insurance function, so that their repayments are adjusted according to their earnings. This should be of great help to realize consumption smoothing, which is prohibited by imperfect capital markets.

In other words, the income contingent nature will make debt repayments resemble dividend payments. Costly state verifications in imperfect information world are likely to disallow equity issues, thereby making debt instruments a major source of funds. Therefore, introducing the ICL may require some innovations in the state verifications, and social security and tax number systems is a promising candidate, for example. In Japan, the ICL scheme utilizes information held by the local tax authorities (as explained later), which involves a year lag, partially impairing the income content nature.

Bruce Chapman is the most vocal proponent of ICL schemes (e.g., Chapman, 2006a, 2006b)[5]. He recommended to various countries to adopt ICLs, and the schemes have been in place in countries such as Australia, New Zealand, United Kingdom, Hungary, and Korea.[6] Initial conditions may matter. Free tuition systems were adopted in the first three countries. In these countries, allowing all students to access ICLs is easy because introducing the ICL will add to the government's revenue. However, countries without free tuition fee systems may hesitate to allow universal access to ICLs due to concerns about its possible damages on fiscal health. On the other hand, the insurance principle may require universal coverage.

[4] In the US, fixed repayment schemes are dominant and the ICL schemes play a minor role in educational finance. This provides a background of concerns about the student loan crisis in recent years (Looney and Yannelis, 2015).

[5] The ICLs could be applied to other areas than education, as argued in Chapman (2006b). For example, Chapman and his coauthors argued for its application to natural disaster related and other loans to disadvantaged areas and persons, and crime reparations, among others.

[6] For example, Acemoglu and Angrist (2000) detect some evidence of external returns to education that seems too small to account for wide variations in per capita incomes worldwide, but could justify public subsidies for education. See Barr (2001) for a textbook explanation.

3. Finance of Higher Education in Japan

This section will briefly provide an overall picture of higher education in Japan.[7] We should consider the following three factors in terms of financing higher education. First, tuition fees have risen significantly over the past 40 years (Figure 1 (1)): four times for private universities and 10 times for national universities. National tuition fees were raised faster to alleviate the private-national tuition gap: the private-national tuition ratio was more than 3 in 1975. The situation had stabilized by the mid-1990s. Fees for both private and national universities have been raised moderately by less than 1% since then, and the tuition ratio has remained flat, at around 1.4.

Second, public support for higher education has changed (Figure 1 (2)). Subsidies to national universities have been reduced by a third over the past 20 years,[8] while supports through JASSO loans have greatly surged. This change could be summarized as a shift in support from institutions to individuals. The decline in the subsidies in the 1990s was remarkable: it is larger than that observed in the period from 2004 to 2014. It must be noted that national universities were corporatized in 2004. This granted them more autonomous management, along with a gradual decline in subsidies from the national budget.[9]

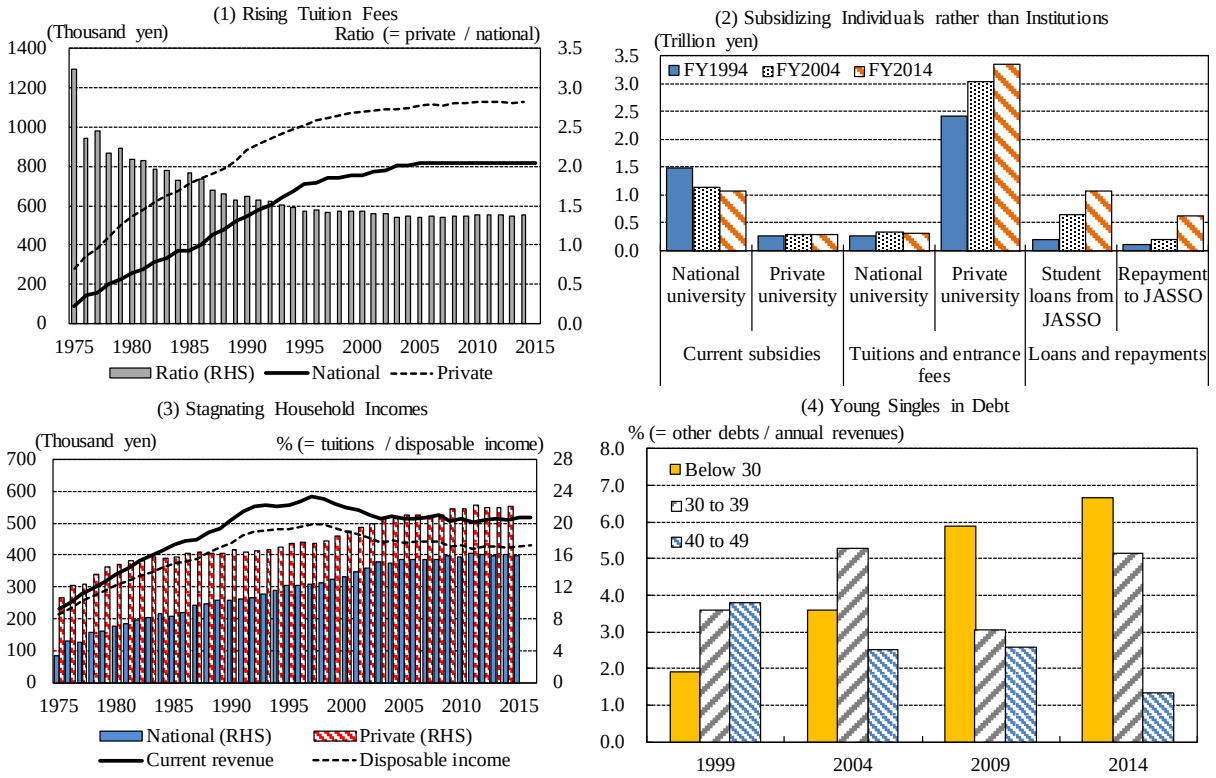
The surge in the JASSO loans reflected the third factor: stagnating household incomes. Disposable income of working households with more than two persons declined in 1997 and remained almost flat since 2000 (Figure 1 (3)). A small but steady increase in tuition fees drove the ratio of fees to disposable income for national and private universities to 16% and 22%, respectively. The number of borrowers of the JASSO loans accounted for more than a third of all the students. The JASSO's outstanding loans amounted to 8.9 trillion yen, about 30% of which is interest-free. In this situation, young households are more in debt these days (Figure 1 (4)), which may depress their consumption-oriented minds.

[7] More comprehensive discussions are available in Kobayashi (2015) and Kobayashi and Armstrong (2017), among others.

[8] Subsidies for private universities have slightly increased, mainly due to an increase in the number of private universities.

[9] See Akai, Suetomi, Senoh, and Mizuta (2014) for a more detailed explanation on changes in fiscal resources concerning education.

Figure 1 Overview of Financing Higher Education in Japan



Notes:

Panel (1): Values include entrance fees.

Panel (2): The coverage of current subsidies and tuitions for national university includes the colleges of National Institute of Technology in 1994, that are excluded in 2004 and 2014. Subsidies for national university include those for university hospitals. Subsidies for private university include those for private technical junior colleges. Tuitions for private university are estimate of JCER in 1994 and 2004.

Panel (3): Workers' household with two or more members. The tuition fees used is the same as in Panel (1).

Panel (4): Values of single households. Other debts are defined as those excluding lands, houses, autos, and mothly or annual installments.

Sources: Association of Private Universities of Japan; Japan Student Services Organization; Ministry of Education, Culture, Sports, Science and Technology; Ministry of Finance; Ministry of Internal Affairs and Communications; The Japan Association of National Universities; The Japan Association of Private Universities and Colleges.

These situations are likely to encourage discussions on how to increase public support to reduce household burdens related to higher education expenditures. In December, 2017, the government compiled a new policy package that includes measures to reform the social security system to become a system oriented to all generations under which both elderly and young citizens are able to enjoy peace of mind.

4. Data and Methodology

4.1 Data

Our main data source is the Japanese General Social Surveys (JGSS)[10] and is collected for nine years: 2000 to 2003, 2005, 2006, 2008, 2010, and 2012. This data comprise citizens aged between 20 and 89, who are chosen using stratification sampling of the population by regions (six regions) and by population size of cities/districts (four categories). The primary sampling units are based on the basic unit districts used for the Population Census. Each survey includes 2000 to 5000 observations and provides information about the following variables: age, sex, education, labor force state, occupation, employment status, firm size of the employer, work hours, and information about members in the household.

4.2 Methodology

We use a microsimulation model to produce individual income and loan repayment profiles, and then calculate fiscal costs of ICLs.[11] The structure of our simulation model is based on Higgins and Sinning (2013) and Higgins (2011), with some modifications. The simulations are conducted using three steps.

In the first step, we estimate distributions for the simulation. As the available data are categorical answers of income classes, they need to be converted into numeric answers using kernel density estimation (Appendix A1.1). We then pick up samples of university graduates aged 59 or under, and estimate two equations: probabilities of labor force states, P(L|M, C) with L=1 (Employed) and L=0 (Not employed); and probabilities of employment statuses, P(E|M, C, L=1) with E=1 (Full-time regular employment) and E=0 (Non-regular employment). The variables, M and C show marital status and dependent child situations, respectively. The details are given in Appendix A1.2.

In the second step, we simulate individual annual revenue profiles, using the obtained distribution. Here, we will make specific assumptions of M and C. That is, we will deal with two cases:

- Case 1: all the males and females get married at age 29, and have a child at age 30; and
- Case 2: all the males and females remain single until age 59 with no child.

For each of the cases, the individuals' labor force state, L, is given by a draw, which follows the estimated P(L|M, C). If they are determined to stay outside the labor force, their revenues are set to zero. Otherwise, we go on to a next draw to decide employment status,

[10] The Japanese General Social Surveys (JGSS) were provided by the Social Science Japan Data Archive, Center for Social Research and Data Archives, Institute of Social Science, The University of Tokyo. The JGSS themselves are designed and carried out by the JGSS Research Center at Osaka University of Commerce (Joint Usage / Research Center for Japanese General Social Surveys accredited by Minister of Education, Culture, Sports, Science, and Technology), in collaboration with the Institute of Social Science at the University of Tokyo.

[11] See Dearden (2017) for an overview on microsimulation methodologies.

which follows P(E|M, C, L=1). Finally, individual annual revenue is determined by a draw from an actual distribution, conditional on L=1 and E, M, and C, that is P(Y|E, M, C, L=1). We then change time varying characteristics, such as age, marital status, presence of child, etc., and repeat the above procedures for every year (Dynamic Ageing). Therefore, income profiles of all individuals in the hypothetical cohort are obtained.

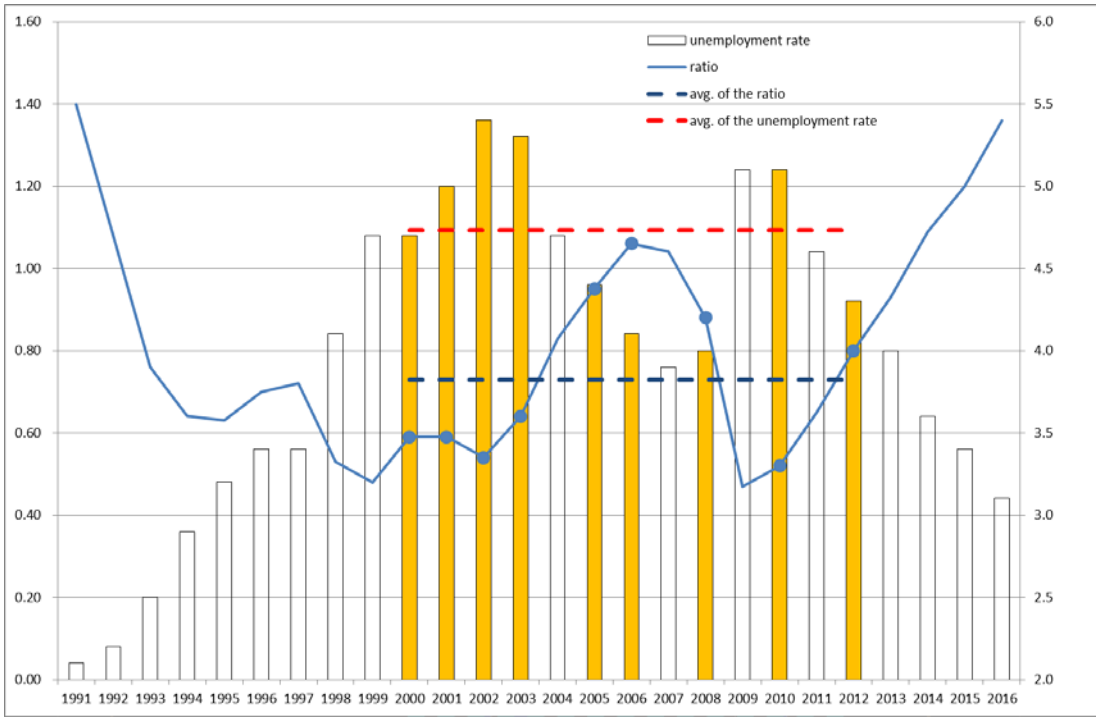
In the third step, we calculate fiscal costs of student loans for two repayment types, the ICL and fixed repayment student loan systems, in each case, for a comparison purpose. The formula of fiscal costs is given below,

$$\text{fiscal costs} = \frac{PDV(Debt) - PDV(Repayments)}{PDV(Debt)} = \frac{2.36 - PDV(Repayments)}{2.36}.$$

Here, debt outstanding is set to 2.36 million yen at age 22, which is the average debt outstanding of JASSO free-of-interest (or Type 1) loans at the end of FY2015. The discount rate is initially set to 0.1%, taking into account recent developments of long-term interest rates but is changed later as a parameter to examine variability of the fiscal costs. The above second and third steps are repeated for each member of the generated cohort.

A caveat is in order. We regard the information about age profiles gained from the cross section data as valid approximation to age profiles over time. Computational restraints due to the number of samples disallowed from using year dummies in the logit models given in Appendix 1. As a result, our simulations might be affected by cyclical and structural factors. Overall, there were slacks in labor markets in the sample periods, despite a large fluctuation before and after the Global Financial Crisis. The average of unemployment and jobs-to-applicants ratio were 4.73% and 0.73, respectively (Figure 2). The prolonged stagnation has made age-wage profiles flatter (Hamaaki, Hori, Maeda, and Murata, 2011).

Figure 2 Overall Labor Market Situations in Sample Years



Sources: Ministry of Internal Affairs and Communications; Ministry of Health, Labor and Welfare.

4.3 Detailed Specifications of Student Loan Schemes

It is necessary to specify details of loan schemes to calculate fiscal costs. We will make the ICL scheme as close to the newly launched one in April 2017, as possible. As the new scheme is launched as a Type I loan, the interest rate charged is set to 0%. The repayments are set to 9% of taxable income (i.e., tax base of local inhabitant taxation) that is calculated as annual revenues minus income deductions. We will take into account only three income deductions: employment deduction, social contributions deduction, and basic deduction. We will ignore the other deductions, such as spouse tax deduction. If the borrowers' annual revenues are below 3 million yen, they are exempted from repayments. This exemption is available for at most 10 years. After exhausting the exemption period, borrowers are required to repay a minimum of 24,000 yen per year, even if they earn nothing. Note that the minimum payments are clearly against the spirit of the ICLs, but are incorporated in the current ICL scheme. We will assume that, even if borrowers become dependents, they make the same repayments as they do when they are singles. We do not consider how much their supporters earn and whether they may change their type of repayment from ICL to fixed repayment, though these are handled in the actual system.

We will also calculate fiscal costs of the Type I fixed repayment loan scheme for comparison. Therefore, the interest rate of loans is again set to 0%. The repayment is set to 160,000 yen for 15 years, which is determined by the JASSO. However, this exemption scheme is available for current Type I loans. That is, if borrowers' annual revenues are below 3 million yen, they are exempted from repayments for at most 10 years.

5. Simulation Results

5.1 Earnings

Let us look at the simulated earnings, which are of critical importance, as emphasized by Dearden (2017). As for Case 1 shown in Figure 3, male earnings tend to increase with larger disparities, as males become older. As a result, the repayment exemption is only available for those in their 30s to 40s, who are below the 10th percentile in the earning distribution, and is more widely applicable to those in their 50s.

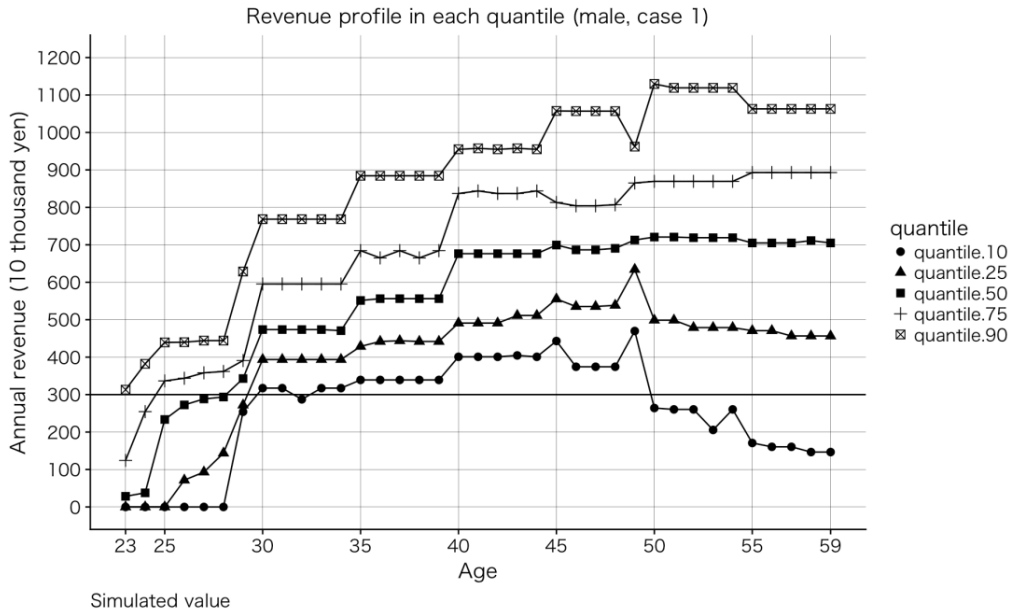
The graph for females tells a very different story. Only those who belong to the top tail can enjoy increases in earnings, while earnings of the rest stay almost flat after the age of 30. In fact, those appearing at the 75th percentile of the earning distribution are below the threshold of 3 million yen. Therefore, most females would be eligible for repayment exemptions throughout their working lives, if the exemptions were applied without the limit of 10 years.

Gender difference is less visible in Case 2 as shown in Figure 4. This is because females are more likely to continue working due to the assumption that they stay single. This is also because single males tend to include low-income earners, and male earnings are likely to be lower than in Case 1. The threshold of 3 million yen is located at around the 25th percentile and the median of the male and female earnings distributions, respectively.

Earnings developments greatly reduce the pace of debt outstanding over time. Figure 5 shows the debt outstanding of both sexes in Cases 1 and 2, together with the fixed repayment type loan counterparts. In Case 1 (shown on the upper left of Figure 5), on an average, males complete repaying their debts in their late 30s, while females, again on an average, do not complete repaying, and still hold some debt at age 59. This is because females leave their jobs at 30 after their marriage. Their revenues are lower than 3 million yen and remain almost unchanged during the simulation period, thereby leaving them in debt at age 59.

Figure 3 Simulated Earnings in Case 1

(1) Males



(2) Females

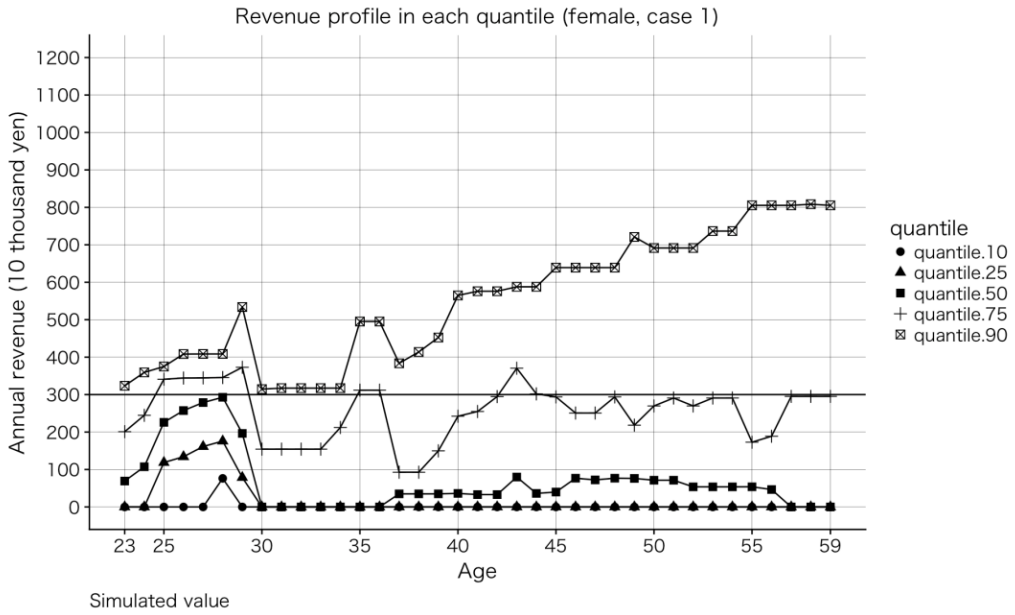
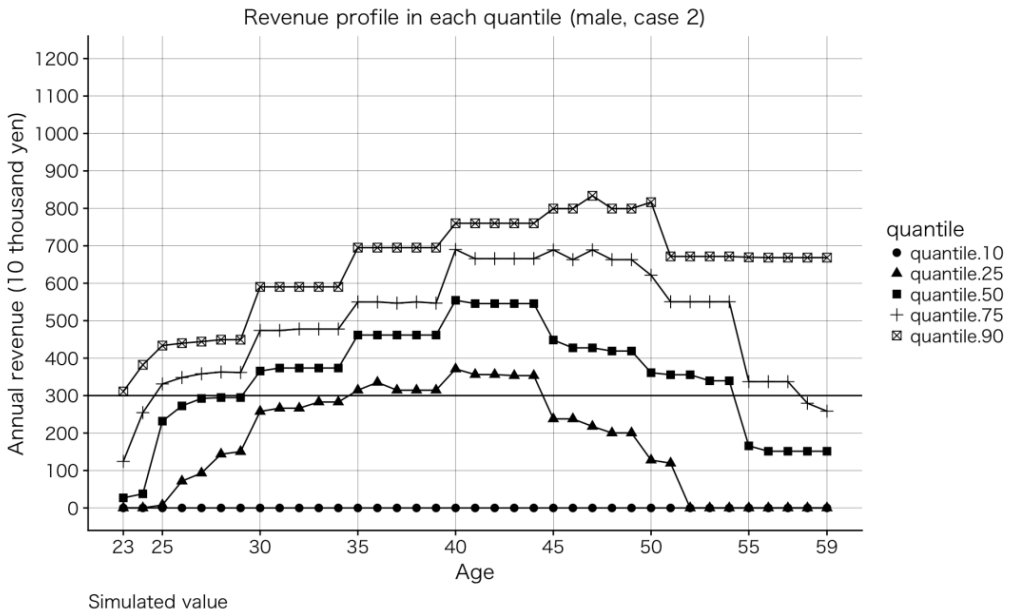


Figure 4 Simulated Earnings in Case 2

(1) Males



(2) Females

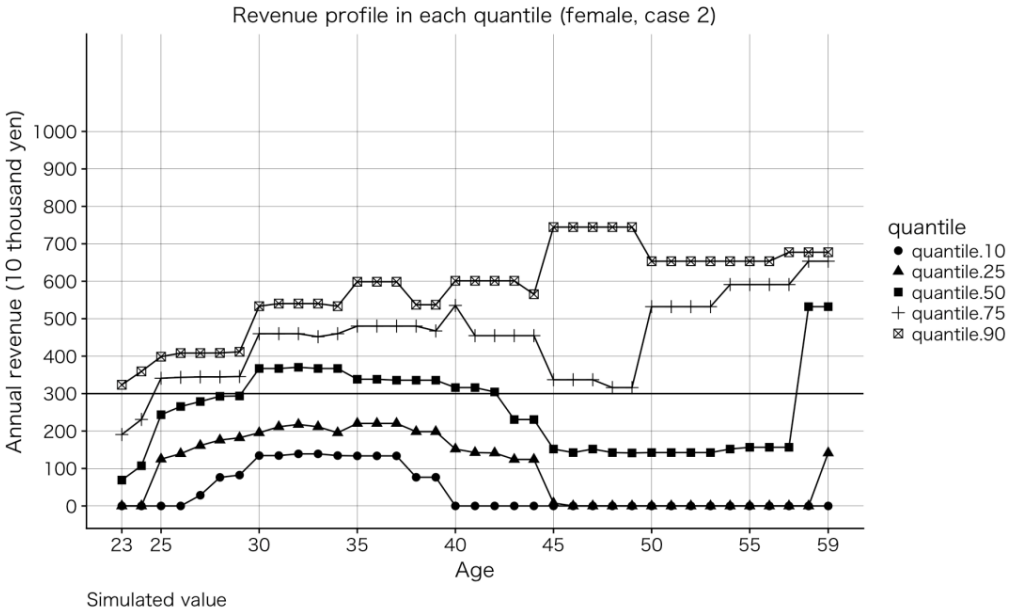
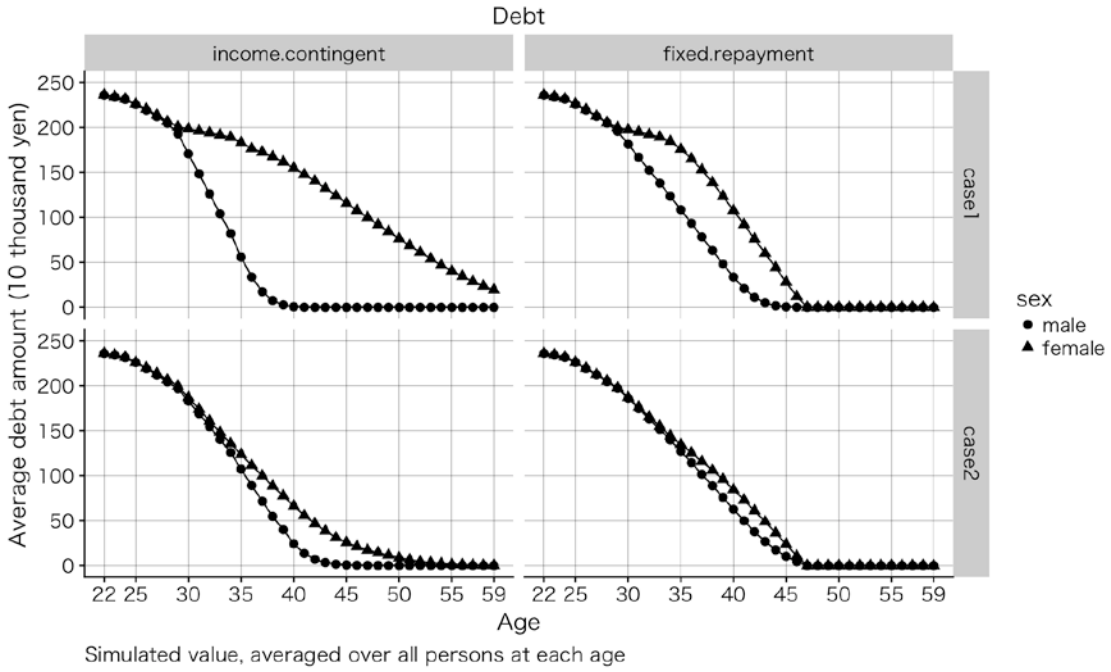


Figure 5 Debt Developments over Repayment Periods



Note that fixed repayments may greatly change situations (shown on the upper right of Figure 5). After enjoying 10-year exemptions, females have to repay 160,000 yen, which enables them to complete repaying the debts at age 47.[12] Since fixed repayments are lower than those in the ICL scheme, males delay getting out of debt by five years.

As for Case 2, both males and females continue to work because they remain single during the simulation period. In terms of ICLs, males complete repaying their debts at about age 45, later than the age in Case 1, thereby reflecting lower wages of single workers. Almost all females complete repayments at age 59. In the fixed repayment scheme, both males and females complete repayment at age 46, much earlier than repayment for ICLs for females.

5.2 Fiscal Costs

Simulating earnings will allow us to calculate the fiscal costs defined in Section 3. The results are summarized in Figure 6 that shows the fiscal costs for a range of discount rates. We will concentrate on two cases with discount rates equal to 0.1% and 2%, respectively. In general, setting the discount rate is related to our projection of the future course of the Japanese economy. If we are pessimistic and think that getting out of the current extraordinary monetary easing may be unlikely in the foreseeable future, the discount rate should be almost zero. On the other hand, if we are optimistic about the future of the economy and expect the

[12] The result is obtained using the following calculation: age 23 plus 10-year exemption plus 2.36 million yen / 160,000 yen.

monetary easing to be corrected soon, the rate should be set to a certain positive figure. Taking into account the above, we will pick up these discount rates and further investigate their fiscal consequences.

Figure 6 Fiscal Costs Comparison between the Current ICL and Fixed Repayments by Case

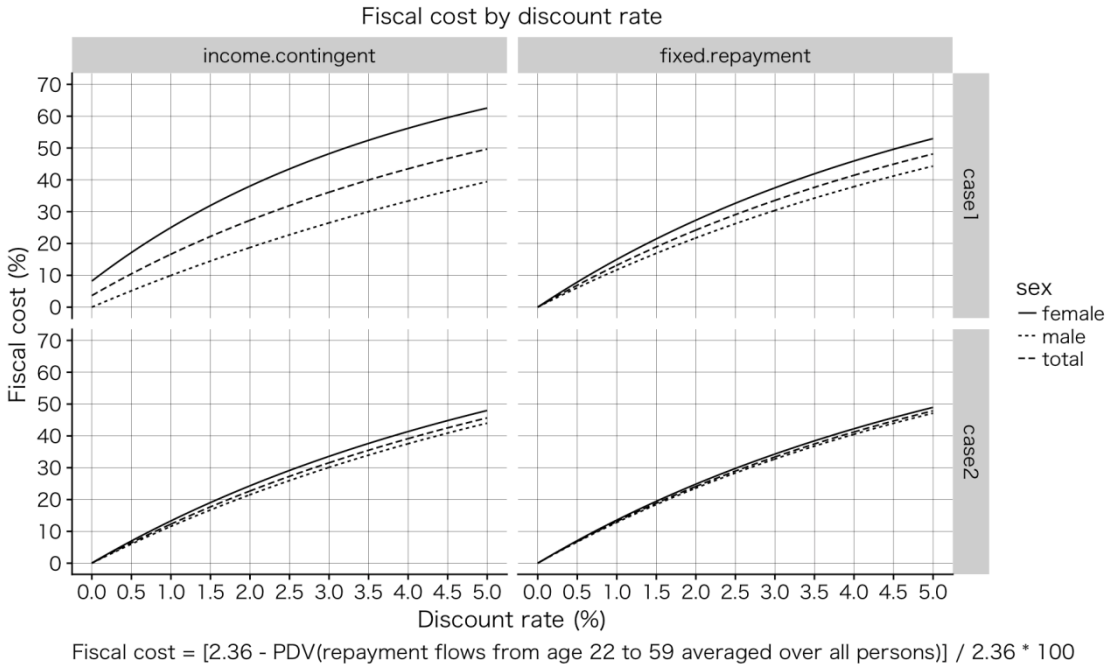


Table 1 shows the results, together with their fix repayment counterparts. As expected, setting discount rates greatly affects the fiscal costs. Roughly speaking, apart from large differences observed in female ICL cases, the fiscal costs are almost in the same magnitude for both discount rates: they fall in the range of 1 to 2% for 0.1% discount rate, and almost around 20% for 2% discount rate. In other words, as long as borrowers continue to work, consequences due to the different natures of repayment schemes – income contingent or fixed – are rather minor. As high-income earners are allowed to complete repaying earlier, fiscal costs for males are lower in the ICL scheme than those in the fixed repayments.

It is notable that applying ICL to females in Case 1 turns out to be very costly: twice compared to that of male counterparts for the discount rate of 2%, and nine times for 0.1%, respectively. The higher costs of the ICLs are accounted for by females unwilling to provide market services. The costs are higher as the discount rate is set lower. Weighted averages of both cases could suggest an overall picture because both cases are likely to represent two extremes in terms of female labor supply behaviors.

However, the results depend on the assumption that borrowers' labor statuses changed every year, and therefore, their annual revenues are highly volatile. This comes from the assumption that an individual's labor status in period *t* is determined independently of that in period *t*-1. The resulting high labor mobility is likely to reduce the fiscal costs, given the

minimum earnings eligible for repayments.[13]

Table 1 Simulation Results of Fiscal Costs with Mobility

Discount rate	Sex	Case 1		Case 2		Weighted Avg.	
		ICL	FR	ICL	FR	ICL	FR
0.1%	Total	5.1%	1.4%	1.3%	1.4%	4.3%	1.4%
	Male	1.1%	1.3%	1.2%	1.4%	1.1%	1.3%
	Female	10.1%	1.6%	1.5%	1.5%	8.5%	1.6%
2%	Total	27.3%	24.2%	22.7%	24.1%	26.4%	24.2%
	Male	18.7%	21.8%	21.5%	23.6%	19.3%	22.1%
	Female	38.0%	27.3%	24.3%	24.8%	35.4%	26.8%

Note: FR stands for "Fixed Repayment." Full mobility means that labor statuses are determined by simulations every year.

Therefore, we will recalculate the fiscal costs with the assumption of no mobility. To be specific, we will calculate the fiscal costs if the borrowers stay at the same percentile of the earnings distributions during their lives. In other words, the borrowers are assumed to track the earning age profiles shown in Figures 2 and 3, if they happen to be located at one of the particular percentiles of 10, 25, 50, 75, and 90. This assumption is again obviously extreme, but could be helpful to assess how biased the above results are.

The changed assumption will produce Tables 2, which summarizes detailed information about males and females in Table A2 and A3, respectively (see Appendix 2). The impacts on the results, except for those of males in Case 1, are huge. The costs may increase by more than 10 percentage points for males in Case 2, and more than 20 percentage points for females in both cases. The increase in costs for males in Case 1 may be mild, about 4 to 5 percentage points.

Overall Table 2 shows that reduced mobility could increase the fiscal costs by up to 15 to 20 percentage points, depending on the assumption of the discount rate. To obtain more specific estimates, it is necessary to get the information at time *t-1*, and model how labor statuses at time *t* are related to the information at time t-1. Since the JGSS collects current information only, it is impossible for us to further investigate this point. Thus, allowing for

[13] One could get the point using the analogy of an option pricing theory. From the perspective of the government, holding ICL assets is equivalent to keeping a stream of call options whose underlying assets are the borrowers' revenues and where exercise prices are set to 3 million yen. A characteristic of this option is that government gains are set at 9% of the total gains from exercising the options, and that the cumulative gains for the government is limited below initial loan assets (e.g., 2.36 million yen in this simulation). See Kim and Kim (2011) and Palacious (2004) for the option pricing approach to the ICL scheme.

time dependency will require use of new information sources. For example, use of the labor force survey could provide transition matrices of labor statuses, and there are also several empirical studies on transitions among labor states. How to incorporate such information into our microsimulation exercises is beyond this study, and should be our future task.

Table 2 Simulation Results of Fiscal Costs without Mobility

Discount rate	Sex	Case 1		Case 2		Weighted Avg.	
		ICL	FR	ICL	FR	ICL	FR
0.1%	Total	26.0%	1.4%	23.3%	1.3%	25.5%	1.4%
	Male	4.7%	1.2%	17.6%	1.3%	7.3%	1.3%
	Female	53.3%	1.6%	30.6%	1.4%	49.0%	1.5%
2%	Total	41.4%	23.6%	39.6%	23.0%	41.1%	23.5%
	Male	23.1%	21.6%	35.0%	22.8%	25.5%	21.8%
	Female	64.9%	26.2%	45.5%	23.3%	61.2%	25.6%

Note: FR stands for "Fixed Repayment." No mobility means that individuals are assumed to stay at the same percentile of revenue distributions during their lives.

5.3 Discussions

The simulation results show that female labor supply behaviors exert a significant influence on the fiscal costs. In particular, if married females provide more labor services in the market at higher wages, it will reduce fiscal costs. In this context, the government's initiatives related to female labor, such as *the Plan to Realize the Dynamic Engagement of All Citizens*, are very important.

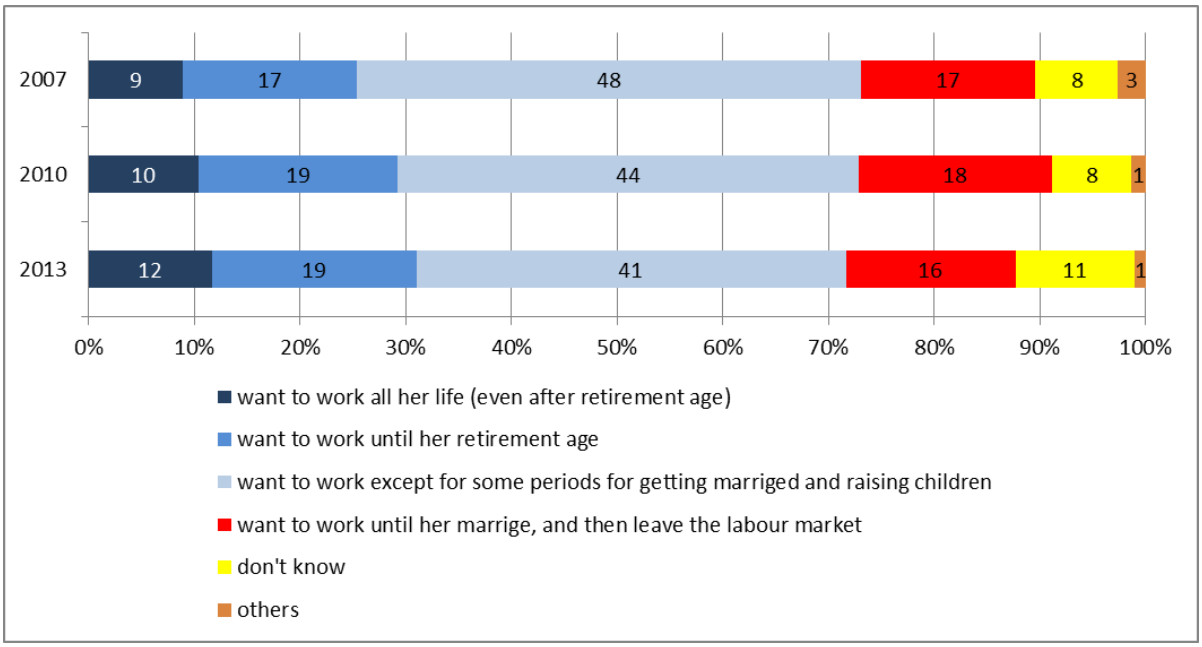
The merit of ICLs is its insurance function against unfortunate labor market outcomes. Therefore, its universal application to students is desirable. This could mean that females who may be unwilling to continue working after their marriages are also eligible for the ICL scheme, thereby increasing the fiscal costs. Such would-be housewives could account for one out of seven among the current third-year female students (Figure 7). Therefore, in addition to an equity issue emphasized by the Ministry of Finance,[14] the universality issue is likely to pose an efficiency problem. Armstrong and Chapman (2017) argue for universality, pointing that the equity concerns could be alleviated by allowing an option of front-loaded payments that wealthy Australian students (as per their research) prefer to utilize and may be useful in Japan as well.

Even if the simulation results are accepted, it is necessary to get information about possible

[14] See the document the MOF submitted to the Fiscal Council on October 31 2017, which is available at http://www.mof.go.jp/about_mof/councils/fiscal_system_council/sub-of_fiscal_system/proceedings/material/zaiseia291031/01.pdf.

benefits of the ICL in the context of cost-benefit analysis. A benefit of the ICL could be measured as the effects that the ICLs enable discouraged students for economic reasons under the fixed repayment loans to study at tertiary institutions.[15] Estimating such a benefit is beyond this study.

Figure 7 Career Preference Survey Results of Third-year Female Students



Source: Univ. of Kyoto, Univ. of Tokyo and DENTSU Scholarship Foundation (2015) "Report on University Students' Career Preference: Changes over the period of 2007, 2010 and 2013"

6. Conclusion

This study has estimated the fiscal costs incurred by ICLs launched in April 2017 using a microsimulation approach. Examining single and married couple cases, the study has detected three factors to affect how costly the loan scheme is: the discount rate, female working conditions, and income mobility.

The case studies show that the range of the possible fiscal costs is very wide, and that the costs are, on average, 20 percentage points higher than their fixed repayment counterparts. The largest costs may amount to about 40% of the mean loan outstanding at the time of graduation. This means that the amount would not be repaid in PDV terms. This amount could

[15] In the context of Australia and other countries where tuition fees were introduced, an issue is whether the ICL has offset tuition fees' discoursing effects on willingness of students in adversity to go on to universities. Chapman and Doris (2017) point out the fact that "the socio-economic make-up of the higher education student body was about the same 25 years after the introduction of the policy as in the late 1980s," and conclude "there have been few consequences for the accessibility to higher education of students from relatively disadvantaged backgrounds, at least as represented by enrolments."

be reduced, depending on the three aforementioned factors. Some examples are: the discount rate falls from 2%; more married females continue working at higher wages; and more income dynamics are introduced, such as changes in the percentages of income distributions during individuals' lives. All these changes will cut fiscal costs.

The lowest cost would lie in the range of 1 to 5% of the mean loan outstanding. The possible range is very large and, therefore, needs to be reduced, which is the most important task in this microsimulation exercise. A promising way would be to incorporate time dependency into the draw performed every year to determine an individual's labor status. This makes it necessary to model the individual probabilities of labor status as conditional on the debtors' past situations. This should require information other than that provided by the JGSS.

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Appendix 1: Details of Simulation Procedures

A1.1 Converting categorical into numeric data

Since the JGSS provides revenue class information only, it is necessary to convert it into numeric data to calculate ICL repayments. We use kernel density estimation to produce numeric revenues data.

First, we generate a new variable by assigning respondents the median values of the categories their answers belong to. The answers are classified into 24 categories, where "no response" and "don't know" are included, but are excluded in the subsequent calculations. We set 23 million yen to the value of the categories with highest revenues, "19: over 23 million yen," and zero to "23: Not working," respectively.

Second, we apply a kernel method to the new variables in JGSS 2000-2012 to produce continuous revenues, using a Gaussian kernel with a bandwidth of 500,000 yen. The obtained distribution enables us to calculate probabilities of each of the 100,000 revenue points, evenly located in the interval between 0 and 25 million, (0, 25, 50, 75, …, 25,000,000).

Therefore, the resulting probability distribution allows us to draw a lottery that determines a revenue value conditional to an individual's revenue class.

A1.2 Details of the estimation

We estimate two binary discrete choice models for labor force state, L, and employment status, E, using logit models. That is, we estimate P(L|M, C) with L=1 (Employed) and L=0 (Not employed), and P(E|M, C, L=1) with E=1 (Full-time regular employment) and E=0 (Other employment, which includes part-time worker, dispatched worker, contract employee, and entrusted employee). See Table A1 for the details of the estimation results.

Appendix 2: Details of Effects of Reduced Mobility

The simulations producing Table 1 assumes high mobility in labor statuses because each individual's labor status is determined by a draw every year. This unrealistic assumption is replaced by the static assumption that each individual stays at the same percentile of the earning distributions from age between 23 and 59. This no mobility assumption increases the fiscal costs as shown in Table 2.

This appendix will provide detailed results of the above recalculation. To be specific, results with no mobility are shown by sex, discount rate, case, and income percentile. See Table A2 and A3 for male and female results, respectively.

Table A1 Estimation Results of the Logit Models

	Labor force state Logit (MLE) L=1: Employed		Employment status Logit (MLE) E=1: Regular employment	
	Coef	SE	Coef	SE
Age	1.126***	0.396	2.828***	0.518
Age squared / 100	-2.421**	1.104	-6.724***	1.399
Age cubed / 1000	0.159	0.097	0.513***	0.12
Female	-19.623**	7.948	0.129	7.975
Married	30.242	29.831	1.256***	0.428
Child (aged 0-6)	-4.337	8.257	-11.879	10.219
Child (aged 7-12)	-2.865	7.657	-62.610***	18.894
Child (aged 13-15)	14.212	22.632	-40.819	36.327
Child (aged 16-18)	89.989	55.653	-21.615	37.809
Female * Age	1.710**	0.72	0.162	0.679
Female * Age squared / 100	-4.578**	2.045	-0.986	1.828
Female * Age cubed / 1000	0.385**	0.184	0.12	0.157
Married * Age	-1.77	2.11		
Married * Age squared / 100	3.597	4.852		
Married * Age cubed / 1000	-0.239	0.364		
Female * Married	26.259	30.709	-2.164***	0.515
Female * Child (aged 0-6)	-1.113	0.791	-0.976	1.21
Female * Child (aged 7-12)	-0.642	0.609	-2.725**	1.366
Female * Child (aged 13-15)	-0.935	0.744	-3.499	2.891
Female * Child (aged 16-18)	-0.1	0.759	-0.369	0.9
Age * Child (aged 0-6)	0.142	0.452	0.722	0.595
Age * Child (aged 7-12)	0.178	0.375	2.912***	0.921
Age * Child (aged 13-15)	-0.531	0.976	2.028	1.679
Age * Child (aged 16-18)	-3.816	2.34	0.844	1.579
Age squared / 100 * Child (aged 0-6)	-0.079	0.609	-0.882	0.825
Age squared / 100 * Child (aged 7-12)	-0.246	0.453	-3.225***	1.072
Age squared / 100 * Child (aged 13-15)	0.502	1.048	-2.293	1.867
Age squared / 100 * Child (aged 16-18)	4.055*	2.456	-0.793	1.639
Female * Married * Age	-2.588	2.223		
Female * Married * Age squared / 100	6.952	5.253		
Female * Married * Age cubed / 1000	-0.581	0.406		
Constant	-14.417***	4.448	-35.755***	6.043
Observations	2206		1720	
McFadden R^2	0.272		0.369	

Notes: ***Significant at the 1 percent level. **Significant at the 5 percent level. *Significant at the 10 percent level.

Table A2 Fiscal Costs for Males With and Without Mobility

Discount rate	Income percentile	Case 1		Case 2	
		ICL	Fixed repayment	ICL	Fixed repayment
0.1%	With mobility				
	Total	1.1%	1.3%	1.2%	1.4%
	Without mobility				
	Total	4.7%	1.2%	17.6%	1.3%
	5th percentile	69.7%	1.8%	73.2%	1.8%
	10th percentile	1.7%	1.6%	73.2%	1.8%
	25th percentile	1.4%	1.5%	31.3%	1.8%
	50th percentile	1.2%	1.4%	1.4%	1.5%
	75th percentile	0.9%	1.0%	1.0%	1.0%
	90th percentile	0.6%	0.8%	0.7%	0.8%
2.0%	With mobility				
	Total	18.7%	21.8%	21.5%	23.6%
	Without mobility				
	Total	23.1%	21.6%	35.0%	22.8%
	5th percentile	80.4%	29.6%	82.7%	29.6%
	10th percentile	28.9%	26.5%	82.7%	29.6%
	25th percentile	24.6%	25.3%	52.7%	29.6%
	50th percentile	21.5%	23.8%	24.8%	25.3%
	75th percentile	16.1%	17.5%	17.2%	17.5%
	90th percentile	11.8%	14.1%	12.6%	14.1%

Note: Fiscal costs without mobility are calculated based on the assumption that ones will stay at the same percentiles of the earning age distribution during their lives.

Table A3 Fiscal Costs for Females With and Without Mobility

Discount rate	Income percentile	Case 1		Case 2	
		ICL	Fixed repayment	ICL	Fixed repayment
0.1%	With mobility				
	Total	10.1%	1.6%	1.5%	1.5%
	Without mobility				
	Total	53.3%	1.6%	30.6%	1.4%
	5th percentile	73.2%	1.8%	73.2%	1.8%
	10th percentile	73.2%	1.8%	73.2%	1.8%
	25th percentile	73.2%	1.8%	73.2%	1.8%
	50th percentile	73.2%	1.8%	1.9%	1.5%
	75th percentile	34.9%	1.5%	1.0%	1.0%
	90th percentile	0.8%	0.8%	0.7%	0.8%
2.0%	With mobility				
	Total	38.0%	27.3%	24.3%	24.8%
	Without mobility				
	Total	64.9%	26.2%	45.5%	23.3%
	5th percentile	82.7%	29.6%	82.7%	29.6%
	10th percentile	82.7%	29.6%	82.7%	29.6%
	25th percentile	82.7%	29.6%	82.7%	29.6%
	50th percentile	82.7%	29.6%	30.8%	25.7%
	75th percentile	50.1%	24.5%	17.7%	17.5%
	90th percentile	15.0%	14.1%	13.4%	14.1%

Note: Fiscal costs without mobility are calculated based on the assumption that ones will stay at the same percentiles of the earning age distribution during their lives.