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Cohort Effects, Spousal Incomes and Female Labour Force Participation in Japan: A Panel Data Analysis

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Abstract

In this paper, I estimate labour supply functions for married women in Japan. In particular, I attempt to capture the differences between three cohorts of women regarding their choice of employment status: full-time employment or part-time employment. I also consider whether there are any cohort-related differences in the choice of working or non-working status. For this purpose, Waves 1-15 (1993-2007) of the Japanese Panel Survey on Consumers (JPSC) are used. The estimation reveals that younger cohorts have higher log odds ratios of full-time employment to not working and of part-time employment to not working. The estimation also reveals that younger cohorts exhibit significantly higher log odds ratios of working to not working compared with older cohorts. For both estimations, the negative effect of having children aged three to five years on both full-time and part-time employment is weaker among the younger cohorts. On the other hand, the negative effect of having children less than two years of age on full-time and part-time employment is common to both older and younger cohorts.

JEL Classification: C230, J210, J220

1. Introduction

In Japan, profiles of female labour force participation have two peaks, as quite a few women withdraw from the labour market in their late 20s through early 30s and then re-enter the job market in their late 30s or thereafter. However, recently, the trough between the two peaks has become shallower, as the labour force participation rates

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of women in their 20s and 30s have increased. According to the *Labour Force Survey* conducted and published by the Statistics Bureau, labour force participation rates for women aged 25-29 and 30-34 increased from 79 to 86 per cent and from 75 to 82 per cent, respectively, in the period 1990-2010. In Japan, it appears that during child-rearing periods, young women today are more likely to remain in the labour force than previous generations were.

However, disaggregation by marital status suggests that increases in female labour force participation in women's 20s or 30s are closely related to increases in the proportion of women who remain single or married but do not have any children. Abe (2011) analysed micro data from the *Employment Status Survey* and found that among younger cohorts of women, who graduated from university in 1986 and after, there was not necessarily a higher proportion in full-time employment than amongst older cohorts, if marital statuses were held constant.

In a number of countries, younger cohorts of women are found to exhibit patterns of labour force participation different from their older counterparts. In this paper, I examine whether there are also any cohort-related changes in the labour force participation of married women in Japan. I also seek to determine whether there are any inter-cohort differentials in the ways in which variables influence the labour supply. For this purpose, I have analysed data on three cohorts from the *Japanese Panel Survey on Consumers* (JPSC).

The remainder of this paper is organised in the following manner. Section 2 is devoted to a brief literature review. Section 3 presents the model and the variables used in the analyses. Section 4 explains the data and provides descriptive statistics. Section 5 interprets the estimated results and section 6 concludes.

2. Literature review

Preceding analyses outside of Japan

In the United States, estimations of female labour supply functions began with Mincer (1962) which served as the theoretical basis for a large number of papers on this topic. Since the 1960s, a number of researchers have found negative effects of spousal income and young children on female labour supply using micro data, mainly the *Current Population Survey* and the *Panel Study on Income Dynamics*. In the 1970s and 1980s, new econometric methods to deal with selection biases and endogeneity problems were introduced (see Hausman, 1978; and Heckman, 1979), which enabled researchers to perform more precise estimations of female labour supply functions. In the 1990s, dynamic estimation methods began to be utilised in estimating female labour force participation. Hyslop (1999) found that there was significant state dependence in female labour force participation using a dynamic model. Since the 1990s, changes in female labour supply over the life cycle have attracted the attention of researchers. Pencavel (1998) documented cohort-related changes in women's labour force participation profiles from 1975 to 1994. Fukuda (2006) found cohort effects in the female labour supply in the U.S. that were much larger than those for Japan,

The negative effects of spousal incomes and the number of children on female labour supply have also been observed in several countries outside the U.S. Additionally, recent studies have found that there are cohort-related changes in female

labour supply in a number of countries. For example, Beaudry and Lemieux (1999) isolated cohort effects from business cycle effects in explaining changes in female labour force participation in Canada. In Australia, Austen and Seymour (2006) found that younger cohorts of women were not only participating in the workforce at a higher rate than earlier cohorts had but were also less affected by their life stages than had been the case for older cohorts. Fourage *et al*. (2010) compared cohort effects in the female labour supply in Germany, the Netherlands, and Great Britain and observed that younger cohorts displayed a less sharp decline in participation around childbirth and a faster increase in participation after childbirth, especially in the Netherlands.

Preceding analyses in Japan

In Japan, Obi (1969a, 1969b, 1979) estimated the labour force participation of married women for various types of households on the basis of cross-sectional data. Since the late 1990s, research on female labour has increased, as panel data, including the JPSC, came to be widely used among researchers. A number of research papers which utilised the JPSC, including Higuchi, Waldfogel and Abe (1999); Matsuura and Shigeno (2001); Nawata and Ii (2004); Takeuchi (2006); Kohara (2006); Kohara (2010) and Okamura and Islam (2011), have been published.[1] Studies on the cohort-related differences in female labour force participation using the JPSC have been scarce. Fukuda's (2006) cohort-analysis was based on the *Labour Force Survey*.

3. Model and variables

In this paper, I estimate two models; one is a random-effect multinomial logit model and the other is a random-effect logit model. The former is based on the assumption that a woman chooses one of three employment statuses – full-time employment, part-time[2] employment, and not working – and the latter is based on the assumption that a woman decides to either work or not to work.

Multinomial logit model with unobserved heterogeneity

The multinomial logit model with unobserved heterogeneity used in this paper is in accordance with that of Grilli and Rampichini (2007).[3] Suppose that individual i has an employment status Y_{it} at wave t. $P\ (Y_{it}=j|\ X_{it})$, $j=0, 1, 2$, is the probability that individual i has response j in wave t given X_{it}, a column vector of explanatory variables for that observation.

In this model, there are three possible labour market outcomes; working full-time ($j=2$), working part-time ($j=1$), and not working ($j=0$). 'Not working' is set as the reference category. Self-employment or family businesses are not considered here. The probability that an individual chooses a working status j at wave t has the form as in equation (1):

[1] Kohara (2006) challenged the myth that homemakers do not work outside the home because of their spouses' high incomes. On the other hand, Kohara (2010) found that married women tended to start working outside the home in response to spousal job loss.
[2] In Japan, there are three main definitions for part-time employees. Part-time employees in the JPSC are defined as those employees in a particular workplace for whom the wage tables applied are quite different from those applied to regular employees (Kishi 2009).
[3] Grilli and Ranpichini (2007) estimated the effects of job skills to job satisfaction.

$$\pi_{it} = p(Y_{it} = j \mid X_{it}) = \frac{\exp(X_{it}\beta_j + \alpha_i + \xi_{it})}{1 + \sum_{k=1}^{2} \exp(X_{it}\beta_k + \alpha_i + \xi_{it})} \quad (1)$$

$$j = \begin{cases} 0\,(not\ working) \\ 1\,(working\ part\text{-}\ time) \\ 2\,(working\ full\text{-}\ time) \end{cases}$$

The random effects, α_i, capture non-observable individual effects with mean zero and variance-covariance matrix Σ_α. The term ξ_{it} denotes random errors at wave *t* for individual *i*.

Random effect logit model

I also estimate the log odds ratio that a respondent works, either part-time or full-time, integrating part-time employment and full-time employment into one employment status: working. That is, there are only two labour market outcomes: working (*m*=1) and not working (*m*=0).

$$P_{it} = p(Y_{it} = m \mid X_{it}) = \frac{\exp(X_{it}\beta_m + \alpha_i + \xi_{it})}{1 + \exp(X_{it}\beta_m + \alpha_i + \xi_{it})} \quad (2)$$

$$m = \begin{cases} 0\,(not\ working) \\ 1\,(working\ ) \end{cases}$$

Variables

For the analysis of the JPSC dataset, I use explanatory variables including age, unemployment rates (UR), cohort dummies, natural logarithm of spousal incomes (log(Hincome)), number of children aged 0-2, 3-5, and 6-17, and years of education, as listed in table 1. I have included the interaction terms between the two cohort dummies, Cohort B and Cohort C, and the other explanatory variables, i.e. Age × Cohort B, Age × Cohort C, log(Hincome) × Cohort B, log(Hincome) × Cohort C, and so on, in X_{it}. This is to test if the effects of the explanatory variables on the employment statuses are different among the three cohorts. I also have included the unemployment rate for women from the *Labour Force Survey* for each year as a macroeconomic variable.

Table 1 - Explanatory variables

Variables	*Measurement*	*Definitions*
Age	Continuous	The respondent's age as of Oct 1st for each wave
Cohort B	Binary	1 if the respondent is in Cohort B, 0 otherwise
Cohort C	Binary	1 if the respondent is in Cohort C, 0 otherwise
UR	Continuous	Unemployment rates for women (%) from the *Labour Force Survey*
Log(Hincome)	Continuous	Natural logarithm of the spousal incomes[11] (in ten thousand yen, deflated by the CPI)
Children0_2	Continuous	Number of children aged 0-2
ChIldren3_5	Continuous	Number of children aged 3-5
Children 6_17	Continuous	Number of children aged 6-17
Grandparents	Binary	1 if living together with children's grandparent(s); 0 otherwise.
Education[12]	Continuous	Number of years of education
Interaction terms		
Age × Cohort B	Continuous	
Age × Cohort C	Continuous	
UR × Cohort B	Continuous	
UR × Cohort C	Continuous	
Log(Hincome) × Cohort B	Continuous	
Log(Hincome) × Cohort C	Continuous	
Children0_2 × Cohort B	Continuous	
Children0_2 × Cohort C	Continuous	
Children3_5 × Cohort B	Continuous	
Children3_5 × Cohort C	Continuous	
Children6_17 × Cohort B	Continuous	
Children6_17 × Cohort C	Continuous	
Education × Cohort B	Continuous	
Education × Cohort C	Continuous	

Notes: [11] Here, 'Spousal income' includes both labour and non-labour income. [12] In this study, years of education are categorised in the following manner: 9 years for middle school; 12 years for high school; 13.5 years for technical school, 14 years for technical college or junior college; 16 years for university; and 19.5 years for graduate school. This conversion is in accordance with Okamura & Islam (2010). Respondents with 'other' kinds of education were omitted from the dataset.

4. Data and descriptive statistics

Data

For the current study, I used the three cohorts in the *Japanese Panel Survey on Consumers* (JPSC), the first panel dataset available in Japan. The survey was administered and the data collected by the Institute for Research on Household Economics, a public research institute. The first wave was conducted in 1993, using a sample of 1,500 women aged between 24 and 34 who had responded to a questionnaire (named Cohort A by the institute).[4] The respondents were all female because the initial objective of this survey was to study the lifestyles of young women across a broad range of factors, such as expenditure, savings, employment status, and family structure. In 1997, when the cumulative attrition rate for Cohort A had grown to 17 per cent, 500 new sample subjects (Cohort B) comprising women aged 24-27 were added.

[4] The questionnaire was sent to respondents and returned to the institute by post.

In 2003, when the cumulative attrition rates for Cohorts A and B had grown to 42 per cent and 35 per cent, respectively, 836 new sample subjects (Cohort C) comprising women aged 24-29 were added. Although Cohort D was added in 2008, it is not addressed in this study.[5] The years of birth for Cohort A, Cohort B, and Cohort C were 1959-1969, 1970-1973 and 1974-1979, respectively. The age ranges of the three cohorts are as depicted in table 2.[6]

Table 2 - The three cohorts of the JPSC used in this study

Cohort	*Years born*	*Oldest observation aged*	*Youngest observation aged*	*Number of waves observed*
A	1959-1969	48 in Wave 15	24 in Wave 1	15 (Waves 1-15)
B	1970-1973	37 in Wave 15	24 in Wave 5	11 (Waves 5-15)
C	1974-1979	33 in Wave 15	24 in Wave 11	5 (Waves 11-15)

Descriptive statistics

Samples of married women in the three Cohorts, i.e. Cohorts A, B, and C, from the JPSC were used in the estimation. I excluded unmarried women from the data because the effects of family factors and changes therein were to be estimated. I also excluded self-employed people, people with no answer as to employment status, and those with missing values vis-à-vis the other explanatory variables listed in table 1. The descriptive statistics of the samples used in this analysis are presented in table 3. As there are no questions about the details of unemployment in the JPSC, unemployed people and those choosing to be out of the labour force, such as homemakers, are classified into the same category 'unemployed or not working' in this paper.

I have compared the distribution of employment statuses for the JPSC samples used in this research with the entire JPSC from Wave1 to Wave 15 and with the Labour Force Survey, an official Japanese statistical publication. As the mean age of the samples used in this paper is approximately 34.1 compared them with the data for women from 25 to 44 years of age from the *Labour Force Survey*, as depicted in table 4. The proportions of both full-time employees and part-time employees in the samples considered in this paper are lower than those for the entire JPSC, as the samples are comprised only of married women.[7] The proportions of full-time employment in the entire JPSC, are close to those of the *Labour Force Survey*, while the proportions of part-time employees and self-employed persons are higher in the entire JPSC than in the Labour Force Survey. The trends for part-time employment and full-time employment are similar in the JPSC Waves 1-15 and the Labour Force Survey from 1993 to 2007. The proportion of part-time employment increased from 16 per cent to 31 per cent in the entire JPSC and from 18 per cent to 28 per cent for females aged 25-44 in the *Labour Force Survey*. The proportion of full-time employment fluctuated at around 30 per cent in the JPSC and at slightly less than 30 per cent in the *Labour Force Survey*.

[5] A brief explanation of the JPSC and the questionnaires used are provided on the institute's English-language website: http://www.kakeiken.or.jp/en/JPSC/jpsc.html.
[6] Sakamoto (2006) analyses the causes and effects of sample attrition in Cohorts A and B in the JPSC. The rates of attrition for each wave are also listed in the JPSC Annual Report (in Japanese).
[7] In the published *Labour Force Survey*, data on employment statuses classified by marital status are not available.

Table 3 - Descriptive statistics

Variable	*Measurement*	*Mean*	*Standard deviation*	*Minimum*	*Maximum*
Working	binary	0.479	0.500	0	1
Full-time employees	binary	0.192	0.394	0	1
Part-time employees	binary	0.287	0.452	0	1
Not in the labour force or unemployed	binary	0.521	0.500	0	1
Age as of October 1st	continuous	34.224	5.281	24	48
Unemployment rate (%)	continuous	4.171	0.829	2.5	5.4
Cohort A	binary	0.754	0.430	0	1
Cohort B	binary	0.140	0.347	0	1
Cohort C	binary	0.105	0.307	0	1
Spousal incomes (in ten thousand yen)	continuous	527.652	272.453	0.985	8143.000
log (Spousal incomes)	continuous	6.168	0.463	-0.015	9.005
Number of children from 0 to 2 years of age	continuous	0.212	0.425	0	3
Number of children from 3 to 5 years of age	continuous	0.364	0.558	0	3
Number of children from 6 to 17 years of age	continuous	0.695	0.843	0	4
Grandparents in the households	binary	0.094	0.292	0	1
Years of education	continuous	12.995	1.640	9	19.5

Source: Unemployment rates are from the *Labour Force Survey*. Descriptive statistics for the other variables are the authors' calculation based on the samples used in the analysis. Number of samples is 14,497.
Note: 'Not working' in the JPSC includes both 'not in the labour force' and 'unemployed'.

5. Estimation results

Results of the random-effect multinomial logit model

Firstly, I apply the multinomial logit model, as in equation (1) in the previous section, using the generalized linear latent and mixed models (GLLAMM) procedure (see Skrondal and Rabe-Hesketh, 2004) in STATA. Maximum likelihood estimation with eight quadrature points was utilized. The estimated results are as listed in appendices A1 and A2.

The upper parts of appendices A1 and A2 exhibit the results for j=1, i.e. the odds ratios of part-time employment compared to not working. Cohort B and Cohort C show significant positive effects for part-time employment for six out of the eight types of estimation.[8] For all eight estimations, age, the number of children aged 6 to 17 years, and the dummy variable for living with grandparents have a significant positive effect on the selection of part-time employment. On the other hand, spousal incomes, the number of children aged 0 to 2 years, and the number of children aged 3 to 5 years have a significant negative effect on part-time employment. Education does not have any effect on the log odds ratio of part-time employment compared to not working.[9] With regard to the interaction terms, Age × Cohort B and Age ×

[8] T-tests indicated that the effect of Cohort B was the same as that of Cohort C.
[9] I have also performed the estimation for the three cohorts separately. The effects of log (Hincome), Children0_2, and Children3_5 on part-time employment and full-time employment were significantly negative for all three cohorts. The positive effect of grandparents was unstable, as the proportion of those living with their children's grandparents was below 10 per cent in all three cohorts.

Table 4 - The JPSC and the *Labour Force Survey*

	Wave	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Samples	full-time employment	17.84	20.57	20.07	19.56	19.71	18.27	18.19	18.24	18.51	17.98	18.03	18.65	20.33	20.95	20.81
	part-time employment	17.96	19.33	22.25	23.57	23.70	26.33	26.92	28.91	32.09	33.07	31.59	32.59	33.06	36.03	35.57
	not working + unemployed	64.20	60.10	57.68	56.87	56.59	55.40	54.89	52.85	49.40	48.95	50.38	48.76	46.61	43.02	43.62
	Number of observations	835	812	827	823	979	980	962	965	913	901	1165	1126	1092	1076	1043
Entire JPSC	full-time employment	34.20	33.68	31.82	28.81	32.65	30.40	28.53	27.15	26.95	25.73	31.28	31.87	30.64	30.61	30.13
	part-time employment	16.00	16.81	18.33	20.11	22.05	23.63	24.66	26.75	28.56	29.36	28.28	27.78	29.57	30.78	31.24
	self-employment	6.87	7.31	8.27	9.01	7.69	7.51	8.72	7.93	8.21	8.43	7.11	7.27	7.49	7.16	7.85
	not working + unemployed	42.93	42.19	41.58	42.06	37.61	38.46	38.09	38.17	36.28	36.48	33.33	33.08	32.30	31.45	30.77
Labour Force Survey, Females 25-44 years of age	full-time employment	29.54	29.77	30.25	31.49	31.81	31.88	29.79	29.89	30.66	30.57	29.79	28.71	30.23	29.51	29.39
	part-time employment	18.00	18.15	18.43	18.40	19.66	19.98	20.53	21.28	23.09	22.79	24.22	26.15	25.40	26.90	27.82
	self-employment	12.34	11.45	10.42	9.91	9.10	8.07	9.26	8.56	6.49	6.66	6.57	6.39	6.10	6.10	5.92
	not working + unemployed	40.11	40.64	40.90	40.21	39.44	40.07	40.43	40.27	39.75	39.98	39.42	38.76	38.27	37.49	36.87

Source: Author's calculation for the samples and the entire JPSC.

Cohort C have a significant negative effect, indicating that the age effects are weaker for Cohorts B and C than for Cohort A. The interaction terms log(Hincome) × Cohort B and log(Hincome) × Cohort C also have significant negative effects on part-time employment; the spousal incomes' negative effects for Cohort B and Cohort C are nearly twice that of Cohort A. The estimated coefficients for the interaction terms Children3_5 × Cohort B and Children3_5 × Cohort C are significantly positive, indicating that the younger cohorts are more likely to work part-time whilst taking care of children 3 to 5 years old.[10]

The lower parts of appendices A1 and A2 present the results for full-time employment compared to not working. For all eight estimations, age, the dummy variable for living with grandparents, and years of education have a significant positive effect while unemployment rates and numbers of children have a significant negative effect on full-time employment, whatever age classes the children may be. The positive effects of Cohort B are observed in seven out of the eight estimations while those of Cohort C are seen in only five out of the eight estimations. The estimated coefficients for the interaction terms log(Hincome) × Cohort B and log(Hincome) × Cohort C indicate that the respondents in Cohorts B and C are twice as responsive to spousal income as those in Cohort A. The estimated coefficients for the interaction terms Children3_5 × Cohort B and Children3_5 × Cohort C are both positive although the estimated coefficient for the former is only significant at the 10 per cent significance level. This suggests that the negative effect of having children aged 3 to 5 years on their mother's full-time employment is weaker for Cohort C than for Cohort A, but is almost the same for Cohort B and Cohort A. The estimated coefficients for the other interaction terms are not statistically significant.

Results of the random-effect logit model

Secondly, I apply the random-effect logit model, as in equation (2) in the previous section. The estimated results are as listed in appendices A3 and A4.

Appendices A3 and A4 demonstrate that both Cohort B and Cohort C have a significant positive effect on the log odds of working in six out of the eight estimations. Amongst the other covariates, age and grandparents within the household have a positive effect, while log spousal income, the number of children aged 2 or younger, and the number of children aged 3 to 5 years have a significant negative effect on the log odds ratio of working. As was the case in the multinomial estimation, the interaction terms log(Hincome) × Cohort B and log(Hincome) × Cohort C have a significant negative effect on the log odds of working as compared to not working. The interaction terms Children3_5 × Cohort B and Children3_5 × Cohort C have a significantly positive effect on the log odds ratio of working to not working.

Effects of cohorts, spousal income, and education

In the analyses presented in the previous subsection, significant positive effects of younger cohorts on full-time employment, part-time employment, and employment at either status are observed. Whereas, for the respondent's age, unemployment rate,

[10] The t-test result cannot reject the hypotheses that the estimated coefficients for log(Hincome) × Cohort B and log(Hincome) × Cohort C are the same.

and the number of children aged 6 to 17 cohort-related differences in the estimated coefficients are not observed. On the other hand, for spousal income, the number of children aged two or younger, and the number of children aged 3 to 5 years cohort-related differences were observed. The insignificant effects of children from 6 to 17 and the negative effects of spousal incomes, children aged 2 or younger and children aged 3 to 5 confirmed the results obtained by Okamura and Islam (2011), in spite of the differences in the methods of estimation. Women in the younger cohorts are found to be more responsive to their husbands' incomes than those in the older cohort. This could be attributed to the fact that in the sample used in this paper women in the younger cohorts are more likely to be of child-rearing age than those in the older cohorts. The effects of the interaction terms between Children3_5 and the cohort dummies are significantly positive. This suggests that women in the younger cohorts are more likely to be working while taking care of children aged 3 to 5 years than those in the older cohorts. The effects of the interaction terms between Children0_2 and the cohort dummies are unexpectedly insignificant. This indicates that the burden of taking care of children aged 2 or younger has not been alleviated for the younger cohorts.

The estimated results also reveal that the unemployment rate has a significant negative effect on full-time employment but no significant effect on part-time employment. Years of education raises the log odds ratio of full-time employment but does not for either the log odds of part-time employment or the log odds of working. The number of children aged 6 to 17 years significantly raises the log odds ratios of part-time employment, while it significantly lowers the log odds ratios of full-time employment.

6. Conclusion

In this study, I have examined the effects of age cohorts on Japanese women's labour market outcomes, on the basis of panel data analyses. In particular, the cohort effects on working, full-time employment, and part-time employment were examined. The main results are summarised below.

Firstly, the cohort effects on the log odds ratios of working full-time to not working and of working part-time to not working were significant in the estimated results using a multinomial logit model; the cohort differentials were also significant in the results of the binary model, in which the dependent variable was log odds of working to not working. That is, the younger cohorts are more likely to be in either part-time or full-time employment than the older cohort. This result was different from that of Abe (2011) based on the *Employment Status Survey*. However, the effect of Cohort C, the youngest cohort, on full-time employment was weaker than that of Cohort B, the second youngest cohort.

Secondly, the effects of the four covariates, age, spousal income, children aged 2 or younger, and children aged 3 to 5 years on labour market outcomes are different among the different cohorts. Respondents in the younger cohorts were less affected by age, particularly in the choice of part-time employment. On the other hand, respondents in the younger cohorts were more affected by their husbands' incomes in their choice of both full-time and part-time employment. One possible explanation for this, given the sample used in this analysis, is that the younger cohorts are more likely

to be of child-rearing age than their older counterparts. The effect of the number of children aged 3 to 5 years is also different between the younger and the older cohorts. The burden of taking care of children aged 3 to 5 years could have been alleviated for the younger cohorts to some extent. On the other hand, the negative effect of the number of children aged 2 or younger on employment is not weaker for the younger cohorts. This could be related to the limited supply of childcare services in Japan for infants younger than one year.

Thirdly, education has a significant positive effect on full-time employment as compared to not working, while having no effect on part-time employment or working, either part-time or full-time. The effect of education on labour market outcomes is uniform among the three cohorts.

The other findings are as follows. Unemployment rates negatively affect full-time employment but do not affect part-time employment. Having children aged 6 to 17 years significantly raises the log odds of part-time employment, while significantly lowering the log odds of full-time employment. Having grandparents in the household promotes both part-time and full-time employment, although the proportion of those living with grandparents was less than 10 per cent.

The slow changes in the proportion of full-time employment in Japan could be explained by the increase in unemployment rates, the decrease in three-generation households, and the difficulties in alleviating the burden of taking care of infants aged two or younger for working mothers.

Neither the cohort-effects on the life-cycle labour supply nor cohort-related differences in the dynamic structure of female labour were clarified in this paper; they are left for future research to consider. It is necessary to continue research on cohort-related differences in labour force participation functions, as they are closely related with cohort-related changes in fertility. Researchers in population economics have continually estimated cohort differentials in marriage and childbirth rates in Japan. Studies on cohort-related differences in employment would complement population studies and help predict future developments in the Japanese labour market.

Appendix

Appendix A1 - Results of the random-effect multinomial logit estimation_1

	(1)		(2)		(3)		(4)	
Part-time employment (j =1)	*Estimated coefficients*	*Standard error*	*Estimated coefficients*	*Standard error*	*Estimated coefficients*	*Standard error*	*Estimated coefficients*	*Standard error*
Age	0.153	0.010***	0.171	0.012***	0.149	0.011***	0.155	0.011***
UR (%)	0.035	0.047	-0.027	0.051	0.066	0.053	0.013	0.048
Cohort B	0.686	0.241***	4.144	1.000***	1.973	0.725***	9.388	2.207***
Cohort C	1.230	0.247***	5.574	2.024***	1.255	1.011	6.915	2.540***
Log(Hincome)	-1.052	0.111***	-1.040	0.114***	-1.052	0.114***	-0.824	0.123***
Children0_2	-2.950	0.118***	-2.939	0.119***	-2.942	0.119***	-2.954	0.119***
Children3_5	-0.688	0.065***	-0.647	0.066***	-0.681	0.066***	-0.674	0.066***
Children6_17	0.106	0.046**	0.145	0.048***	0.103	0.047**	0.114	0.047**
Grandparents	0.429	0.126***	0.416	0.132***	0.428	0.132***	0.410	0.132***
Education(years)	-0.063	0.054	-0.056	0.063	-0.065	0.063	-0.060	0.064
Intercept	1.587	0.941*	0.991	1.053	1.620	1.040	0.161	1.087
Age × Cohort C	-0.109	0.031***						
Age × Cohort B	-0.145	0.069**						
UR × Cohort B	-0.294	0.152*						
UR × Cohort C	-0.016	0.222						
Log(Hincome) × Cohort B	-1.434	0.361***						
Log(Hincome) × Cohort C	-0.943	0.423**						
Part-time employment (j =2)	*Estimated coefficients*	*Standard error*	*Estimated coefficients*	*Standard error*	*Estimated coefficients*	*Standard error*	*Estimated coefficients*	*Standard error*
Age	0.129	0.011***	0.142	0.012***	0.127	0.011***	0.131	0.011***
UR (%)	-0.126	0.050**	-0.166	0.054***	-0.112	0.057*	-0.147	0.051***
Cohort B	0.843	0.262***	2.945	1.013***	1.232	0.738*	8.806	2.227***
Cohort C	1.133	0.250***	3.168	2.056	1.168	1.039	6.127	2.535**
Log(Hincome)	-1.235	0.114***	-1.227	0.116***	-1.236	0.116***	-1.030	0.126***
Children0_2	-2.004	0.108***	-1.988	0.109***	-1.996	0.109***	-2.007	0.109***
Children3_5	-0.837	0.069***	-0.805	0.070***	-0.833	0.069***	-0.823	0.069***
Children6_17	-0.143	0.049***	-0.116	0.051**	-0.145	0.050***	-0.135	0.050***
Grandparents	0.876	0.128***	0.868	0.134***	0.874	0.134***	0.857	0.134***
Education(years)	0.261	0.065***	0.266	0.064***	0.259	0.064***	0.264	0.064***
Intercept	-0.474	0.953	-0.895	1.064	-0.410	1.052	-1.760	1.102
Age × Cohort B			-0.067	0.031**				
Age × Cohort C			-0.067	0.070				
UR × Cohort B					-0.093	0.156		
UR × Cohort C					-0.015	0.229	-	-
Log(Hincome) × Cohort B							-1.332	0.365***
Log(Hincome) × Cohort C							-0.828	0.422**
N of observations	14497		14497		14497		14497	
N of groups	1921		1921		1921		1921	
Log likelihood	-10339.849		-10335.903		-10342.586		-10334.496	
sigma_u	11.859	0.779	11.268	0.705	11.278	0.706	11.356	0.711

Notes: Based on equation (1). *: significant at the 10% significance level, **: significant at the 5% significance level, ***: significant at the 1% significance level.

Appendix A2 - Results of the random-effect multinomial logit estimation_2

	(5)		(6)		(7)		(8)	
Part-time employment (j =1)	*Estimated coefficients*	*Standard error*	*Estimated coefficients*	*Standard error*	*Estimated coefficients*	*Standard error*	*Estimated coefficients*	*Standard error*
Age	0.152	0.011***	0.146	0.011***	0.155	0.011***	0.153	0.011***
UR (%)	0.038	0.047	0.032	0.047	0.022	0.048	0.038	0.047
Cohort B	0.753	0.298**	0.358	0.303	0.806	0.304***	-0.673	2.293
Cohort C	1.222	0.287***	0.791	0.292***	1.313	0.290***	-1.587	1.958
log(Hincome)	-1.051	0.114***	-1.054	0.114***	-1.050	0.114***	-1.051	0.114***
Children0_2	-2.943	0.151***	-2.927	0.119***	-2.946	0.119***	-2.935	0.118***
Children3_5	-0.686	0.065***	-0.911	0.077***	-0.688	0.066***	-0.680	0.065***
Children6_17	0.107	0.047**	0.103	0.047**	0.132	0.050***	0.109	0.047**
Grandparents	0.432	0.132***	0.425	0.133***	0.424	0.132***	0.428	0.132***
Education(years)	-0.064	0.064	-0.052	0.064	-0.071	0.064	-0.128	0.083
Intercept	1.603	1.039	1.801	1.043*	1.630	1.039	2.412	1.237*
Children0_2 × Cohort B	-0.209	0.284						
Children0_2 × Cohort C	0.156	0.300						
Children3_5 × Cohort B			0.745	0.167***				
Children3_5 × Cohort C			0.940	0.212***				
Children6_17 × Cohort B					-0.215	0.147		
Children6_17 × Cohort C					-0.160	0.240		
Education × Cohort B						0.107	0.176	
Education × Cohort C						0.215	0.149	
Part-time employment (j =2)	*Estimated coefficients*	*Standard error*	*Estimated coefficients*	*Standard error*	*Estimated coefficients*	*Standard error*	*Estimated coefficients*	*Standard error*
Age	0.130	0.011***	0.125	0.011***	0.131	0.011***	0.128	0.011***
UR (%)	-0.118	0.050**	-0.120	0.050**	-0.138	0.051**	-0.127	0.050**
Cohort B	0.962	0.301***	0.680	0.304**	0.939	0.305***	2.769	2.302
Cohort C	1.234	0.291***	0.857	0.293***	1.188	0.291***	-0.367	1.973
Log(Hincome)	-1.236	0.116***	-1.235	0.116***	-1.234	0.116***	-1.228	0.116***
Children0_2	-1.798	0.133***	-1.981	0.109***	-1.998	0.109***	-1.996	0.109***
Children3_5	-0.840	0.069***	-0.926	0.081***	-0.838	0.069***	-0.841	0.069***
Children6_17	-0.139	0.050***	-0.143	0.050***	-0.122	0.053**	-0.147	0.050***
Grandparents	0.880	0.134***	0.877	0.134***	0.872	0.134***	0.883	0.134***
Education(years)	0.259	0.064***	0.269	0.064***	0.254	0.064***	0.243	0.084***
Intercept	-0.538	1.051	-0.411	1.054	-0.425	1.050	-0.258	1.250
Children0_2 × Cohort B	-0.534	0.255**						
Children0_2 × Cohort C	-0.453	0.284						
Children3_5 × Cohort B			0.306	0.179*				
Children3_5 × Cohort C			0.547	0.227**				
Children6_17 × Cohort B					-0.187	0.156		
Children6_17 × Cohort C					-0.102	0.253		
Education × Cohort B						-0.146	0.176	
Education × Cohort C						0.115	0.149	

Appendix A2 - Results of the random-effect multinomial logit estimation_2 (continued)

	(5)		(6)		(7)		(8)	
Part-time employment (j =2)	*Estimated coefficients*	*Standard error*	*Estimated coefficients*	*Standard error*	*Estimated coefficients*	*Standard error*	*Estimated coefficients*	*Standard error*
N of observations	14497		14497		14497		14497	
N of groups	1921		1921		1921		1921	
Log likelihood	-10339.444		-10325.437		-10343.513		-10331.421	
sigma_u	11.287	0.707	11.313	0.709	11.260	0.705	11.265	0.705

Notes: Based on equation (1). *: significant at the 10% significance level, **: significant at the 5% significance level, ***: significant at the 1% significance level.

Appendix A3 - Results of the random-effect logit estimation_1

	(1)		(2)		(3)		(4)	
	Marginal effects	*Standard error*	*Marginal effects*	*Standard error*	*Marginal effects*	*Standard error*	*Marginal effects*	*Standard error*
Age	0.140	0.010***	0.155	0.011***	0.136	0.011***	0.142	0.010***
UR (%)	-0.037	0.045	-0.090	0.048*	-0.012	0.050	-0.059	0.045
Cohort B	0.719	0.256***	3.589	0.935***	1.560	0.668**	9.320	2.164***
Cohort C	1.155	0.242***	4.299	1.940**	1.246	0.949	6.465	2.485**
Log(Hincome)	-1.120	0.109***	-1.112	0.111***	-1.120	0.111***	-0.899	0.120***
Children0_2	-2.412	0.102***	-2.397	0.102***	-2.403	0.102***	-2.414	0.103***
Children3_5	-0.760	0.061***	-0.722	0.063***	-0.754	0.062***	-0.746	0.062***
Children6_17	0.016	0.045	0.049	0.046	0.013	0.045	0.024	0.045
Grandparents	0.612	0.124***	0.600	0.129***	0.611	0.129***	0.593	0.130***
Education(years)	0.080	0.053	0.082	0.062	0.079	0.062	0.081	0.063
Age × Cohort C			-0.091	0.028***				
Age × Cohort B			-0.104	0.066				
UR × Cohort B					-0.199	0.139		
UR × Cohort C					-0.029	0.208		
Log(Hincome) × Cohort B							-1.416	0.354***
Log(Hincome) × Cohort C							-0.879	0.414**
N of observation	14497		14497		14497		14497	
N of groups	1921		1921		1921		1921	
Log likelihood	-6075.852		-6074.752		-6079.658		-6070.279	
sigma_u	11.729	0.772	11.162	0.700	11.166	0.700	11.252	0.706

Notes: Based on equation (2). *: significant at the 10% significance level, **: significant at the 5% significance level, ***: significant at the 1% significance level.

Appendix A4 - Results of the random-effect logit estimation_2

	(5)		(6)		(7)		(8)	
	Marginal effects	*Standard error*	*Marginal effects*	*Standard error*	*Marginal effects*	*Standard error*	*Marginal effects*	*Standard error*
Age	0.140	0.010***	0.134	0.010***	0.142	0.010***	0.139	0.010***
UR (%)	-0.032	0.045	-0.035	0.045	-0.051	0.046	-0.036	0.045
Cohort B	0.803	0.293***	0.470	0.297	0.838	0.297***	0.673	2.263
Cohort C	1.198	0.282***	0.787	0.285***	1.228	0.282***	-1.208	1.925
log(Hincome)	-1.121	0.111***	-1.124	0.111***	-1.119	0.111***	-1.116	0.111***
Children0_2	-2.278	0.125***	-2.388	0.102***	-2.407	0.102***	-2.401	0.102***
Children3_5	-0.759	0.062***	-0.927	0.071***	-0.760	0.062	-0.756	0.062***
Children6_17	0.018	0.045	0.014	0.045	0.041	0.048	0.016	0.045
Grandparents	0.614	0.130***	0.611	0.130***	0.607	0.129***	0.613	0.129***
Education(years)	0.075	0.062	0.088	0.063	0.075	0.063	0.032	0.082
Children0_2 × Cohort B	-0.399	0.240*						
Children0_2 × Cohort C	-0.233	0.265						
Children3_5 × Cohort B			0.552	0.157***				
Children3-5 × Cohort C			0.790	0.204***				
Children 6_17 × Cohort B					-0.220	0.141		
Children 6_17 × Cohort C					-0.136	0.235		
Education × Cohort B						0.003	0.173	
Education × Cohort C						0.179	0.146	
N of observation	14497		14497		14497		14497	
N of groups	1921		1921		1921		1921	
Log likelihood	-6079.127		-6068.391		-6079.382		-6079.696	
sigma_u	11.184	0.702	11.214	0.703	11.148	0.699	11.156	0.700

Notes: Based on equation (2). *: significant at the 10% significance level, **: significant at the 5% significance level, ***: significant at the 1% significance level.

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