Why is the life cycle of happiness unusual in Japan?

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1 Introduction

This paper attempts to explain an unusual finding in previous studies about the life cycle of happiness in Japan. While it has become common to find happiness U-shaped over the life cycle, with the lowest point reached in the early 40s and a recovery up to the old age (Blanchflower and Oswald, 2004, 2008; Clark, 2007), a different pattern was reported for Japan (Cabinet Office, 2009; Tsutsui *et al.*, 2010; Commission on Measuring Well-being, 2011). Specifically, Japan does not seem much different in the first half of the life cycle, with a declining happiness from young age to the early 40s. But a notable divergence appears in the second half of life cycle, when happiness in Japan does not increase after the 40s, but largely stays flat (Tsutsui *et al.*, 2010). Evidently, the age-happiness profile in Japan is not U-shaped like in many other countries, but L-shaped, with a conspicuous lack of increased happiness in the old age. Overall, it is the elderly in Japan that appear to be the least happy across different age groups (Commission on Measuring Well-being, 2011, p. 16).

As a possible explanation for this peculiar pattern of the age-happiness profile in Japan, Tsutsui *et al.* (2010) suggested a possible bias in estimated age effects due to omitted cohort effects (p. 51-53). This potential bias in age effects was previously emphasized by Clark (2007), who examined whether cohort effects may account for the U-shape in happiness in the United Kingdom, but found that U-shape remained largely unchanged even with included cohort effects. So far, no similar study has been done with Japanese data.

Our goal in this paper is to verify whether cohort effects may explain the L-shape in age-happiness profile in Japan. In practice, when cohort effects are added to regression specifications, they are commonly used together with the effects of age and calendar year. This creates an identification problem among age, cohort and period effects, because these three effects are linearly dependent, with the individual's age equal exactly to the current year minus the year of birth. The identification problem in age-period-cohort (A-P-C) models has long been known in economics (Deaton and Paxson, 1994), and it can be solved by imposing restrictions on parameter estimates of the A-P-C effects.

In this paper, we consider two approaches that solve the identification problem. First, we deal with the exact linearity among A-P-C effects by specifying one of these effects with a non-linear function, as a part of a semiparametric regression model (Wunder *et al.*, in press; Movshuk, 2011). We also consider an alternative restriction from Deaton and Paxson (1994), who solved the identification problem by restricting period effects to be orthogonal to a linear time trend[1]. The key assumption of the Deaton-Paxson (D-P) restriction is that period effects do not contain linear time trends. If linear trends are actually present in period effects, the D-P approach would attribute them to age and cohort effects, leading to biased estimates of these effects (Deaton and Paxson, 1997, p. 103). Fortunately, we could verify the validity of the D-P assumption with our semiparametric approach to solve the identification problem and we found no significant linear time trend in estimated period effects. This made either of our two approaches applicable to estimating A-P-C models of happiness in Japan.

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[1] Another solution to the identification problem was suggested by Clark (2007) and Blanchflower and Oswald (2008), who assumed that regression parameters among A-P-C effects have different time blocks. Namely, Clark (2007) represented age effects with 5-year age blocks, and left cohort and period effects unrestricted (as one-year dummy variables), and a similar restriction was used by Blanchflower and Oswald (2008). However, the approach was questioned by de Ree and Alessie (2011), who showed that slight modifications in the structure of time blocks may greatly change estimates of age effect. We applied the same sensitivity check to Japanese data, and confirmed the result of de Ree and Alessie (2011) that changing the time span of age blocks greatly modified the pattern of estimated age effects. For brevity, we do not consider the third solution here.

2 Data

We used data from the Osaka University's 21 Century Center of Excellence program, which conducts "Preference and Life Satisfaction Survey" (PLiSS). One important advantage of the dataset is its panel structure. Other features of the survey were described in previous studies with the PLiSS data (such as Kamesaka *et al.* (2010) and Tsutsui *et al.* (2010)).

3 Model specification

Our regression specifications assume an experienced personal utility $U_{i,t}$ for individual i at time t that depends of a vector of personal and demographic characteristics $\boldsymbol{x}_{i,t}$, with $U_{i,t} = u(\boldsymbol{x}_{i,t})$. The utility $U_{i,t}$ is known only to the individual i, who reports it as reported happiness R, which is a function of $U_{i,t}$: $R_{i,t} = r(U_{i,t})$, or $R_{i,t} = r(u(\boldsymbol{x}_{i,t}))$. The reported happiness $R_{i,t}$ depends on $\boldsymbol{x}_{i,t}$ through parametric and nonparametric effects in a semiparametric regression model $R_{i,t} = r(u(\boldsymbol{x}_{i,t})) + \varepsilon_{i,t}$, where $\varepsilon_{i,t}$ is a conventional disturbance term.

The vector of explanatory variables $\boldsymbol{x}_{i,t}$ includes personal judgment about standard of living[2], age (specified as a smooth nonparametric term $s(age)$ to avoid the identification problem), time t and various demographic and personal characteristics. Our baseline specification is essentially a semiparametric age-period model, which we refer as Model 1: $R_{i,t} = s(age_{i,t}) + \alpha_t' D_t + \beta' \boldsymbol{x}_{i,t} + \varepsilon_{i,t}$. In Model 2, we add a set of dummy variables for birth cohorts D_c, with birth year defined by $c = t - a$, producing the following A-P-C model: $R_{i,t} = s(age_{i,t}) + \alpha_t' D_t + \alpha_c' D_c + \beta' \boldsymbol{x}_{i,t} + \varepsilon_{i,t}$. In Model 3, we explore the validity of the Deaton-Paxson solution to the identification problem, and examine their key assumption that period effects are orthogonal to a linear time trend. To test this assumption, we replace the matrix of time dummies D_t with a linear time trend t, which yields Model 3: $R_{i,t} = s(age_{i,t}) + \gamma_t' t + \alpha_c' D_c + \beta' \boldsymbol{x}_{i,t} + \varepsilon_{i,t}$. The Deaton-Paxson restriction is valid if the null hypothesis $H_0 : \gamma_t = 0$ is not rejected by the data.

In Models 4 and 5, we apply the Deaton-Paxson restrictions on the period effect (namely, $\sum \hat{\alpha}_t = 0$ and $\sum \hat{\alpha}_t t = 0$), which in practice means using a transformed matrix of time dummies, which we denote by D_t^*. After replacing D_t in Models 2 and 3 by D_t^*, age effects can be estimated with an unrestricted matrix of age dummies D_a. This results in two new models: $R_{i,t} = \alpha_a' D_a + \alpha_t' D_t^* + \beta' \boldsymbol{x}_{i,t} + \varepsilon_{i,t}$ (Model 4) and $R_{i,t} = \alpha_a' D_a + \alpha_t' D_t^* + \alpha_c' D_c + \beta' \boldsymbol{x}_{i,t} + \varepsilon_{i,t}$ (Model 5). In Model 6, we used the panel structure of the PLiSS dataset, and introduced fixed effects α_i across individuals: $R_{i,t} = \alpha_i' D_i + \alpha_a' D_a + \alpha_t' D_t^* + \alpha_c' D_c + \beta' \boldsymbol{x}_{i,t} + \varepsilon_{i,t}$.

4 Results

Table 1 presents results of estimating our three semiparametric models, while Figure 1 plots estimates for age, cohort and period effects in Models 1 and 2. When cohort effects were omitted in Model 1, we confirmed the peculiar pattern for Japan that the age effect on happiness is L-shaped (Panel A of Figure 1). The highest happiness is reached in the early 30s, with a constant decline until the early 50, and little change in the later part of the life cycle. As for parametric estimates for Model 1, they are reported in Table 1. By far the the largest impact on happiness was from differences in standards of living. Compared with individuals who placed themselves in the reference group 1 (the lowest standard of living), happiness in group 7[3] (the highest standards of living) was higher by 3.56 points, and had a large t-value (50.03). It is also noteworthy that the positive effect on happiness was increasing almost linearly across different levels of standards of living, with almost no flattening in marginal additions to the effect. The second largest impact on happiness was from differences in marital status, with marriage increasing happiness by 0.58 points, in comparison with the reference category of single individuals. Finally, excellent health (or more precisely, the lack of worries about health) increased happiness by 0.50 points compared with the reference category of people who worried about their health.

When cohort effects were added in Model 2, age-happiness profile was no longer L-shaped, but flat (as shown in Panel B of Figure 1). On the other hand, estimates of cohort effects showed progressively increasing happiness across more recent birth cohorts, especially for those who were born between the early 1960s and 1980s. Evidently, the reduced age effect between the early 30s and 50s in Model 1 was due to the increasing happiness among individuals in the 1960s and the early part of the 1970s.

In Model 3, we replaced the set of time dummies with a linear time trend; the estimate of time trend was positive, but had insignificant t-statistics (1.01), supporting the validity of D-P restriction to solve the identification problem. Table 2 reports results with the D-P approach. Overall, estimates for Models 4

2 The variable is a proxy for relative income, and was found to have a superior explanatory power in Japanese data, as compared with absolute levels of income (Tsutsui *et al.*, 2010, p. 59).

3 Original data differentiated 11 categories, but contained relatively few responses for the lowest and highest standards of living. After aggregating these extreme categories, we obtained 7 categories with sufficiently large number of responses.

and 5 (in columns (1) and (2) of Table 2) turned very similar to comparable estimated for Models 1 and 2 (in columns (1) and (2) of Table 1). As for age effect, it was highly significant in Model 4 (column (1) of Table 3), but turned insignificant after adding cohort effects in Model 5, with p-value is only 0.645 (column (2) of Table 3).

After we added fixed effects to Model 6, the magnitude of many parameter estimates was reduced compared with previous models with no fixed effects. For example, the effect from the highest standard of living was halved, to 1.89 points. Similarly, the effect of excellent health increased happiness by only 0.17 points, which is about one third of the comparable estimates from excellent health in Models 4 and 5. Moreover, many groups of variables were no longer statistically significant. Results for total sample are shown in first three columns of Table 3. Only five groups of variables remained significant at 5 percent significance level: period effects, standards of living, health, marital status, and children. When we split the sample into men and women, we found both similarities and sharp differences between genders. For both men and women, differences in standards of living and health remained important. On the other hand, marital status was significant for only men, while the number of children was significant for only women, with the positive effect on happiness from the increased number of children (for brevity, the result is omitted).

5 Conclusion

We reached three major conclusions in this paper. First we confirmed previous studies that without cohort effects, the age-happiness profile is L-shaped in Japan, with the gradual decline between the young and middle age, and little change in happiness after the middle age. Second, we found that after adding cohort effects, the age-happiness profile becomes flat in our semiparametric A-P-C model. Similarly, the APC model with the D-P restriction on period effects resulted in statistically insignificant estimates of age effect as a whole. Third, we examined whether our results would hold after accounting for fixed effects across individuals. The fixed-effect model was only computationally feasible with the D-P approach to the identification problem, and confirmed our previous finding that age does not have significant effect on happiness. Instead, four other factors proved important determinants of happiness. Differences in the standard of living and health status were important for both men and women. In addition, we found significant asymmetries in determinants of happiness between genders: marital status was important for men, but not for women, while children were important for women, but not for men. The result is similar to Kamesaka *et al.* (2010), who also found important differences between Japanese men and women in significant determinants of happiness.

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Table 1. Regression estimates for semiparametric regression models

	(1)		(2)		(3)	
	Age-Period model		Age-Period-Cohort model		Age-Time trend-Cohort model	
Gender: women	0.19***	(6.86)	0.19***	(6.75)	0.19***	(6.83)
Standard of living: 2	0.79***	(13.12)	0.80***	(13.26)	0.80***	(13.16)
Standard of living: 3	1.35***	(23.14)	1.36***	(23.29)	1.35***	(23.17)
Standard of living: 4	1.96***	(35.96)	1.97***	(36.08)	1.97***	(35.95)
Standard of living: 5	2.47***	(42.42)	2.47***	(42.30)	2.46***	(42.16)
Standard of living: 6	2.96***	(48.45)	2.96***	(48.38)	2.95***	(48.25)
Standard of living: 7	3.56***	(50.03)	3.56***	(49.91)	3.55***	(49.75)
Health: neutral	0.18***	(7.02)	0.17***	(6.78)	0.18***	(6.78)
Health: not worried	0.50***	(18.16)	0.50***	(17.96)	0.50***	(18.05)
Marital: married	0.58***	(10.96)	0.58***	(10.97)	0.59***	(11.15)
Marital: divorced	0.23***	(3.35)	0.23***	(3.30)	0.24***	(3.37)
Marital: widowed	0.12	(1.46)	0.14	(1.65)	0.14	(1.69)
Job: unemployed	−0.05	(0.49)	−0.04	(0.44)	−0.01	(0.10)
Job: out of labor force	0.29***	(6.11)	0.29***	(6.12)	0.32***	(6.69)
Work: company empl.	0.17***	(3.59)	0.16***	(3.39)	0.19***	(3.96)
Work: pub. empl.	0.30***	(4.75)	0.30***	(4.79)	0.33***	(5.20)
Work: manager.	0.29***	(3.86)	0.30***	(3.98)	0.32***	(4.28)
Work: self-empl.	0.26***	(4.83)	0.26***	(4.81)	0.28***	(5.29)
Religion: neutral	−0.01	(0.42)	−0.02	(0.61)	−0.02	(0.65)
Religion: strong	0.49***	(11.19)	0.49***	(11.33)	0.49***	(11.31)
Educ: 2-year college	0.15***	(4.67)	0.15***	(4.61)	0.15***	(4.64)
Educ: university	0.17***	(5.78)	0.17***	(5.98)	0.17***	(6.00)
Educ: graduate	0.08	(1.01)	0.10	(1.34)	0.11	(1.41)
Child: 1	0.16**	(3.01)	0.16**	(3.15)	0.16**	(3.10)
Children: 2	0.17***	(3.59)	0.18***	(3.79)	0.17***	(3.71)
Children: 3 or more	0.21***	(4.30)	0.23***	(4.57)	0.22***	(4.48)
Home: own with loan	0.03	(0.99)	0.02	(0.62)	0.02	(0.60)
Home: rent	−0.03	(1.06)	−0.05	(1.51)	−0.05	(1.57)
Smoke: occasional	−0.17***	(3.76)	−0.16***	(3.64)	−0.16038	(3.61)
Smoke: 10 cigs	−0.26***	(6.12)	−0.27***	(6.23)	−0.27***	(6.24)
Smoke: 20 cigs and more	−0.22***	(6.94)	−0.23***	(6.98)	−0.23***	(7.02)
Drink: occasional	−0.05	(1.66)	−0.05	(1.55)	−0.05	(1.57)
Drink: 1 per day	−0.02	(0.58)	−0.03	(0.65)	−0.03	(0.66)
Drink: 3 per day	0.08	(1.75)	0.09*	(2.01)	0.09*	(2.02)
Time trend					0.01	(1.01)
Intercept	2.45***	(24.21)	2.35***	(5.89)	−11.59	(0.84)
Year effect	*Yes*		*Yes*		*No*	
Cohort effect	*No*		*Yes*		*Yes*	
Region effects	*Yes*		*Yes*		*Yes*	
Estimated degrees of freedom for nonparametric effects						
$s(age)$	5.83***		0.83		0.06	
Sample size	18,983		18,983		18,983	
Deviance explained	0.313		0.319		0.317	

Absolute t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Reference categories are (1) gender: male, (2) standard of living: 1 (lowest), (3) health: worried, (4) marital: never married, (5) job: employed, (6) work: not employed, (7) religion: weak, (8) educ: secondary school, (9) child: none, (10) home: owner, no loan, (11) smoke: no, (12) drink: no.

Table 2. Regression estimates with the Deaton-Paxson restriction.

	(1)		(2)		(3)	
	Age-Period model		Age-Period-Cohort model		Fixed effect model	
Gender: women	0.19***	(4.87)	0.19***	(4.92)		
Standard of living: 2	0.79***	(6.60)	0.80***	(6.89)	0.45***	(4.56)
Standard of living: 3	1.36***	(11.47)	1.37***	(11.82)	0.73***	(6.93)
Standard of living: 4	1.96***	(17.18)	1.98***	(17.85)	1.10***	(10.12)
Standard of living: 5	2.47***	(21.33)	2.47***	(21.93)	1.36***	(12.04)
Standard of living: 6	2.95***	(25.28)	2.96***	(26.16)	1.59***	(13.70)
Standard of living: 7	3.56***	(28.62)	3.57***	(29.43)	1.89***	(14.70)
Health: neutral	0.18***	(5.53)	0.17***	(5.40)	0.08*	(2.29)
Health: not worried	0.51***	(13.21)	0.50***	(13.14)	0.17***	(3.97)
Marital: married	0.57***	(7.71)	0.58***	(7.98)	0.45**	(2.99)
Marital: divorced	0.23*	(2.33)	0.24*	(2.44)	0.24	(1.67)
Marital: widowed	0.11	(1.15)	0.14	(1.39)	−0.27	(1.17)
Job: unemployed	−0.05	(0.36)	−0.05	(0.36)	0.05	(0.31)
Job: out of labor force	0.30***	(5.32)	0.29***	(5.21)	0.01	(0.14)
Work: company empl.	0.17**	(2.96)	0.16**	(2.78)	−0.06	(0.88)
Work: pub. empl.	0.30***	(3.48)	0.30***	(3.56)	−0.12	(0.80)
Work: manager.	0.29***	(3.55)	0.30***	(3.67)	0.16	(1.20)
Work: self-empl.	0.25***	(4.00)	0.25***	(3.97)	0.08	(0.92)
Religion: neutral	−0.01	(0.36)	−0.02	(0.54)	−0.02	(0.42)
Religion: strong	0.49***	(9.12)	0.49***	(9.16)	0.04	(0.49)
Educ: 2-year college	0.15***	(3.40)	0.15***	(3.43)	−0.01	(0.09)
Educ: university	0.17***	(4.38)	0.17***	(4.48)	0.08	(0.65)
Educ: graduate	0.08	(0.90)	0.11	(1.16)	−0.08	(0.25)
Child: 1	0.17*	(2.39)	0.17*	(2.46)	0.34**	(2.88)
Children: 2	0.17**	(2.83)	0.18**	(2.91)	0.36**	(3.00)
Children: 3 or more	0.22**	(3.22)	0.22***	(3.36)	0.17	(1.48)
Home: own with loan	0.03	(0.74)	0.02	(0.56)	−0.01	(0.26)
Home: rent	−0.04	(0.73)	−0.05	(1.03)	−0.16	(1.19)
Smoke: occasional	−0.17**	(2.69)	−0.17**	(2.66)	−0.03	(0.52)
Smoke: 10 cigs.	−0.26***	(4.84)	−0.26***	(4.88)	−0.01	(0.11)
Smoke: 20 cigs. and more	−0.22***	(5.23)	−0.22***	(5.30)	0.08	(0.79)
Drink: occasional	−0.05	(1.22)	−0.04	(1.08)	−0.06	(0.93)
Drink: 1 per day	−0.02	(0.49)	−0.03	(0.54)	−0.07	(0.79)
Drink: 3 per day	0.08	(1.40)	0.09	(1.67)	−0.11	(1.07)
Intercept	3.09***	(6.63)	18.68*	(2.15)	5.56**	(3.17)
Year effect	*Yes*		*Yes*		*Yes*	
Cohort effects	*No*		*Yes*		As fixed effects	
Region effects	*Yes*		*Yes*		*No*	
Sample size	18,983		18,983		18,983	
Adjusted R^2	0.312		0.316		0.069	

Absolute t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Reference categories are the same as in Table 1.

Figure 1. Estimates of age, cohort and period effects in semiparametric models.

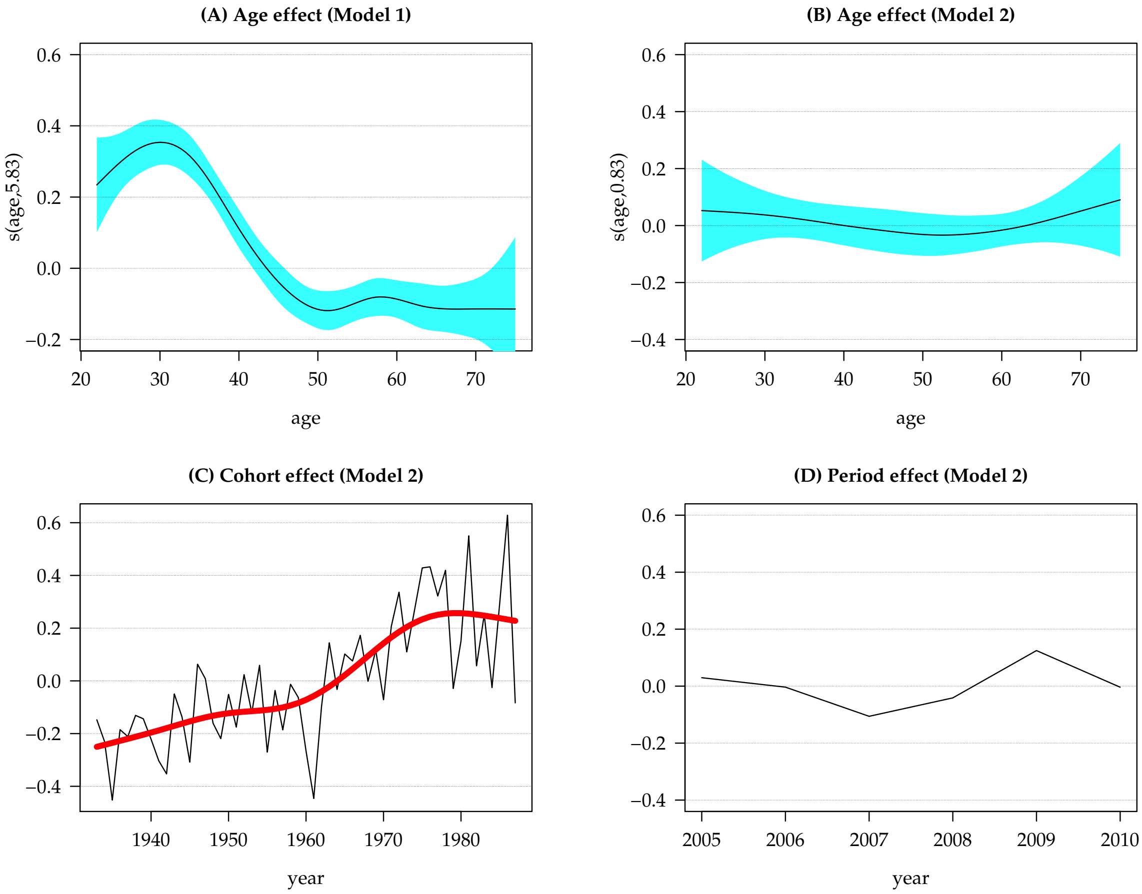

Table 3. P-values in the hypothesis testing for groups of dummy variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All sample			Men			Women		
Model:	A-P	A-P-C	FE	A-P	A-P-C	FE	A-P	A-P-C	FE
Age effect	<0.001	0.645	0.152	0.000	0.966	0.098	0.000	0.370	0.138
Cohort effect		<0.001			<0.001			<0.001	
Period effect	<0.001	<0.001	0.004	0.001	0.002	0.019	0.005	0.001	0.088
Standard of living	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Health	<0.001	<0.001	<0.001	<0.001	<0.001	0.015	<0.001	<0.001	0.019
Marital status	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.186
Have job?	<0.001	<0.001	0.954	0.001	0.001	0.106	<0.001	<0.001	0.070
Job type	<0.001	<0.001	0.292	0.790	0.594	0.907	0.006	0.005	0.162
Religion	<0.001	<0.001	0.656	<0.001	<0.001	0.557	<0.001	<0.001	0.283
Education	<0.001	<0.001	0.847	0.016	0.023	0.306	<0.001	<0.001	0.700
Children	0.015	0.010	0.015	0.055	0.024	0.259	0.126	0.136	0.034
House	0.426	0.360	0.484	0.451	0.543	0.352	0.004	0.002	0.767
Smoking	<0.001	<0.001	0.640	<0.001	<0.001	0.320	<0.001	<0.001	0.308
Alcohol	0.047	0.028	0.709	0.010	0.002	0.942	0.342	0.354	0.779
Region	0.000	<0.001		<0.001	<0.001		0.007	0.004	

Note: A-P and A-P-C denotes age-period and age-period-cohort models (*i.e.*, Model 4 and Model 5, respectively). FE refers to Model 6 with fixed effects.