

Happy Generations, Depressed Generations: How and Why Chinese People’s Life Satisfactions Vary across Generations^{*}

Yu-Sung Su[†] and Yuling Yao[‡]

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Abstract

The paper introduces a novel Bayesian multilevel model based on the age-period-cohort framework to examine the relationship of happiness and age of Chinese people using the CGSS survey data. The model both solves the co-linearity problem and makes the computation more stable. The statistical results show how the happiness of Chinese people changes in individual’s life circle and how one’s life experience is accumulated to his happiness attitude with cognitive development. Additionally the results identify some different generation patterns in China, explaining the generation difference on happiness across various birth year.

Keywords: happiness, generation difference, Bayesian multilevel model, age-period-cohort framework

1 Introduction

Most researches on the generation differences of Chinese people are ambiguous in which their divisions of generation are somewhat ad-hoc. In Chinese context, we are familiar with concepts like “post-80s generation” or the “post-90s generation” (Wang 2009; Deng et al. 2010). But what is the exact difference between people who born in 1980 and 1990, or between 1989 and 1991? Nevertheless, we are also used to name female elderly who are doing square dancing as *Dama* (大妈) in China. But is there any fundamental difference between a 50-year-old woman and a 45-year-old one among these *Dama*?

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[†]Associate Professor, Department of Political Science, Tsinghua University, Beijing, 100084, P.R.China, E-mail: suyusung@tsinghua.edu.cn

[‡]Ph.D. Student, Department of Statistics, Columbia University, New York, NY, 10025, USA

This paper attempts to unravel the generation difference of Chinese people using a novel model-based approach with longitudinal survey data.

Any arbitrary efforts on defining generation often neglects the fact that generation is confounded with age. When some researches try to summarize the feature of “post-80s generation” in 2010 (Yu 2009; Xu 2012), they just summarize the feature of these groups in their thirties. Their analyses were limited with the observational time frame. There are many approaches to address this limitation. In theory, the difference of attitudes among generations actually merely reflect the cognitive accumulation. Thus psychologist like Hermelin (1977) has conduct many researches about the development of memory and the function of cognitive development decades ago, both from empirical data and physical evidence like hemispheric lateralization. Nevertheless, due to the availability of data, they did not develop a good model to describe the accumulation of happiness.

Some economists and socialists utilize another approach to study happiness and generation. Some try to establish an age-period-cohort analytic model on life happiness pattern. As Fukuda (2013) summarizes, many researches applied the age-period-cohort decomposition to the US happiness data. They paid most of their attention to solving the non-identify problem caused by the co-linear relationship (i.e. $\text{age} = \text{period} - \text{cohort}$). Others like Deaton and Paxson (1994) assumed that period effects have a zero mean and are orthogonal to a linear time trend. Accordingly, they developed an orthogonal period-effect (OPE) model. Still others like Heckman and Robb (1985) argued that age, period and cohort effects are unobservable and thus applied other observable variables like unemployment rate to the regression model of period effect. This advanced model is called the proxy-variable (PV) model. It is the first time researchers introduce macro-level data to explain the age-period-cohort Framework. Yang (2008) is the first one to use a multilevel model in this framework to model the US happiness from 1972 to 2004, but he still limits the model to the polynomial orders. Fukuda (2011) develops a principal component (PC) model to overcome the perfect co-linearity among age, period and cohort dummy variables. In sum, all the aforementioned models are quite limited since they either assume a dummy regression or set an ad-hoc polynomial order, which leads to an unstable and unexplainable fluctuation in fitted results.

Apart from the research on happiness, political scientists have also laid emphasis on “Political Socialization” that refers to “developmental processes by which people or adolescents acquire political cognition, attitudes, and behaviors” (Powell and Cowart 2002). In this vein, Ghitza and Gelman (2014) analyzed the generation pattern of the US presidential voting. They used a Bayesian multilevel model with a macro-level approval rate and successfully explain how the long term partisan preference is accumulated for

each generation. Nevertheless their model does not assume any age effect, which is not uncommon for most social and economic issues.

The paper will advance the study of age-period-cohort framework by introducing a novel Bayesian multilevel model to estimate Chinese people's difference on their attitude toward happiness both across different generations and different ages. As a matter of fact, individuals' happiness and satisfaction are exactly the reflection of their life attitude, so via our model we will demonstrate the feature of different generations in China .

The paper is organized as follows: section 2 introduces the data we use in the empirical analysis. The plotting of the raw data gives us some modelling intuitions. Section 3 compares various statistical models in the age-period-cohort framework. Then introduces our novel Bayesian multilevel Model. Section 4 displays the fitted results and explains them with sociological and economical interpretations. The fitted results then present the story of Chinese generation difference in section 5. Further discussions are left in section 6.

2 Data

2.1 The Happiness Data in the CGSS Data

Similar to the US General Social Survey (GSS) data used by Yang (2008), China has conducted series of nationwide surveys called "Chinese General Social Survey" (CGSS) since the year 2003. It provides repeated data on Chinese adults' attitudes and behavior on various social and economic issues. We utilized eight waves (2003, 2005, 2006, 2008, 2010, 2011, 2012, 2013) of the CGSS data. Particularly, for the purpose of the analysis, we chose the question that measures the happiness of the respondents. The question wordings are: "Generally speaking, do you think your life is happy or not? (总的来说, 您认为您的生活是否幸福?)". The responses are selected from the five choices: very unhappy (很不幸福), somewhat unhappy (比较不幸福), between happy and unhappy (居于幸福与不幸福之间), somewhat happy (比较幸福), and very happy (非常幸福). We recoded such a variable into a dichotomous one where 1 indicates either somewhat happy or very happy and 0 otherwise. Each year we have roughly ten thousands respondents. And the ages of the respondents are ranging roughly from 18 to 84.

Figure 1 shows the relationship between respondents' age and their happiness in each wave of the CGSS survey. The size of the circle represents the sample size of the respondents in specific age in each survey. Intuitively, we can see a *U*-shaped relationship between age and happiness in each wave of the surveys, especially seen from the locally

weighted scatterplot smoothing (LOWESS) curves. This trend suggests that there might exist a strong pattern between happiness and age, or in other words, a life circle. It seems Chinese people in their middle ages, roughly 40-50, are most likely to be unhappy. This is not a shocking finding. Rather, it coincides with the findings of many existing studies in other countries (Frijters and Beaton 2012; Baetschmann 2014; Bell 2014). Fukuda (2013) termed the effect of the age on happiness the “age effect,” which in general means that people at different place of the life cycle, such as childhood, mature adulthood, employment, marriage, retirement and so on, may in turn have feelings corresponding to that age.

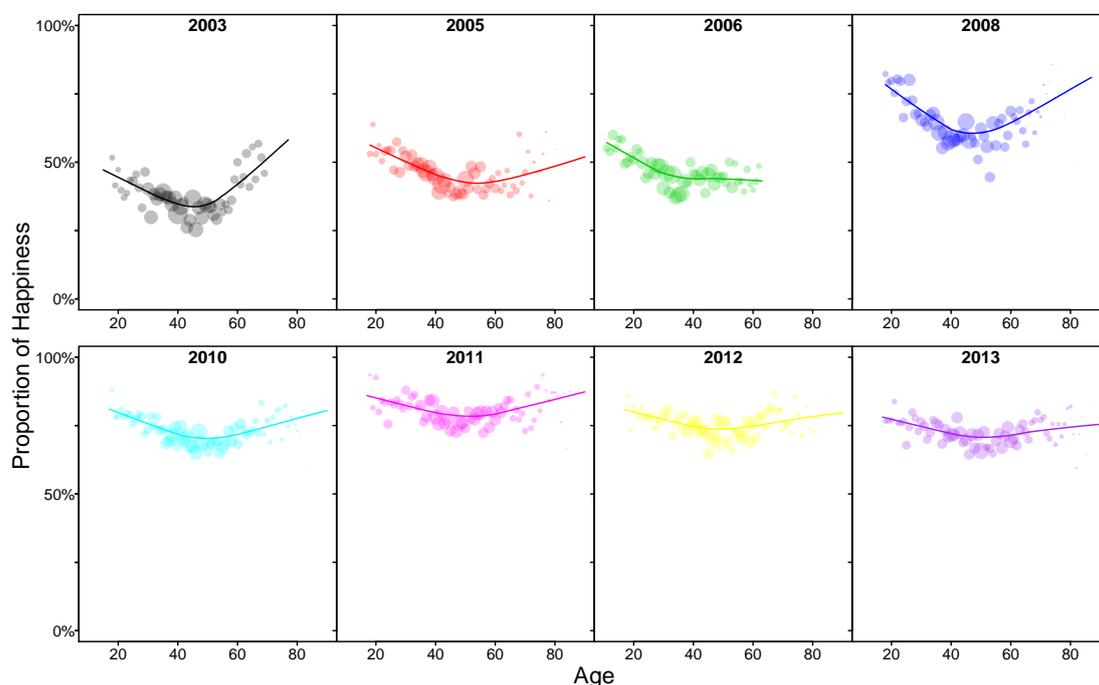


Figure 1: *Plots of age and happiness of respondents in the 2003, 2005, 2006, 2008, 2010, 2011, 2012, 2013 CGSS surveys. The size of the circles represents the sample size of the respondents in specific age in each survey. The solid lines are the locally weighted scatterplot smoothing (LOWESS) curves.*

Looking at these curves in different angles, we can observe further nuance variances of these curves. As Figure 2 shows, we can see that although each wave of the survey shares an U -shaped trend, the nadir of each curve seems not stay at the same age (i.e. a shift in a horizontal dimension). In particular, as shown in the left panel of Figure 2, the curves of the 2003, 2005, 2006, and 2008 share similar nadirs around the age 45, while the curves of the 2010, 2011, 2012, and 2013 have the low points around the age 45. Moreover, if we examine the the bottom of the curves differently by looking at the birth year of each wave, as shown in the right panel of Figure 2, we can observe that the

curves of 2003, 2005, 2006, and 2008 share similar nadirs around the year 1965, while the curves of 2010, 2011, 2012, and 2013 have the low points around the year 1960.

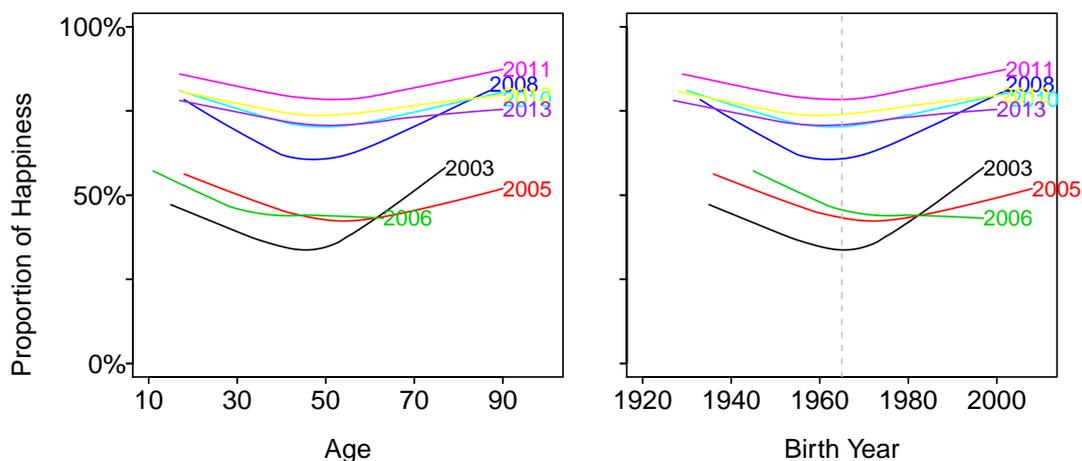


Figure 2: Plots of age, birth year and happiness in the 2003, 2005, 2006, 2008, 2010, 2011, 2012, 2013 CGSS surveys. The left panel plots respondent's age against his happiness and the right panel plots his birth year against his happiness.

In short, Chinese people born in 1960 are more likely to feel depressed comparing with their brothers and sisters. We will use the “generation effect” to describe this relationship between birth year and happiness. Alternatively, it is also called ‘the ‘cohort effect’ in some literature. Namely, people born in a same year will share similar life experience from birth till the survey time, the accumulation of which implies that birth generation may affect their happiness.

Finally, there exists a vertical shift between these eight curves. It is natural that people surveyed in different years will have some systematic difference, which should be called “period effect”. On the one hand, the nationwide atmosphere may change due to social and economic changes in various survey years, with which individual attitudes may change. On the other hand, there is no guarantee that the manners and the methods of each year's survey are exactly the same, which will also leads to systematic difference among responses in these five waves surveys.

It is not easy to identify each effect without a satisfying statistical manner since they always interact with each other. All the intuition above will help up develop a good model to analyze them accurately in section 3.2.

2.2 Macro-level Time Series Data

Both the period effect and the generation effect may be associated with some national-level variables, such as asset price, interest rate, inflation rate and unemployment rate, which are unique to the time. For instance, Di Tella and MacCulloch (2008) argued that a surge in asset values may increase the wealth of all household in a give period while a drop in mart interest rates relative to mortgage interest rate will have a positive impact on home ownership. Likewise, Heckman and Robb (1985) use these macro data to explain the period effect. But they assumed such influence is nil in each age.

Accordingly, we will use macro data to explain the accumulation of generation effects. Considering the birth years of the respondents in our CGSS data do range dramatically from the 1920s to the 1990s, we need to find a long-term and national-level factor to indicate respondents' life experience that begins no later than the 1920s. In this sense, real GDP per capital growth rate maybe the only choice. The Maddison Historical Estimated GDP Data of China ranges from 1929 to 2010. As Figure 3 shows (all GDP here are measured in constant 1990 PPP dollar), in spite of a general upward trend of real GDP, there are some fluctuations in historical GDP per capital growth rate data. The growth rate data will be used in the model in section 3.7.

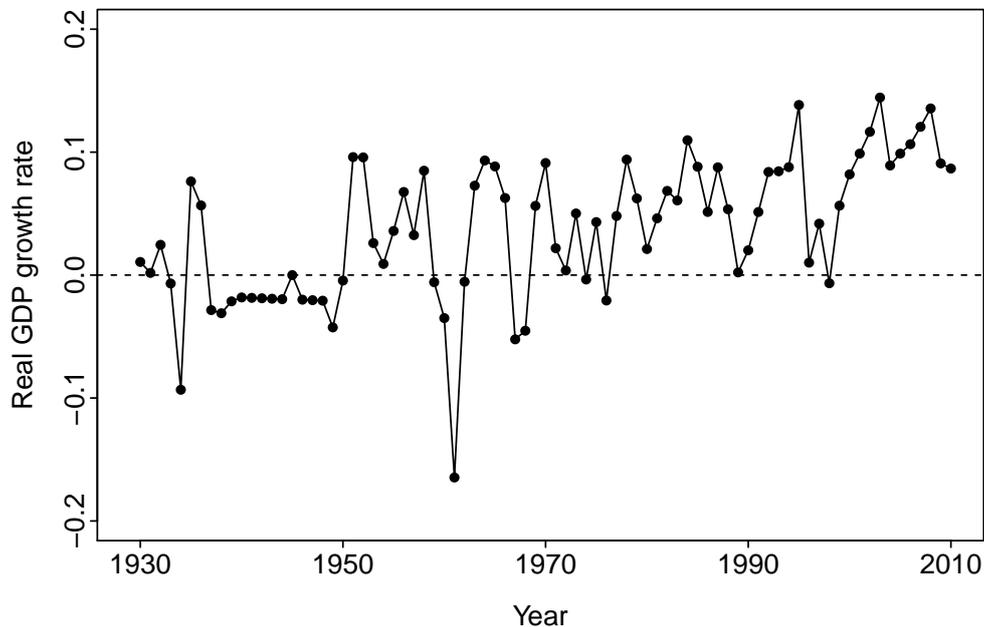


Figure 3: *China's real GDP growth rate from 1929 to 2010. All GDP data is from Madison Historical GDP Estimation and measured in constant 1990 PPP US dollar*

3 Statistical Models

Many scholars have developed various statistic models to analyze the happiness in the US (Heckman and Robb 1985; Yang 2008; Deaton and Paxson 1994; Fukuda 2011). The biggest modelling hurdle they face is how to solve the non-identified parameters in regressions caused by the interaction of three effects (age = period – cohort). Fukuda (Fukuda 2013) have pointed out the six major models with this regards and documented the cons and pros of each model. Multilevel regression model stands out to be the most saturated; but not without limits. In the following sections, we will discuss briefly about these five models borrowing the notation used by Fukuda (2013).

3.1 All dummy model

All dummy model has been the mostly used to examine the relationship between happiness and age. The model assumes that the n th respondent who is aged i in the survey time t and with a birth year c have a happiness linear related to his age, survey time, birth year and other demographical variable D_n (Equation (1)):

$$y_n = \alpha + A_i + P_t + B_c + \theta D_n + \epsilon_n, \quad \epsilon_n \sim N(0, \sigma^2) \quad (1)$$

Here A_i, P_t, B_c are the dummy variables for age i , survey time t and birth year c . The model suffers a multi-collinearity problem since age (i) = survey time (t) – birth year (c). Hence one additional condition (Equation (2)) is set to solve the identification issue:

$$\sum_{i=1}^I A_i = \sum_{t=1}^T P_t = \sum_{c=1}^C B_c = 0 \quad (2)$$

Obviously, this model will not be stable unless the number of observation is huge enough, which is often not the case in social science studies. The sum of age-period-cohort effect equals zero condition (Equation (2)) is feasible in mathematics but will become unexplainable if more data has been introduced into the model.

3.2 Polynomial Age-Effect (PAE) Model

Another approach to avoiding the multi-collinearity problem is to add a high-order variable in the regression. Most researches prefer to introduce high-order polynomial terms (say till 4th order) to the regression, as shown in Equation (3). Hence the model is often called polynomial age-effect (PAE) Model.

$$y_n = \alpha + \beta_2 i^2 + \beta_3 i^3 + \beta^4 i^4 + P_t + B_c + \theta D_n + \epsilon \quad (3)$$

The immediate puzzle of readers would be why the model stays at a quadratic term; why not 5th or higher? Moreover, in theory, there is no guarantee that the polynomial will always converge.

3.3 Proxy-Variable (PV) Model

Heckman and Robb (1985) introduce a proxy-variable (PV) model, where they substitute the period effect dummies P_t with a given macro-level variable (say unemployment rate) V_t in year t , as shown in Equation (4).

$$y_n = \alpha + A_i + \mu V_t + B_c + \theta D_n + \epsilon_n, \quad \epsilon_n \sim N(0, \sigma^2) \quad (4)$$

Obviously, such a model will strongly depend on the selection of the macro-level variable D_n . As a matter of fact, there is not any fundamental improvement between the PV model (Equation 4) and the all dummy model (Equation 1) statistically.

3.4 Orthogonal Period-Effect Model

Inspired by the economics of consumption, Deaton and Paxson (1994) introduce this model by assuming that period effects have means zero and are orthogonal to a linear time trend ($t = 1, 2, 3, \dots, T$).

$$\begin{aligned}
 y_n &= \alpha + A_i + P_t + B_c + \theta D_n + \epsilon_n, \\
 P_{T-1} &= \sum_{t=1}^{T-2} P_t - T \sum_{t=1}^{T-2} t P_t, \\
 P_T &= - \sum_{t=1}^{T-2} t P_t + (T-1) \sum_{t=1}^{T-2} t P_t
 \end{aligned} \quad (5)$$

It is said that this model is widely used in the estimation of wage equations and the modeling of financial risk taking.

3.5 Principal Component (PC) Model

Fukuda (2011) developed a principal component (PC) model to avoid co-linearity. Briefly speaking, it runs the regression with $(I - 1) + (T - 1) + (C - 1)$ variables firstly to get rid of co-linearity, and then get the principal component of these dummies. Finally it uses the selected principal components in the regression. Fukuda (2013) argues that this model is better than the former ones because it avoids arbitrary settings.

3.6 Yang's Multilevel Model

Yang (2008) introduces a multilevel model with similar regards; but unfortunately he still limited himself to use a polynomial age-effect term, as shown in Equation (6):

$$\begin{aligned}
 \text{Level 1: } & y_n = \alpha_{ct} + \beta_{1ct}i + \beta_{2ct}i^2 + \beta_{3ct}D_n + \epsilon \\
 \text{Level 2: } & \alpha_{ct} = \pi_0 + \mu_{0j} + \tau_{0k}, \quad k = 1, 2, 3 \\
 & \beta_{kct} = \pi_k + \mu_{kc} + \tau_{kt}, \quad k = 1, 2, 3 \\
 & \pi_k \sim N(0, \sigma_\pi^2), \mu_k \sim N(0, \sigma_\mu^2), \tau_k \sim N(0, \sigma_\tau^2), \quad k = 1, 2, 3
 \end{aligned} \tag{6}$$

Henceforth, the model suffers similar queries as those of the PAE model.

In short, the aforementioned models are successful in solving the co-linearity. But they either use a dummy or an arbitrary ordered polynomial, which makes the model both difficult to explain and unstable. Furthermore, although Heckman and Robb (1985) tries to use the macro level data to model the period effect in the PV model, they ignore the longer generation/cohort effect. Finally, none of the model above considers the cognitive development in the generation effect. To solve the problem, a new model is needed.

3.7 Bayesian Multilevel Model

We borrow partly the multilevel generation effect model from the work of Ghitza and Gelman (2014) on modelling Americans' voting behaviors in the presidential elections. Then we integrate such a model to the age-period-cohort framework. In this multilevel model, firstly respondents are divided into cells according to his birth year cohort $c \in C = \{1930, 1931, \dots, 2013\}$, the survey year $t \in T = \{2003, 2005, 2006, 2008, 2010, 2011, 2012, 2013\}$, and the gender/home ownership group $g \in G = \{\text{male without home ownership, female with home ownership, male with home ownership, and female with home ownership}\}$. Accordingly, a respondent's age when taking the survey will be $i = t - c$. We

denote the index of the cell to be $j = (c, t)$, meaning j shares the same birth year c , the same survey time t , the same age i . In each cell j , we label the number of observations in the cell as n_j , and the number of observations that are happy (who choose 4 somewhat happy and 5 very happy in the CGSS data) as y_j .

Level 1 model (within the cell)

$$y_j \sim \text{Binomial}(n_j, \theta_j), \quad (7)$$

where θ_j is the parameter estimated from the model. To be explicit, θ_j is the expected proportion of happy respondents within cell j . It is a combination of age effect A_j , period effect B_j , and generation effect γ_j :

$$\theta_j = \text{logit}^{-1}(A_j + B_j + \gamma_j) \quad (8)$$

Level 2 model (among the cell)

We define the generation effect (a.k.a. the cohort effect) γ_j for the cell j with birth year c and survey time t :

$$\gamma_j = \beta_{g[j]} \sum_{i=1}^{84} w_i \times X_{j,i} \quad (9)$$

where $X_{j,i}$ is the annually real GDP per capital growth rate for age $i \in I\{1, 2, \dots, 84\}$ that corresponds to the birth year cohort in the cell j . Instead of setting a constant dummy for every birth year, we let the generation effect to be a dynamic accumulation from his birth up to the survey time, varied year by year. It is the core of this model.

The brains of human beings brain are by no means a Markov Chain. We have a long-term and ever-lasting memory right after we are born. Thus the attitude of one generation toward happiness can be assumed as an accumulation of his life experience. Each year's GDP growth rate can serve as a predictor to describe this life experience. In other words, we are using X 's to approximate this life experience, assuming that an era with high growth rate would inspire people at that time to be happier, and a depression would frustrate the whole generation. Additionally, w_i indicates the age-specific weight in age i , indicating the extent to which people are sensitive to the change of the outer society as their age varies. The influence of each year's GDP growth rate is "memorized" in this weight w_i . To better modeling w_i , we impose an $AR - 1$ restriction to w_i so as to make it having a smoother structure:

$$w_i \sim N(w_{i-1}, \sigma_2), \quad \forall i > 1 \quad (10)$$

w 's are drawn from a scale parameter $\sigma = 1$, as shown in Equation (10), and are restricted to sum to 1 so as to keep the model identified.

β term is estimated the extent to which this happiness accumulation process modeled by the age weights w is different for each gender/home ownership group, indexed on $g[j]$. According to recent studies (Knight et al. 2009; Graham and Chattopadhyay 2012; Helliwell et al. 2015; Zweig 2015), women reported to be happier than men in general after control for other variables. And to introduce some Chinese context into the analysis, we expect those who have home ownership should be happier than those who don't because life would be a lot easier for those who have a housing property and thus life experience to them should be more pleasant (Dietz and Haurin 2003; Davies et al. 2009; Li et al. 2011). Nonetheless, we impose a non-informative priors on β 's in the model letting the data speaks for itself.

The modelled happiness data are surveyed from 10 different years. It is very likely that some random incidents may influence the data in the specific survey year t , the period effects, which are denoted as $\alpha_{t,g} \sim N(0, \sigma_\alpha)$. α 's is indexed by t and g to allow it vary not only by survey time but also by gender/home ownership group.

We introduce an interaction term $\lambda_{g[j]}$ here to acknowledge the fact that people might be more likely to be influenced by radome incidents of a specific survey year at a certain age. In other words, instead of having a monotonic period effects for all age groups, we let the period effects vary across different age groups via the interaction term $\lambda_g[j]$. We impose an Half-Normal($0, \sigma_\lambda$) prior on λ to normalize the interaction effect toward zero. The period effect B_j then is:

$$\begin{aligned} B_j &= \alpha_{t[j],g[j]} + \lambda_{g[j]} w_{i[j]} \alpha_{t[j],g[j]} \\ &= (1 + \lambda_{g[j]} w_{i[j]}) \alpha_{t[j],g[j]} \\ \alpha_{t,g} &\sim N(0, \sigma_\alpha) \\ \lambda_g &\sim \text{Half-Normal}(0, \sigma_\lambda) \end{aligned} \quad (11)$$

Finally, just like the all dummy Model, we denote A_m as the parameter of the age effect for every age year $m \in M\{18, 19, \dots, 84\}$. Additionally, in order to have a smoother structural form, we also impose an $AR - 1$ restriction on the age effect A_m :

$$A_m \sim N(A_{m-1}, 1), \quad (12)$$

where A 's are drawn from a scale parameter $\sigma_A = 1$ as shown in Equation (12).

We use Stan (Stan Development Team 2015) in conjunction with R (R Core Team 2015) to fit the model. Stan uses the No-U-Turn (NUTS) sampler (Hoffman and Gelman 2014), an extension of Hamiltonian Monte Carlo (HMC) sampling. We run the model using Stan with 16 chains and 5000 iterations, and save the last 500 iterations of each chain. The Gelman-Rubin \hat{R} statistics (Gelman et al. 2004) of each parameters are below the benchmark of 1.1, demonstrating the convergence of the model.

4 Statistical Results

4.1 Age Effects A_m

The left panel of Figure 4 shows the fitted posterior means (the solid dots) and the confidence intervals of age effects A_m for ages ranging from 18 to 84. Overall, the estimates of age effects follow the overall pattern (the inverse- U shape) of Chinese people's happiness as shown in Figure 1.

The pattern found here is exactly what we have expected with our intuition in Figure 1. In fact, the U -shaped age-happiness curve is also the pattern verified in all previous researches with US data with other models. That is young people are happy because they are just under the protection of the family. Then they have to establish themselves in the society, to work hard, to bear the economic pressure, to raise their children, to purchase a house, etc. So they become more and more depressed when they grow up (as age goes on).

The midlife crisis is reflected in the bottom point that appears in the age 50, very close to the bottom of the age effect detected with US data (according to different studies, ranging from 33 to 50). Then fortunately, after 55, the typical age that Chinese people begin to prepare for retirement and seem to become happier again. In this period, the employment pressure does not exist anymore, so people have a chance to lead a happy sunset. But finally, the health condition and life quality factor in when they are getting older (as age goes on again), making senior people become unhappier after the top around 70. Nonetheless, the model has little explanatory power on the age effects after age 70 because there are very few respondents whose age are over 70's in the CGSS datasets (The size of the dots represents the sample size).

The right panel of Figure 4 demonstrates that women are happier than men in regardless of owning a house or not. Chinese people with home ownership are happier than those who do not have home ownership if gender is not for consideration. However,

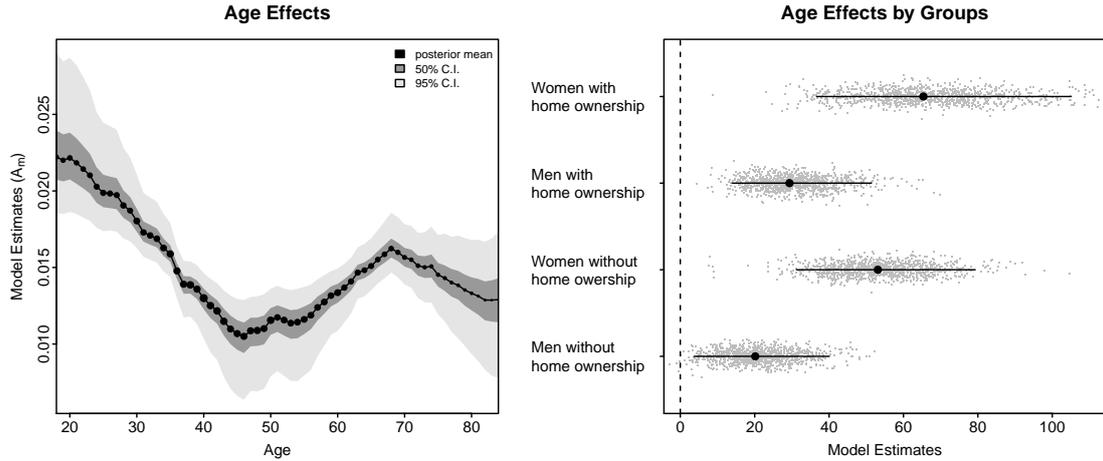


Figure 4: Plot of the fitted values of age effects A_m for ages ranging from 18 to 84 by 4 different groups. The dark solid dots in the right panel indicate the posterior means of the age effects A_m . The light and dark gray areas are the 50% and 95% C.I. respectively. Likewise, the dark solid dots in the left panel represent the posterior means of the age effects A_m of 4 different groups (men and women with or without home ownership) and the light dots are the simulated estimates of the age effects by 4 different groups. The horizontal bars in the left panels are the 95% C.I.

the difference between these two groups is subtle. Putting gender and home ownership altogether for comparison, we find that women with home ownership are much happier than men without home ownership.

4.2 Age-Specific Weights w_i

In the model, w_i reflects the weight at which the macro-level variable (real GDP per capital growth rate) is accumulated to individual's attitude at the age i . The left panel of Figure 5 shows the fitted posterior means and the confidence intervals of the age-specific weight w_i , with age i ranging from 1 (right after the birth) to 84. In most years, the age-specific weights w_i are positive. Only in the early ages and later years, they are indifferent from zero that the 95% confidence intervals cover zero.

Looking closely at the curve, we observe that the age-specific weights climbs up gradually from age 1 until the teenage years and stabilizes with little fluctuations across the ages between 20's to 40's. Then it goes up again and peaks at the age 52. After the age 52, it drops all the way till the age of 84. This pattern is consistent with the psychologist's research on cognitive development. Gelman (1978) finds that increasing age brings increasing ability to make cognitive decision about a task, and to absorb more information. In short, in the early ages, people care less about the national economy as they are

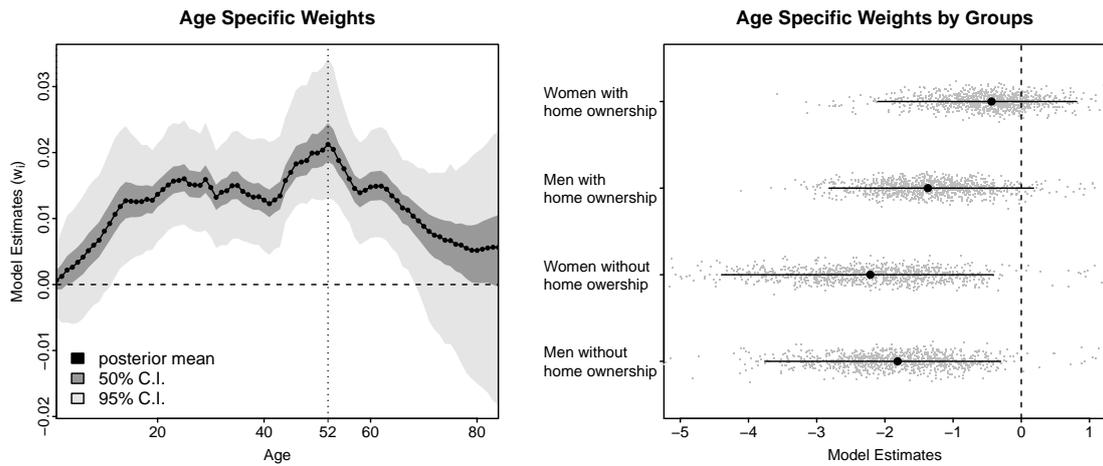


Figure 5: Plot of the fitted value of age specific weights w_i , for ages ranging from 1 to 84 by 4 different groups. The dark solid dots in the right panel indicate the posterior means of the age weights w_i . The light and dark gray areas are the 50% and 95% C.I. respectively. Likewise, the dark solid dots in the left panel represent the posterior means of the varying coefficients β_g of the age specific weights of 4 different groups (men and women with or without home ownership) and the light dots are the simulated estimates of the coefficients by 4 different groups. The horizontal bars in the left panels are the 95% C.I.

dependent upon their parents. The importance of the national economy grows stronger on people's attitude toward happiness between age 13 and 40 when they are struggling with their lives (schooling and working, etc). The flat movement of the curves in this period might reflect that fact that although the economy is important, it is indifferent between age 13 and 40 because this is the period when people are busying establishing themselves by accruing knowledge and wealth through hardworking. In other words, they are somewhat less elastic to the economy in this period.

The economy has much stronger impact on people between age 40 and 60 when they are supposed to achieve most what they can get in their lives. They are more elastic to the economy compared to the previous period because a catastrophic recession during this period might cause losses of everything they earned and they do not have enough time and energy to get the losses back. In the later years, the economy is no longer important to the people as they have enough wealth and decedents to be dependent upon. Additionally death is steps away so the economy is of no big deal to the people in the later years.

The right panel of Figure 5 show that varying coefficients β_g of the age specific weights and their values are all negative. Combining the negative β_g with the estimates of the age specific weights, we conclude that Chinese people are in fact happier when the national economy is in its downturn. This is counterintuitive but not without scientific backup.

Diamond and Hicks (2012) find that couples reported happier relationship in a bad economy because they can blame all the problems that cause lower relationship satisfaction to the economy. Under the same vein, Chinese people reported lower life satisfaction in a good economy probably because there was no economy as an excuse to blame for their unhappiness. They were responsible for their own misfortune.

Nevertheless, comparing the four β_g , we find that such psychological reflection on economy is attenuated if he or she has a home ownership. In other words, these people are less elastic to the national economy. This echoes the findings of Liu and Zhou (2002) that Chinese people feel more economic secured thus are less affected by national economy when they have home ownership.

4.3 Period Effects B_j

Figure 6 visually displays the period effects of 8 different survey years by 4 different gender/home ownership groups. Comparatively speaking, Chinese people surveyed in 2003 have lower life satisfaction than those surveyed in the later years. In other words, Chinese people felt happier after 2003; and such happy feelings peak at 2011 but diminish gradually in the later two survey years of 2012 and 2013.

Home ownership enhances people's changing attitude on life satisfaction in various survey times. However, such buttressing is less obvious in the later years. Gender difference, however, is much more obvious revealed in such period effects. Comparatively speaking, men not only have a better start in 2003 than women did, they reported more positive life satisfaction (happy) early in 2008 than women did in 2010.

Figure 7 displays the estimated standardize effective size ratio of the interaction effects of the age-specific weights and period effects. People with age 20 and age 52 are chosen to make a comparison. Since the comparison is between groups, the interpretation is more intuitive. People with home ownership, the ratio is center around 0, meaning there is no difference in terms of happiness between 20 years old Chinese and 52 years old ones.

The story is different for people without home ownership. The ratio center around 1.2 (there is substantial mass distributed around 1.0 to 1.4), representing that older Chinese (age 52) are 0-40% happier than younger ones (age 20). Nonetheless, such estimates bear great uncertainty (wide 95% C.I. bars) that this inference is inconclusive.

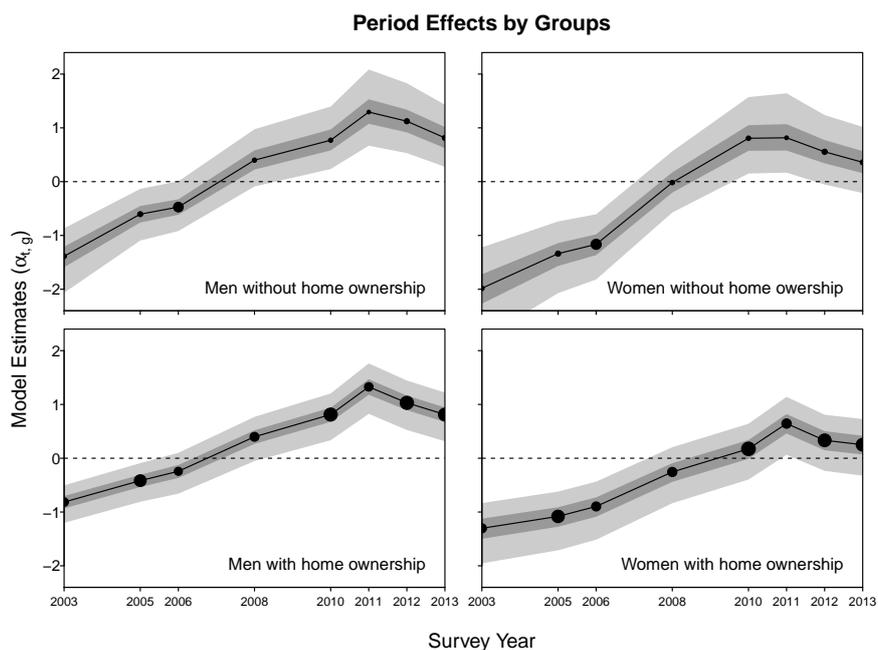


Figure 6: Estimates of the period effects B_j of 8 different survey years. The dark solid dots indicate the posterior means of the period effects B_j . The size of the dots representing the sample size of the corresponding survey years. The light and dark gray areas are the 50% and 95% C.I. respectively. Overall, Chinese people felt less happier in 2003 than others in later years.

5 Chinese Generations

To better interpret the generation effects, we borrow findings from some qualitative studies. In their study of American generations, Howe and Strauss (1991) define a generation as the aggregation of people born over a span of roughly twenty years. Accordingly, people's life could be partitioned into 4 different periods: childhood, young adulthood, midlife and old age. Under the same vein, many works have been devoted into defining Chinese generations with historical, social and cultural perspectives (e.g. Yang (1997); Schütte (1998); Liu and Zhou (2002)).

In particular, Liu and Zhou (2002) propose that some major historical events help shaped different consumer behaviors. Although their research was not about Chinese people's happiness, it sheds important lights on our hypothetical partitioning of Chinese people into different generations. Some major historical events are: the anti-Japanese war (1931-1945), China's war of liberalization (the civil war with the Nationalists, 1945-1950), the Great Leap Forward (1958-1960) which led to three years of the Great Chinese Famine (1959-1961), the Cultural revolution (1966-1976) that overthrew the Chinese traditions, the Down to the Countryside movement that interrupted young peo-

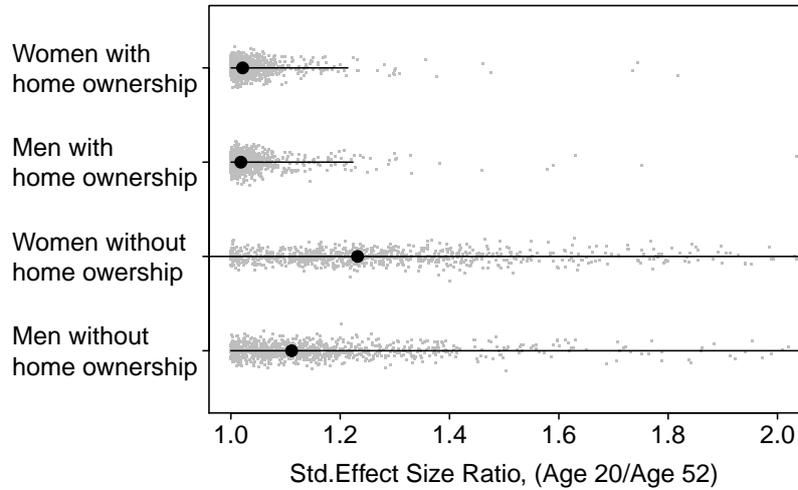


Figure 7: Estimated standardized effective size ratio of the interaction effects λ_g of the period effects and the age specific weights of 4 different groups between age 20 and age 52. The solid dark dots represent the posterior means of the estimates and the solid light dots are the simulated estimates of λ_{g} . The bars are the 95% C.I. Overall, older people without home ownership (age 52) are 0-40% happier than younger people without home ownership (age 20). Such a difference is nearly nil among people with ownership.

ple's education, the restoration of National College Entrance Examination (1977) which reinstated the college education, the Reform and Openness policy (1978-1990) which transformed China's planned economy to a capitalist one, the enforcement of One-Child policy (1978), the reform of College Entrance Examination that lead to the abolition of college education at public expense (1990-) and the rise of internet (1990-).

We enlist two more events to extend this list of events. They are the Asian financial crisis (1997) which caused a plummet in China's economy and the important thoughts of Three Representatives (2002) which allowed the capitalists to join the CCP party. Accordingly, Figure 8 depicts this divinatory generational partitions of Chinese people with the corresponding historical events.

We propose 5 different generations of Chinese people with labels corresponding to the unique life experience each generation has been accumulated into its memory. These The five generations are the war generation (born before 1945), the lost generation (born between 1956 and 1960), the lucky generation (born between 1960 and 1970), the generation of transition (born between 1970-1980), the solitaire generation (born after 1980).¹ Although this generation division is arbitrary and subjective and is against our initial purpose of a quantitative inquiry of generation difference, it is a necessitate stepping

¹We could have proposed a 6th generation (born after 1990). However it would be a redundant effort because the youngest group respondents in the 2013 CGSS data were born in 1995.

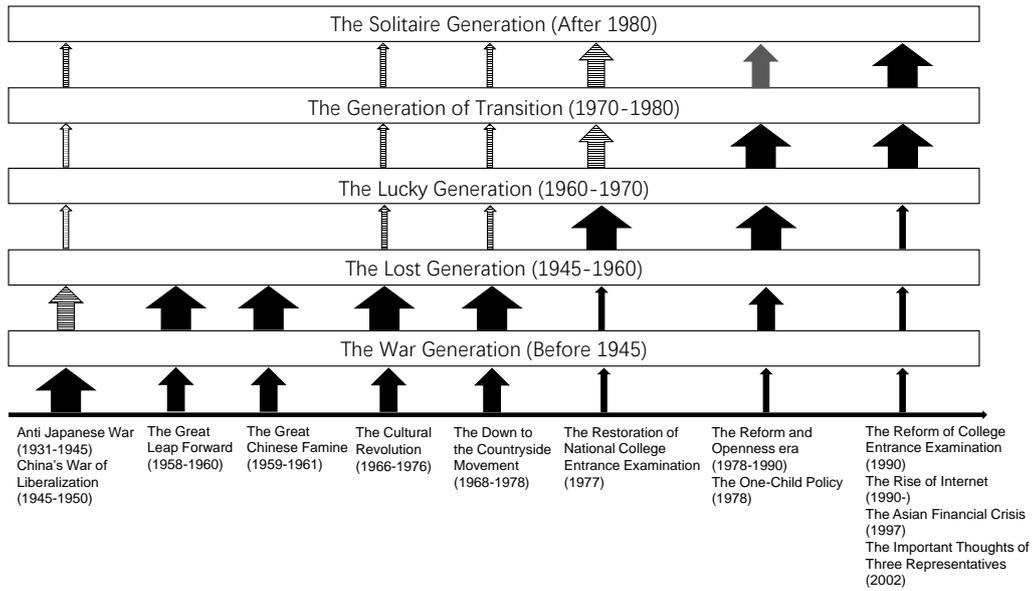


Figure 8: Illustration of the five divinatory generations of Chinese people (replicated and revised from the figure 1 in Liu and Zhou (2002)). The solid arrows indicate the direct influences of the historical events on the Chinese consumers and the dashed ones represents the indirect influences of the historical events on the younger Chinese people via the elder ones. The size of the arrows indicate the magnitude of the influence.

stone to our following analysis. Moreover, to further aid our following interpretation of the various generation with quantitative results, we summarize the aforementioned historical events into 9 different periods as shown in Table 1. In the following sections, We choose specific birth year as the reference to examine the generation effects.

Period	Time Span	Major Events
I	1930–1950	the anti-Japanese war, China's war of Liberalization
II	1950–1958	the initial years of CCP's ruling
III	1958–1961	the Great Leap Forward, the Great Chinese Famine
IV	1961–1966	the Cultural Revolution, the Down to the Countryside Movement
V	1966–1978	the restoration of national entrance examination
VI	1978–1990	the reform and openness, the One Child policy
VII	1990–1997	the reform of college entrance examination, the rise of internet
VIII	1997–2002	the the Asian financial crisis
IX	2002–2013	the important thoughts of Three Representatives

Table 1: Nine periods of major historical events between 1930–2013

The War Generation

The first generation spent their childhood in wars. The end of the civil war between the CCP and the KMT on 1950 and hence the initial ruling period of the CCP bring about a first steady peak for this generation in their young adulthood. Their midlives witnessed some disastrous events between 1958 and 1978 which resulted in a plummet in the economy. The economy remained bumpy in the course of two decades. However, it was also the years where this generation feels most happy. In their dawn, their life satisfaction gradually declines with the subsequent economic transitions that took place after 1978. In short, the happier years of this generation happen to be the most difficult decades in Chinese history. Nevertheless, although the economy was bad, it was the years when the state pretty much took care of every citizen's living. Contrast to this period, after 1978 when China's economy was flying and started its transition to market economy, this generation showed their depression probably because many of their social welfare was diminished and taken away as the state marketized the economy.

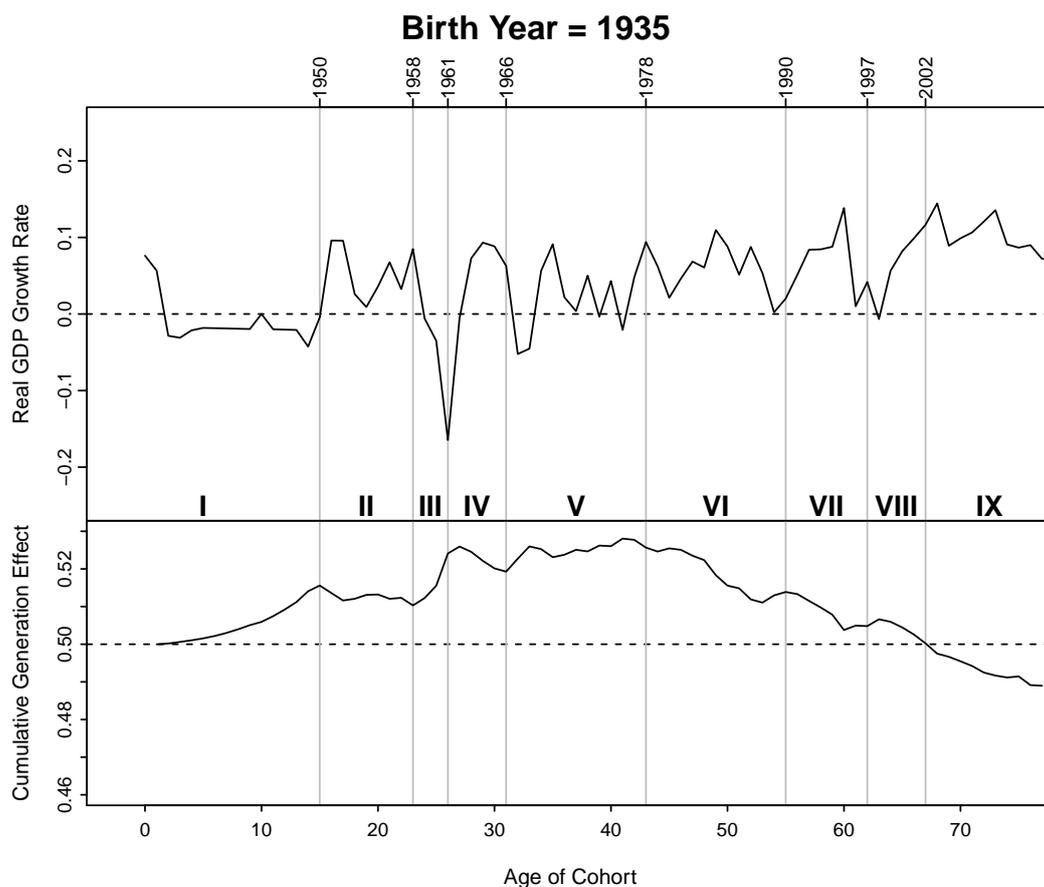


Figure 9: The war generation

The Lost Generation

The lost generation got its name because they spent their childhood in the most difficult time of Chinese recent history. They then served as the Red Guards in the Cultural Revolution and went down to the countryside to experience the peasant and worker's life in their young adulthood. As a result, they were not properly educated. Nevertheless, comparatively speaking, the data shows that they felt happy in these chaotic period. It was not until 1978 when the economic transition began that they realized how much has this happy period haunted themselves in this market economy. They were not well educated and did not accumulated enough wealth. Hence their happiness drops rapidly in their mid lives and old ages.

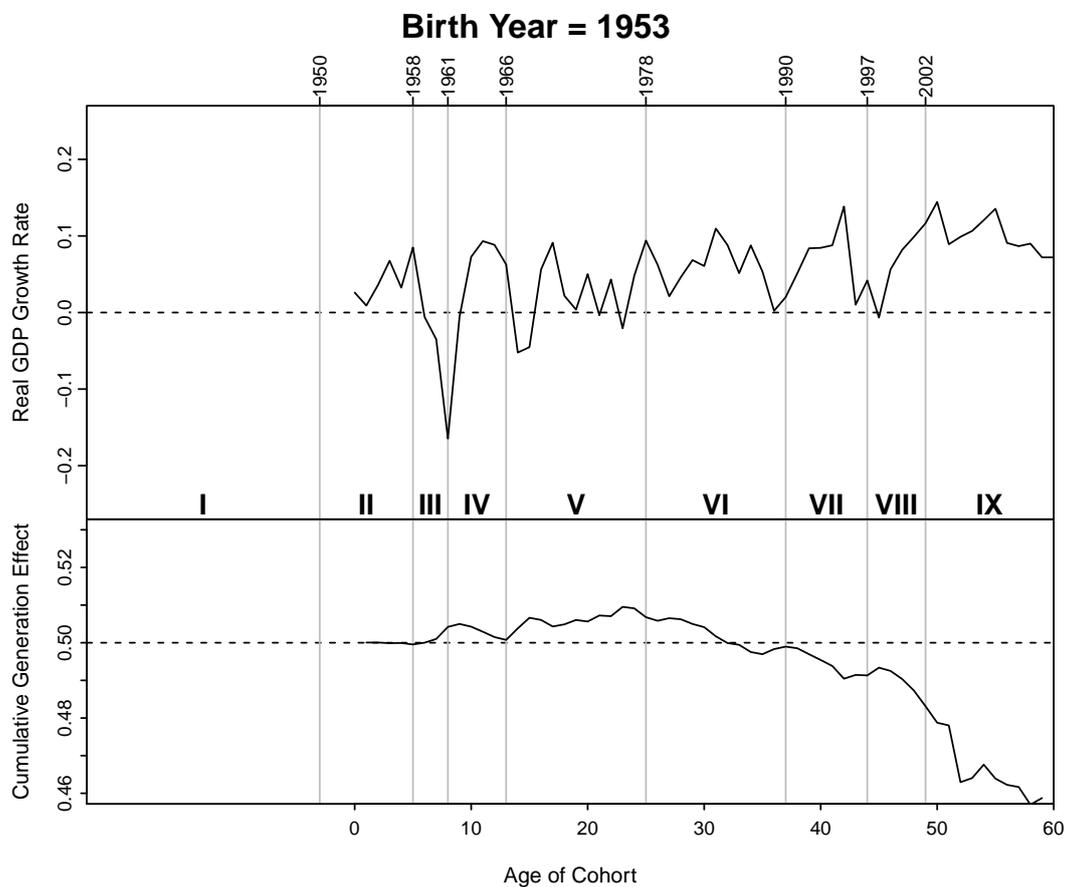


Figure 10: The lost generation

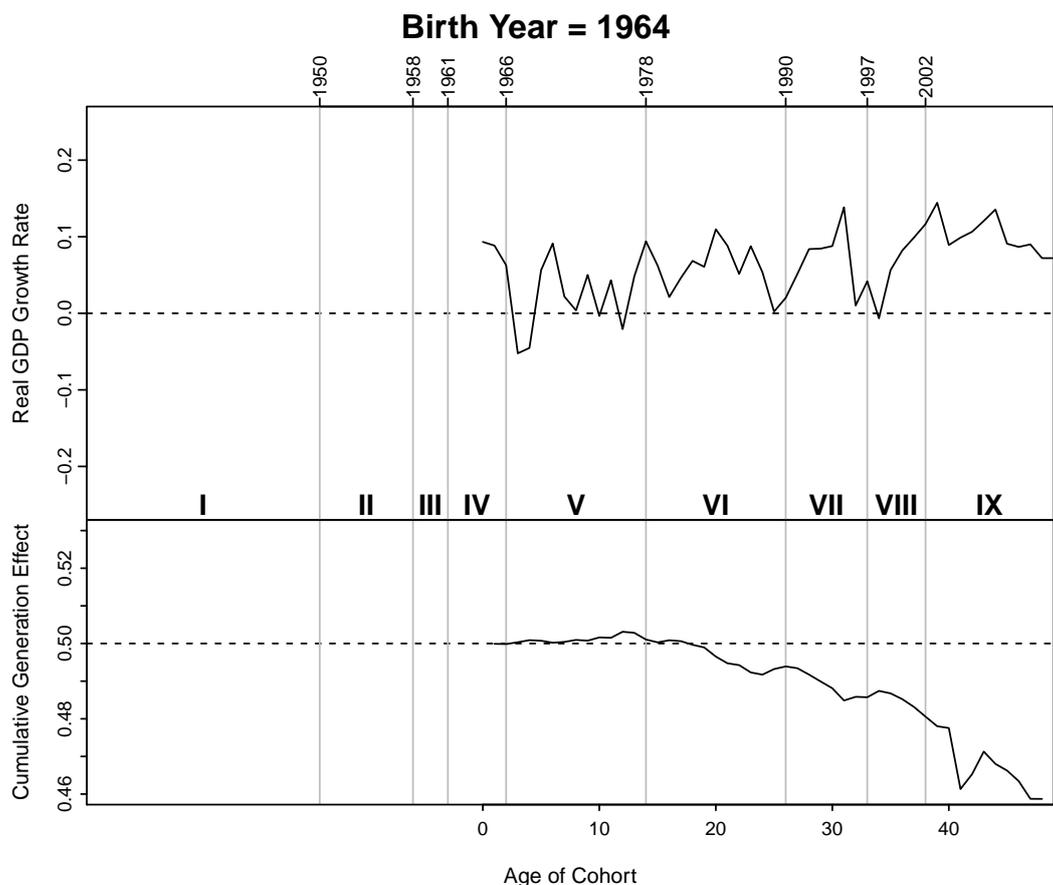


Figure 11: The lucky generation

The Lucky Generation

The lucky generation on average is not as happy as the previous two generations. They are lucky because they did not born in the war times and did not grew up in the bad economy. The Culture Revolution took place in their childhood which has nothing to do with them because they were too young. Their young adulthood and midlives were in the period of economic transition. Most of them joined the wagons toward market economy but felt unhappier than their childhood. The cruel fact could be that only a few could be the real lucky ones in this journey. For the rest, they faced the reality that it is laborious to make the end meets. They might have remembered how easy life was in the state planned economy. Subsequently, their life satisfaction drops right after their young adulthood.

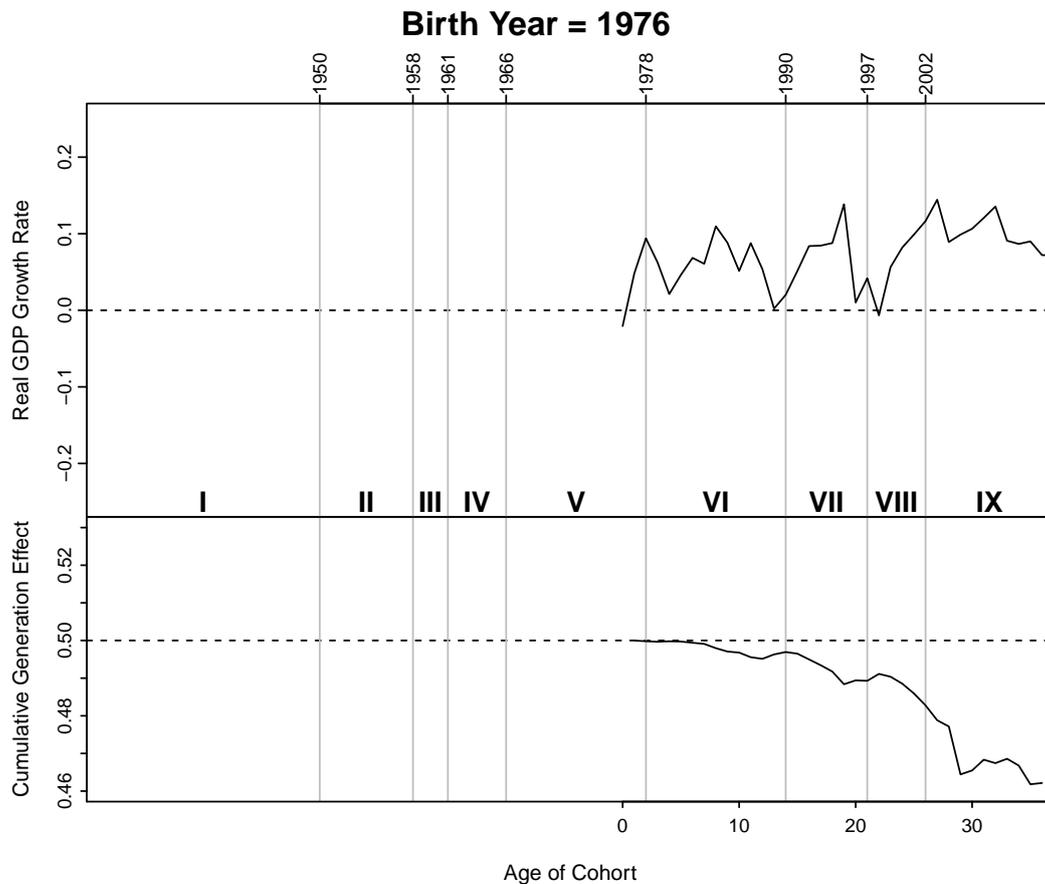


Figure 12: The generation of transition

The Generation of Transition

This generation starts their childhood in the economic transition period. They have neither the memory of previous chaotic periods and nor do they have the recollection of the state planned economy. In their childhood, they might witness their parents losing jobs which once offered by the state. The situation was not uncommon in many families. By the time they were to attend college, the government has cancelled many tuition subsidies. Their first jobs might be terminated early due to the Asian financial crisis. With such rough starts, their happiness drops right after their young adulthood and plummets in their midlives.

The Solitaire Generation

The solitaire generation grows up alone thanks to one child policy enforced on 1978. The Asian financial crisis has minor influence, though, in their young adulthood, they

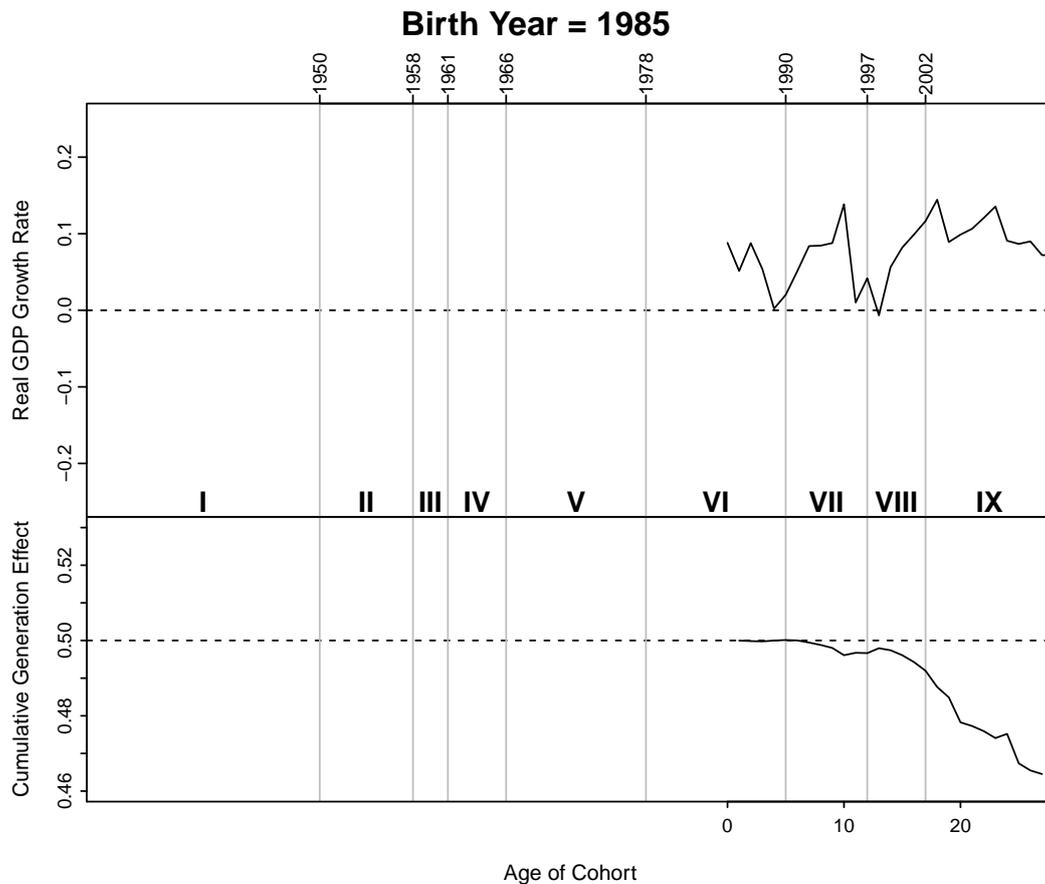


Figure 13: The solitaire generation

witnessed the soaring housing prices. This dreadful situation was hopeless to most of them who were new to the pricey society. Henceforth, it would not be a surprise to observe an early drop of their happiness in their young adulthood. Their life satisfactions further plummet in their midlives.

6 Further discussion

We have developed a novel Bayesian Multilevel model for the age-period-cohort framework, and successfully apply it to Chinese happiness survey data. The new model not only solves the co-linearity problem with a Bayesian approach, but also leads to a more stable result. From the fitted data, we can understand the pattern of the happiness changes in life-circle (age effect), the cognitive development and accumulation of macro changes (generation effect) and the random factor in each survey (period effect). Particularly, we see the story about the difference on happiness across generation in China.

Finally, it has to be acknowledged that some question remains unsolved. For one thing, though we use annual GDP per capital growth rate which is actually not a perfect predictor for happiness. This may be either a result of the faked Chinese economics data, or a result of the fact that GDP growth rate and individual's life has low correlation. This might lead to our underestimation of the generation effect.

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