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ABSTRACT

Is Subjective Well-Being Insured Against Income Shocks? Evidence from 20-Year Panel Data in South Korea

Using 20 years of nationally representative panel data in South Korea, we estimate how life satisfaction responds to income shocks. We document that unexpected income changes significantly impact an individual's life satisfaction, and the magnitudes depend on the persistence of income shocks. We find that permanent income shocks substantially penetrate life satisfaction, while transitory income shocks have minimal impact. We also find that life satisfaction regarding external factors such as family income and leisure activities is more sensitive to income shocks than life satisfaction related to social relationships. Our findings imply that it is critical for the government to address persistent income losses in the economy (e.g., long-term unemployment driven by skill-biased technological changes or work-limiting disability) as a means to improving social welfare.

JEL Classification: D31, D60, I31

Keywords: life satisfaction, insurance, income shocks, KLIPS

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1. Introduction

Understanding the welfare consequences of unexpected income changes is crucial for policymakers because this information can provide a basis for the optimal design of social insurance and welfare programs. Ideally, a fully-fledged structural life-cycle model of economic choices (e.g., consumption and employment) that can closely approximate the real world would allow us to simulate the welfare impact of unexpected income changes. However, this approach requires significant computational costs, and the source of identification is often ambiguous. A more commonly used approach in the literature is to indirectly capture underlying welfare via observable proxies such as consumption spending (Blundell et al., 2008; Kaplan & Violante, 2010).[1]

An alternative approach involves directly measuring individuals' well-being via survey responses and using its variation to assess the influences of socio-economic shocks. Subjective well-being (SWB), measured by self-reported happiness or life satisfaction, is known to be an informative measure of well-being linked to various aspects of life, including health, social relationships, and labor productivity (Graham, 2008; Oswald et al., 2015) and is useful in evaluating the impacts of public policies (Kahneman & Krueger, 2006; Kim & Koh, 2018; Layard, 2012). Hence, examining the change in SWB can be useful to understand the welfare consequences of unexpected income shocks.

This paper examines the extent to which a person's happiness is insured against unexpected income changes by assessing how their SWB responds to income shocks using data drawn from the Korea Labor and Income Panel Study (KLIPS). Specifically, we

[1] See Meghir and Pistaferri (2011) for a theoretical framework and a survey of literature on the impact of income changes on consumption.

investigate whether the size of the response depends on the nature of the income shock (i.e., persistent versus transitory income shocks). Through an individual's intertemporal choice, the reaction of subjective life satisfaction can depend on the persistence of income changes as in the consumption literature (Attanasio & Pistaferri, 2014; Blundell et al., 2008; Hall & Mishikin, 1982). If an income shock only lasts for a short time, people can maintain their life satisfaction simply by changing their spending/saving behaviors. However, when shocks have persistent effects on future income flow, such as work-limiting long-term disability or skill-biased technological changes, this impact may have larger, longer-term consequences on their well-being.[2]

For empirical analysis, we adapt the framework of Blundell et al. (2008) which provides a parsimonious approach to understanding the impact of unexpected income changes on consumption spending. To this end, we replace consumption spending with SWB data from the 2000–2019 KLIPS and quantify how well individuals can cope with permanent and transitory income shocks.

We first document the evolution of self-reported well-being and household income in Korea (hereafter, Korea). The data reveal that SWB and household income have been increasing over the last two decades while their inequalities measured by unconditional variances have steadily decreased. We also show that various domain-specific life satisfaction measures also have similar upward patterns except for relationship-related satisfaction, which

[2] While we consider income losses to illustrate the differential impact of permanent and temporary income shocks, our methodology does not distinguish income gains and losses. Nonetheless, we acknowledge important non-linearities in the income-wellbeing relationship. First, responses to income losses likely differ from responses to income gains due to loss aversion (Kahneman and Tversky, 1979). Second, the marginal impact of income shocks may vary across the income distribution, with larger effects for lower-income households who have less financial buffer against shocks. Third, the impact could depend on the size of the shock, with particularly large shocks potentially having disproportionate effects on wellbeing. While thoroughly analyzing these non-linearities is beyond our current scope due to the current limitation of the methodology, future research using our framework could explore these heterogeneous patterns.

shows a constant trend. Notably, the increasing trends of life satisfaction in Korea are quite different from the constant or declining SWB trends in other industrialized countries in Western Europe and America. The distinctive trend in life satisfaction suggests the importance of understanding the changes in well-being and its determinants under different economic environments.

We then estimate how life satisfaction responds to income shocks and explore how the degree of responses has evolved over the past two decades in Korea. The estimation results indicate that persistent income shocks have a sizable and significant impact on life satisfaction, whereas temporary shocks have minimal impact. We also find that life satisfaction regarding pecuniary factors such as family income and leisure activities is more sensitive to income shocks than life satisfaction related to social relationships. This finding may suggest that the improvement of overall well-being, driven by income-related satisfaction, is induced by permanent income improvements in Korea during the observation periods.

Lastly, our analysis shows that the degree of responses in life satisfaction to permanent income shocks becomes smaller over time, indicating that insurance against permanent income shocks has grown stronger for the past two decades. For example, since 2008, the impact of permanent income shocks on life satisfaction has been half as large as before. Our findings suggest that improved social insurance and welfare programs, together with steady economic growth, may have played an important role in ensuring life satisfaction against income shocks during the same time period in Korea.

While a significant body of research links income to subjective well-being (SWB) (Frey & Stutzer, 2002; Clark, Frijters, & Shields, 2008; Kim & Oswald, 2021), empirical studies typically find that income gains increase life satisfaction, although the effects are

more pronounced in cross-sectional studies than in panel studies. This disparity may reflect the smoothing of utility over time as predicted by the life-cycle permanent income hypothesis, where permanent shocks influence life satisfaction more than transitory ones. Studies using individual-level panel data have begun to explore this differentiation, with research from both developed and developing contexts - such as Bayer and Juessen (2015) in Germany and Cai and Park (2016) in rural China - confirming the greater impact of persistent shocks compared to temporary ones.

Our study builds on this foundation by examining the impact of income shocks on SWB in Korea, a context distinct from both Western developed and less-developed countries. Korea's unique trajectory—from a developing country to an advanced economy—offers a novel setting to study these dynamics (Kim, 2011). Korea's rapid economic growth has been accompanied by significant social changes, including the expansion of social insurance systems and welfare programs over the last two decades (Lee, 2015). For instance, welfare spending as a share of GDP grew from 2.6% in 1990 to 15.5% by 2019, converging toward the OECD average of 16.4% (OECD, 2023). Such changes likely influence the extent to which individuals can buffer income shocks, affecting SWB outcomes in ways that may differ from both high-income Western and less-developed countries.

To the best of our knowledge, this is the first study to assess SWB responses to income shocks in a non-Western developed country. This distinction is important as SWB trends in Korea diverge from patterns observed elsewhere. While SWB has remained stable or declined in many Western countries, Korea has experienced increasing trends in life satisfaction despite rising inequality over the last decades (Suzuki, 2009). These differences highlight the value of examining how SWB adapts to income shocks within Korea's unique socio-economic context.

The rest of the paper is structured as follows. Section 2 introduces the data and discusses the pattern of subjective well-being over the past twenty years in Korea. Section 3 describes the empirical methodology used in the empirical analysis. Section 4 presents and discusses the findings. Section 5 concludes.

2. Data

We use data from the 2000–2019 Korea Labor Income Panel Study (KLIPS) for our empirical analyses. The KLIPS is a nationally representative panel survey of Korean households living in urban areas and surveys every household member aged 15 years and above. Since 1998, it has collected rich information on individual and household characteristics, such as educational attainment, marital status, labor market activity, household income, household spending, and social activities.

In our analysis, we focus on the period from 2000 to 2019. We exclude the observations before 2000 to ensure data consistency in income measurement and mitigate the potential impact of the Asian financial crisis in 1997.[3] Data collected from 2020 onward is also excluded from our analysis to avoid the potential influence of the COVID-19 pandemic. We only use the sample originating from households included in the initial Wave in 1998 to avoid the potential influence of introducing additional samples.[4,5] Finally, the sample is restricted to individuals aged between 30 and 60 years. We chose 30 years as the youngest

[3] Before 1999, the KLIPS asked about annual income over the last 12 months at the time of interview. From 1999 and onward, it has asked about annual income for the last calendar year.

[4] KLIPS added additional samples in 2009 and 2018, respectively.

[5] While we follow the original households and their members, the sample evolves over time due to two key factors. First, household members who turn 15 become eligible to participate in the individual survey module. Second, the sample expands through newly established households originating from the initial sample households through household division, such as marriage or attaining independence upon reaching adulthood. This design, similar to the U.S. Panel Study of Income Dynamics (PSID), results in an expanding sample that includes new individuals over time.

age to focus on individuals who already entered the labor market and 60 years as the oldest age to avoid the potential effects of retirement.[6] The resulting sample consists of 13,875 individuals from 7,473 households.

The KLIPS is ideal for our analysis because it has repeatedly asked respondents about self-reported life satisfaction questions during our study period. It employs five-level Likert-type questions to assess overall life satisfaction, as well as questions about domain-specific life satisfaction—family income, leisure activities, living environment, relationship with immediate family members, relationship with relatives, and other social relationships (e.g., friends and colleagues). For example, in terms of overall life satisfaction, the KLIPS asks the following question: "Overall, how satisfied are you with your life?".[7] Respondents could choose from "completely satisfied" to "completely dissatisfied." We treat an ordinal variable as a cardinal variable by assigning "1" to "completely dissatisfied," "2" to "dissatisfied," "3" to "neither satisfied nor dissatisfied," "4" to "satisfied," and "5" to "completely satisfied," following the SWB literature.[8]

[Table 1]

Table 1 presents summary statistics for the key variables for the selected years. On average, our sample respondents were in their 40s with increased average age over time,

[6] The empirical results remain robust even if we extend the sample to include individuals aged between 25 and 65 years.

[7] The questions on domain-specific life satisfaction are as follows: 1) "How satisfied are you with family income?", 2) "How satisfied are you with leisure activities?", 3) "How satisfied are you with living environment?", 4) "How satisfied are you with family relationships?", 5) "How satisfied are you with relative relationships?"; and 6) "How satisfied are you with other social relationships?"

[8] Ferrer-i-Carbonell and Frijters (2004) and Cheng et al. (2022) show that assuming cardinality or ordinality of a SWB measure makes little difference in their empirical analysis.

reflecting the aging demographic structure of Korea.[9] 52% of sample respondents were male in 2000. The ratio changes slightly to 54% in 2019. The household size, measured by the number of household members living together, decreased from 3.93 in 2000 to 3.25 in 2019. Additionally, the number of children in households decreased from 1.14 in 2000 to 0.51 in 2019 reflecting the decreasing fertility rate during the observation period. Educational attainment increased significantly, with the proportion of individuals who are college graduates increasing from 24% in 2000 to 60% in 2019. The proportion of individuals employed increased from 73% in 2000 to 77% in 2019. At the same time, annual household income grew from KRW 39.3 million (US$29,482) in 2000 to KRW 63.2 million (US$47,419) in 2019.[10] Regarding life satisfaction, the level of overall life satisfaction increased from 3.05 in 2000 to 3.44 in 2019. The levels of life satisfaction related to family income, leisure activity, and living environment has increased by 0.4–0.6 points, while life satisfaction related to family, relatives, and other social relationships has increased relatively slowly by about 0.1 points.

[Figure 1]

Figure 1 illustrates the trends in self-reported overall life satisfaction, domain-specific life satisfaction, and household income from 2000 to 2019. Panel A shows the life satisfaction trend, with its average score ranging from 3.05 in 2000 to 3.44 in 2019.[11] Panel B

[9] The proportions of people aged over 65 years were 7.03% in 2000 and 15.5% in 2019 (Statistics Korea, 2005–2019).

[10] We measure annual (after-tax) household income as the sum of earned income, financial income, income from real estates (e.g. rents), income from social insurance (e.g. pension, unemployment benefit, etc.), public and private transfer income, and other income. Monetary units are in KRW 1 million and CPI-adjusted using 2020 as the base year. Income-related data is measured as of the last calendar year. As of 25 February 2024, US$1 is equivalent to 1,333 Korean won (KRW).

[11] As a robustness check, we construct a binary variable that indicates whether a respondent was satisfied or very satisfied with their overall life and then conducted the same exercise. The increasing pattern, reported in

reveals that the life satisfaction variance has been steadily declining by almost 30% in the past 20 years. The increasing trend in life satisfaction in Korea is distinctive compared to other developed countries, as shown in Figure A3. For example, the U.S., European countries, and Australia all exhibit relatively stable trends in the Cantril Life Ladder scale[12], while it has been steadily decreasing in Japan.

Panel C shows the same trend of six different domain-specific life satisfaction measures. People have become more satisfied with their lives in terms of family income, leisure activities, and living environment, probably reflecting Korea's steady economic growth (as shown in Panels E and F below), while relationship-specific life satisfaction has not grown much. Panel D also indicates reductions in the variance of domain-specific life satisfaction consistent with the trend in the variance of overall life satisfaction.

Panels E and F show an upward trend in average household income and a downward trend in household income inequality. A surge in inequality in 2008 is likely due to the recent Great Recession. The decreasing trend in income inequality corresponds with the expansion of the social safety net and welfare system since 2008 in Korea (Ahn et al., 2021).

3. Methodology

We examine the impact of permanent and transitory income shocks on self-reported life satisfaction by closely following the methodology proposed by Blundell et al. (2008; hereafter BPP), which estimated the degree of consumption insurance (i.e., the spending response to income shocks). We adapt BPP's method by replacing consumption spending

Figure A1, remains robust. In Figure A2, we also confirm that the increasing trend in overall life satisfaction is robust regardless of birth cohorts, education attainment levels, household wealth, and gender.

[12] The Cantril Life Ladder is one of the most frequently used measures of subjective wellbeing which asks respondents to evaluate their lives in general on a ladder on a scale from 0 (worst) to 10 (best) (Cantril, 1965).

with the life satisfaction measure to assess the degree of life satisfaction insurance against income shocks. We briefly describe the empirical specification following BPP's notational convention as below. The detailed step-by-step procedures are explained in Appendix A.4.

Individual *i*, whose household income (*Y*) at year *t*, is written as follows:

$$log\ Y_{i,t} = Z_{i,t} \cdot \varphi_t + P_{i,t} + v_{i,t}\ , (1),$$

where *Z* denotes observable characteristics such as age, gender, education attainment, province of residence, household size, the number of children, and employment status.[13] *P* denotes a permanent unobservable component, and *v* is a transitory unobservable component. We also assume that the permanent component (P) has the random walk process as follows:

$$P_{i,t} = P_{i-1,t} + \zeta_{i,t}\ , (2),$$

where ζ is an *i.i.d.* shock drawn from a normal distribution $N(0, \sigma_\zeta^2)$.[14] The transitory component (*v*) is assumed to follow an MA(1) process:[15]

$$v_{i,t} = \sum_{j=0}^{q} \Theta_j \varepsilon_{i,t-j}\ ,\ \ (3),$$

with $\Theta_0 \equiv 1$.

According to the above-stated assumptions, the unexplained income innovation can be described as follows:

$$\Delta y_{i,t} = \zeta_{i,t} + \Delta v_{i,t}\ ,\quad (4),$$

where $y_{i,t}$ is $logY_{i,t} - Z_{i,t}\phi_t$, that is, the unexplained log-transformed income.

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[13] Income changes are typically associated with changes in several characteristics that affect life satisfaction directly (e.g., age and education attainment). By including these controls, we account for their direct effects on life satisfaction and ensure that the identified income shocks represent unexpected changes unrelated to these factors.

[14] Permanent income shocks represent an unexpected and persistent change in an individual's income stream, such as externally imposed industry-wide economic disruptions (e.g., the China shock), long-term economic restructuring (e.g., skill-biased technological change), or long-term income shock driven by work-limiting disability. These events alter expected income trajectories, which differ from transitory ones, which tend to be short-lived fluctuations such as seasonal employment changes.

[15] We also conduct the same exercise using the MA(2) process. The results reported in Table A1 remain robust.

We can similarly isolate the unexplained component of life satisfaction using equation (1) and derive the unexplained change in life satisfaction as follows:

$$\Delta LS_{i,t} = \phi_{i,t} \cdot \zeta_{i,t} + \psi_{i,t} \cdot \varepsilon_{i,t} + \xi_{i,t}\,, \qquad (5),$$

where *ΔLS* is the unexplained change in the life satisfaction score. We model the impact of permanent income shocks (ζ) on a person's life satisfaction with a loading factor (ϕ), while transitory income shocks (ε) are assigned a loading factor (ψ). The specification described in equation (5) implies that a one percent increase in the permanent income shock (ζ) and temporary income shock (ε) affects the change in residual life satisfaction by ϕ percent and ψ percent, respectively. It is noteworthy that equation (5) does not include observable characteristics because they were already partialled out when estimating equation (1) (also for the life satisfaction variable). $\xi_{i,t}$ is an *i.i.d.* error term. ϕ and ψ are the parameters of interest that capture the degree of transition from permanent and transitory shocks to life satisfaction, respectively. For instance, ϕ (ψ) equal to "0" indicates full insurance against permanent (transitory) income shocks, i.e., unexpected income changes do not have any influence on SWB. A positive value of ϕ (ψ) indicates incomplete life satisfaction insurance against permanent (transitory) income shocks. We based our identification of the insurance parameters on BPP (2008) and describe the entire procedures of estimating the life satisfaction insurance parameters via the minimum distance estimator in Appendix A.4. We use the longitudinal individual weights provided by KILPS in all estimations.

4. Estimation results

In this section, we present empirical evidence on (1) the trends of variance in permanent and transitory income shocks, (2) life satisfaction insurance parameters, and (3) how these parameters evolve over time and across groups.

First, we report the moments required to estimate the life satisfaction insurance parameters, including the auto-covariance matrix of income innovation, life satisfaction innovation, and life satisfaction–income growth in Korea from 2001 to 2019 in Tables A2–A4. The results of these tables indicate a simultaneous and nearly monotonic decrease in the variance of unexplained components of log-transformed income and life satisfaction. For example, the variances of the first difference in unexplained log-transformed income steadily decreased from 0.460 in 2001 to 0.153 in 2019. That of unexplained life satisfaction also constantly declined from 0.520 in 2001 to 0.316 in 2019.

[Figure 2]

Second, Figure 2 depicts the evolution of variance in permanent and transitory income shocks.[16] The estimated variance of permanent income shocks remains relatively stable over time. By contrast, we observe that the estimated variance of transitory income shocks has been slightly declining, and the magnitude is larger than that of permanent income shocks. A surge in the variance of transitory income shock in 2008 is likely due to the Great Recession. Although the variance of income itself (shown in Panel F of Figure 1) steadily and significantly decreased over time, the variance of income shocks has not changed much. This pattern suggests the importance of isolating the unexpected portion of income changes from overall income changes and also by their persistence.

[Table 2]

Table 2 presents our parameter estimates of interest, which represent the degree of life satisfaction insurance against permanent and transitory income shocks. In Column (1), the

[16] It covers between 2002 and 2018 due to the identification strategy of using the differenced data following BPP (2008).

coefficient estimate is 0.471, which means that an unexpected ten percent decrease in permanent income leads to a decrease in an individual's life satisfaction by 0.0471 points. Meanwhile, the degree of life satisfaction against transitory income shocks is 0.049, meaning that an unexpected ten percent decrease in transitory income reduces life satisfaction by only 0.0049 points. Both estimates are statistically significant at the one percent level. This finding suggests that the contemporaneous SWB impact of a permanent income shock is about ten times larger than that of a temporary one, suggesting the importance of developing income insurance for permanent income losses, such as structural changes in the economy or long-term work-limiting disability.[17,18]

To better contextualize how our insurance parameters compare to the correlates of household income with overall life satisfaction, we estimate the life satisfaction score on log-transformed income with individual and time fixed effects (without and with other observables such as age, education attainment, province of residence, number of children, household size, and employed status). We report the regression results in Table A11, which show that a 100 percent increase in household income is significantly associated with an increase of an individual's life satisfaction score by almost 0.10, equivalent to 0.16 SD. This magnitude is nearly twice as large as our life satisfaction insurance parameter against transitory income shocks, but 80 percent smaller than our life satisfaction insurance

[17] We account for household size by including it as one of the control variables through the estimation procedures. As a robustness check, we additionally estimate the model using equivalised household income. Specifically, we use two measures: i) household income by the square root of the household size and ii) the OECD equivalence scale assigning a value of 1 to the first household member, of 0.7 to each additional adult, and of 0.5 to each child. We find that the results reported in Table A9 remain robust to the baseline findings.

[18] We conducted additional analyses using alternative definitions of life satisfaction, including the log-transformed score, a binary indicator (1 if satisfied or very satisfied, 0 otherwise), and the standardized score. Results in Table A5 confirm that life satisfaction is more sensitive to permanent income changes than transitory ones. The log-transformed score in column (1) produces smaller estimates, likely due to the nature of the logarithm. The binary indicator in column (2) shows that permanent income changes lead to about 21 times more people crossing the "satisfied" or "very satisfied" threshold compared to transitory changes, highlighting the value of alternative definitions for a comprehensive understanding of income effects on SWB.

parameter against permanent income shocks. This difference likely reflects that the observed household income is determined by complex processes including transitory and permanent shocks and other observable characteristics.

To further benchmark the magnitude of our life satisfaction insurance parameter against transitory income shocks, we consider two notable studies in the literature, specifically, Lindqvist et al. (2020) and Kim & Oswald (2021) which analyze Swedish and Singapore data, respectively. Lindqvist et al. (2020) report that a $100,000 increase in lottery wins leads to an increase in overall life satisfaction by 0.037 SD. Kim & Oswald (2021) shows that a 100% increase in lottery winning amount leads to an increase of life satisfaction score by .0031. As the average lottery prize is $353 and the standard deviation of life satisfaction is 0.77 in Kim & Oswald (2021), the back-of-the-envelope calculation (i.e., simple linear extrapolation) suggests that a $10,000 (US$7,576) increase in the lottery prize leads to an increase in overall life satisfaction by 0.11 SD. In our study, we estimate that an unexpected 100 percent change in transitory income affects life satisfaction by only 0.049 points (0.08 SD). As we cannot directly observe transitory and permanent portions of household income from the data, we naively assume that the percent change in transitory income is equivalent to the percent change of annual household income. Based on this assumption, our back-of-the-envelope calculation implies that a $41,890 increase of transitory income (a 100 percent increase) leads to an increase of life satisfaction by 0.08 SD. While the magnitude is quite comparable to that found by Lindqvist et al. (2020), it seems to be lower than that reported by Kim & Oswald (2021). The transitory nature of income shocks and the difference in contexts (e.g., thrill-of-winning effects in the lottery setting) may explain the magnitude differences.

One might be concerned about whether the estimated effect of permanent income may reflect the combined effects of both income and health. To address this issue, we re-estimate the insurance parameters by including health status and/or risky health behaviors in observable characteristics, $Z_{i,t}$. The results reported in Table A12 indicate that, while the degree of insurance against permanent income shocks becomes stronger after controlling for subjective health status or health behaviors, the baseline results remain robust. We also conduct robustness checks by considering different transformations of the life satisfaction variable (e.g., score, binary indicator, and standard deviation) and find that the results reported in Table A5 remain consistent.

We then evaluate the changes in the degree of life satisfaction insurance over time. Since the 2008 Great Recession, we separately estimate the life satisfaction insurance parameters before and after 2008. By doing so, we attempt to understand the dynamics of life satisfaction insurance in Korea. Columns (2) and (3) of Table 2 show that the impact of permanent income shocks on life satisfaction insurance became stronger after 2008. For instance, the degree of life satisfaction insurance against permanent income shocks is estimated at 0.361 in 2009–2019, suggesting a significant improvement in life satisfaction insurance compared to the pre-2008 period (0.595). However, the degree of life satisfaction insurance against transitory income shocks is not much different between the two periods. We also consider the three time periods (2002–2008, 2009–2014, and 2015–2019) instead of just before and after 2008. Table A6 reports consistent evidence that the degree of life satisfaction insurance against permanent income shocks becomes stronger over time.

[Table 3]

To have a more comprehensive understanding of which aspect of SWB is most sensitive to income shocks, we estimate domain-specific SWB insurance parameters. Table 3 reports the estimated degree of domain-specific life satisfaction insurance parameters concerning 1) family income, 2) leisure activities, 3) living environment, 4) family relationship, 5) relationship with relatives, and 6) social relationship with friends and others. The results indicate that life satisfaction with regard to extrinsic aspects of life is more sensitive to income shocks compared to that of social relationships. For example, income-specific life satisfaction (=0.999) is about three times more sensitive to a permanent income shock than family-specific life satisfaction (=0.413). The responses to transitory income shocks across different domain-specific life satisfaction measures also show similar patterns, but the magnitudes are much smaller or close to zero and generally statistically insignificant. Consistent with the overall life satisfaction measure, we find that the insurance degree of domain-specific life satisfaction against permanent income shocks became stronger over time, especially in terms of income-specific life satisfaction (See Table A7).

[Table 4]

Lastly, we conduct heterogeneity analyses to understand how the degree of life satisfaction insurance varies by population groups and report the results in Table 4. Specifically, we divide the sample by a respondent's age (below 45 years vs. 45 years and above), by education attainments (college and above vs. high school and below), and by gender (male vs. female). In Columns (1) and (2), we find the level of life satisfaction insurance against permanent income shocks for the younger group (0.520) is weaker than the level for the older group (0.436). Columns (3) and (4) reveal that the insurance against permanent shocks for the less-educated group (0.496) is more vulnerable than the more-educated group (0.421). Columns (5) and (6) exhibit that the level of life satisfaction

insurance was lower for males (0.539) than females (0.378). In addition, we find that, over time, the degree of life satisfaction insurance against permanent income shocks becomes stronger across all groups (See Table A8). The general patterns of weaker SWB insurance against income shocks for relatively more vulnerable populations suggest a need for strengthening the social safety net for those groups.

In addition, we examine how domain-specific life satisfaction insurance against income shocks varies across different population groups and confirm which aspects of life satisfaction drive changes in overall life satisfaction in response to income shocks. The results reported in Table A10 reveal distinct patterns across domains and demographic groups. For example, life satisfaction regarding factors such as family income, leisure activities, and living environment exhibits weaker insurance against permanent income shocks for the younger and the less educated individuals, which leads to larger changes in overall life satisfaction suggesting greater financial vulnerability in these groups. Similarly, permanent income shocks have a stronger impact on financial and overall life satisfaction for men than for women. The findings again suggest that life satisfaction domains closely tied to financial status are the primary channels through which permanent income shocks affect overall life satisfaction, which is more pronounced among younger males. In contrast, life satisfaction related to social relationships among younger individuals is less sensitive to permanent income shocks compared to older individuals. Transitory income shocks have a weaker overall impact and thus it was difficult to draw meaningful inferences.

5. Concluding Remarks

We estimate the degree of life satisfaction insurance against income shocks using large-scale individual-level panel data of 20 years in Korea. Extensive research in this strand of the literature has focused on income insurance or consumption insurance as proxies of

unobservable individual-level utility. In this paper, we use self-reported responses to a SWB question as a more direct measure of individual-level utility. Our empirical analyses indicate that permanent income shocks exert a substantial impact on life satisfaction, whereas transitory income shocks have little impact. We find that life satisfaction regarding external factors such as family income, and leisure activities is more sensitive to income shocks than life satisfaction related to social relationships. In addition, we estimate that the degree of life satisfaction insurance against permanent income shocks becomes stronger over time, consistent with steady economic growth and improved social insurance and welfare programs in South Korea during the same period. Our findings imply that it is critical for the government to address persistent income losses in the economy, e.g., long-term unemployment driven by skill-biased technological changes or work-limiting disability as a means to improving social welfare (Card et al., 2010; Crépon & van den Berg, 2016).

While our study contributes valuable insights, we acknowledge its limitations, which could lead to fruitful avenues for future research. First, we have focused exclusively on life satisfaction due to the data limitation. Life satisfaction is known to capture cognitive and evaluative aspects of SWB. Thus, it would be meaningful to broaden our analysis to experiential or eudaimonic measures of SWB, such as happiness and life meaning, for a comprehensive understanding of SWB insurance. Second, we do not address changes in family composition, which can significantly affect SWB insurance. Thus, it would be interesting to consider a more structural framework that can incorporate family structure in explaining the evolution of income risks and SWB insurance.

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Tables

Table 1: Sample characteristics (selected years)

	2000	2005	2010	2015	2019
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Age	42.84 (8.38)	43.38 (8.38)	44.31 (8.64)	45.64 (8.76)	45.43 (9.36)
Male	0.52 (0.50)	0.53 (0.50)	0.54 (0.50)	0.54 (0.50)	0.54 (0.50)
Household size	3.93 (1.13)	3.68 (1.13)	3.44 (1.17)	3.34 (1.18)	3.25 (1.18)
Number of children	1.14 (0.98)	0.97 (0.99)	0.78 (0.94)	0.67 (0.91)	0.51 (0.83)
College graduation or above	0.24 (0.43)	0.35 (0.48)	0.46 (0.50)	0.53 (0.50)	0.60 (0.49)
Employed	0.73 (0.50)	0.75 (0.49)	0.75 (0.46)	0.77 (0.45)	0.77 (0.48)
Annual household income	39.30 (31.03)	52.88 (36.83)	55.35 (35.67)	60.73 (37.80)	63.21 (37.31)
Overall life satisfaction	3.05 (0.67)	3.24 (0.64)	3.40 (0.58)	3.45 (0.57)	3.44 (0.57)
Life satisfaction over family income	2.50 (0.79)	2.68 (0.80)	2.94 (0.73)	3.02 (0.69)	3.09 (0.67)
Life satisfaction over leisure time	2.70 (0.80)	2.91 (0.79)	3.12 (0.68)	3.17 (0.68)	3.23 (0.66)
Life satisfaction over living environment	3.14 (0.74)	3.26 (0.76)	3.37 (0.65)	3.48 (0.65)	3.52 (0.60)
Life satisfaction over relationship with family	3.63 (0.64)	3.66 (0.64)	3.60 (0.59)	3.65 (0.59)	3.68 (0.55)
Life satisfaction over relationship with relatives	3.44 (0.64)	3.43 (0.63)	3.50 (0.58)	3.46 (0.59)	3.49 (0.55)
Life satisfaction over social relationship	3.41 (0.62)	3.39 (0.62)	3.49 (0.57)	3.48 (0.59)	3.48 (0.57)
Observations	6073	5947	5639	5131	4761

Source: Author's own calculation using the KLIPS data (waves 3–22) using the longitudinal individual weight.
Notes: Standard deviations are in parentheses. Monetary units are in KRW 1 million using 2020 as the base year.

Table 2: Life satisfaction insurance parameter estimates

	(1) All	(2) 2002–08	(3) 2009–19
φ (Life satisfaction insurance parameter for permanent income shocks)	0.471 (0.053)	0.595 (0.090)	0.361 (0.063)
ψ (Life satisfaction insurance parameter for transitory income shocks)	0.049 (0.016)	0.043 (0.022)	0.056 (0.024)

Note: Standard errors clustered at the individual level are reported in parentheses.

Table 3: Domain-specific life satisfaction insurance parameter estimates

	(1) Family income	(2) Leisure activities	(3) Living environment	(4) Relationship with family	(5) Relationship with relatives	(6) Relationship with other social
φ (Permanent income)	0.999 (0.070)	0.471 (0.063)	0.358 (0.057)	0.413 (0.053)	0.338 (0.051)	0.294 (0.050)
ψ (Transitory income)	0.053 (0.019)	0.019 (0.020)	0.014 (0.018)	-0.013 (0.016)	-0.006 (0.016)	-0.0001 (0.016)

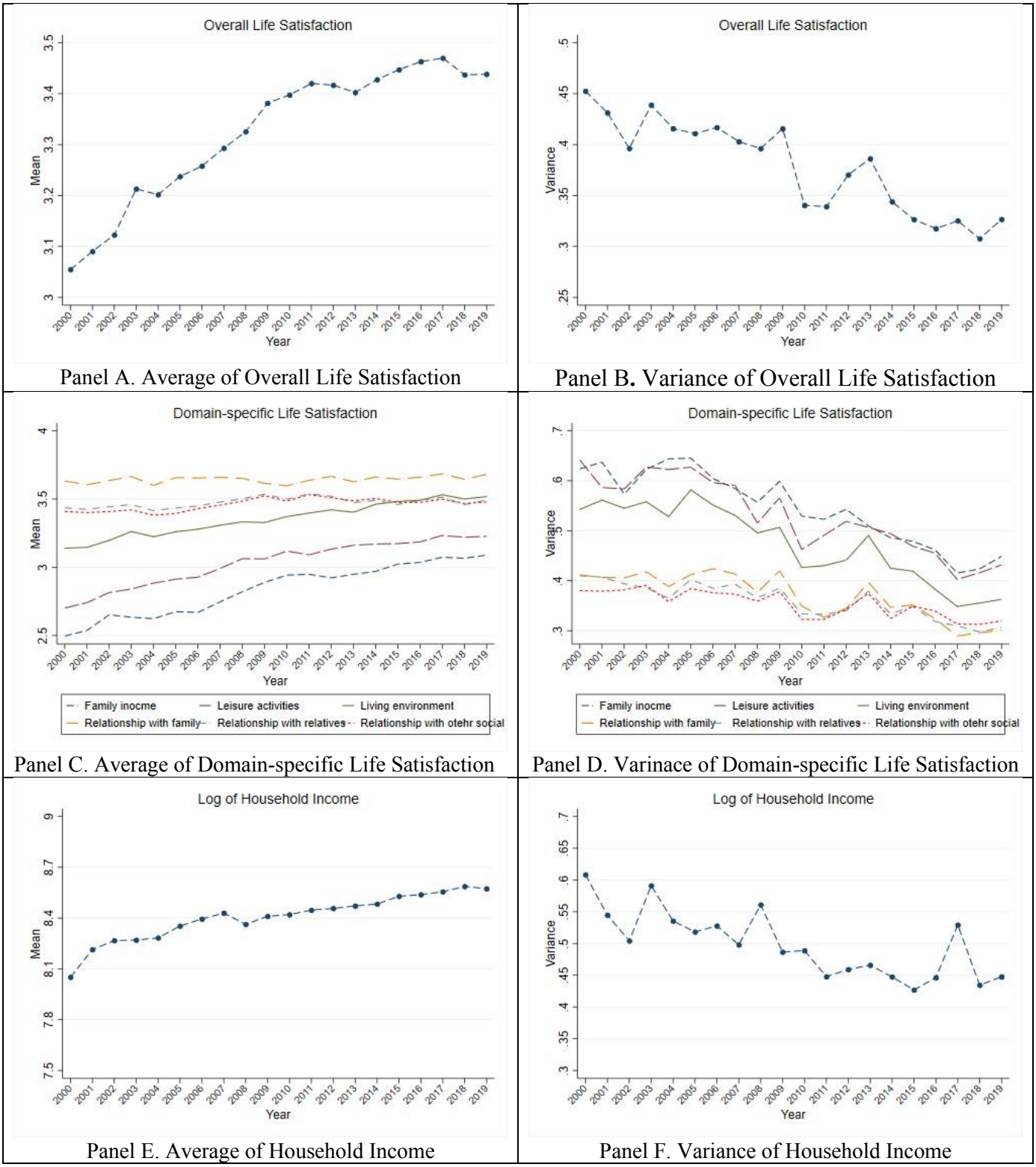
Note: Standard errors clustered at the individual level are reported in parentheses.

Table 4: Life satisfaction insurance parameter estimates by demographic characteristics

	(1) Age < 45	(2) Age ≥ 45	(3) College and above	(4) High school and below	(5) Male	(6) Female
φ (Permanent income)	0.520 (0.082)	0.436 (0.069)	0.421 (0.082)	0.496 (0.068)	0.539 (0.072)	0.378 (0.077)
ψ (Transitory income)	0.046 (0.024)	0.051 (0.021)	0.005 (0.030)	0.067 (0.019)	0.030 (0.020)	0.079 (0.026)

Note: Standard errors clustered at the individual level are reported in parentheses.

Figures



Panel A. Average of Overall Life Satisfaction

Panel B**.** Variance of Overall Life Satisfaction

Panel C. Average of Domain-specific Life Satisfaction

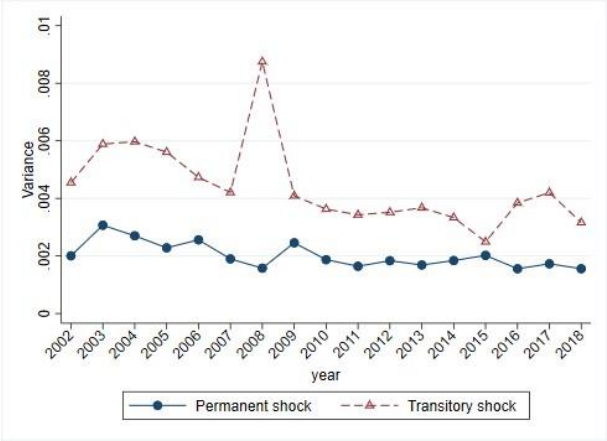
Panel D. Varinace of Domain-specific Life Satisfaction

Panel E. Average of Household Income

Panel F. Variance of Household Income

Source: Author's own calculation using the 2000–2019 KLIPS data

Figure 1: Trends of average and variance in overall life satisfaction and household income



Source: Author's calculation using the 2000–2019 KLIPS data

Figure 2: The evolution of variances of permanent and transitory income shocks

Appendix

A.1 Trends in life satisfaction by individual characteristics

Figure A2 depicts trends in overall life satisfaction by birth cohort, education level, wealth status, and gender. Panel A illustrates the life satisfaction trends of respondents born in the birth cohorts 1940s, 1950s, 1960s, 1970s, and 1980s, respectively. The figures indicate an increasing trend in overall life satisfaction for all cohorts and show significant gaps across different birth cohorts. It reflects large cohort differences in life experiences and circumstances due to the rapid economic growth and social changes in Korea. Panel B reports a substantial gap in overall life satisfaction between less-educated individuals and more-educated ones. However, it is noteworthy that the gap has been narrowing over the last two decades, which could reflect expanded social insurance and welfare benefits for low-skilled workers in Korea (Ahn et al., 2021). Panel C illustrates trends in overall life satisfaction by household net worth. We observe an increasing trend for both the high-wealth group and the low-wealth group. Consistent with existing literature (Bayer & Juessen, 2015; Clark et al., 2019), we confirm that people with higher wealth are more satisfied with their lives. Panel D depicts trends in overall life satisfaction by gender. We observe that life satisfaction levels have risen regardless of gender. However, we find diverging trends between males and females from the 2010s. Unlike previous studies, the gender difference in Korea appears to be negligible; if anything, women's life satisfaction levels are slightly higher than men's over time.

A.2. Comparison with selected other countries

In Figure A3, we illustrate trends in life satisfaction for selected countries (United States, United Kingdom, Australia, Japan, and Germany). Panel A presents trends using the Gallup World Poll data for 2006–2018. Over the last 20 years, the U.S., European countries, and Australia all show relatively stable trends in the Cantrii Life Ladder scale. In Japan, it has been steadily decreasing, potentially reflecting the so-called "lost 20 years." Panels B to F show the trends of life satisfaction using large-scale, nationally representative panel data in these countries. Panel B shows that life satisfaction has been decreasing in the US, as shown by data from the General Social Survey. As shown in Panels C and D, we find that the U.K. and Australia have experienced stable trends of life satisfaction using the data from the British Household Panel Survey (BHPS) and Household Income and Labour Dynamics (HILDA), respectively. Suzuki (2009) also documented that Japan has stable trends in life satisfaction using data from the Survey of Life of the People. Unfortunately, we cannot document this trend as we do not have access to the Japanese data. By contrast, Panel F indicates that Germany has experienced a modest increase in life satisfaction by using data from the Socio-Economic Panel. Thus, we argue that the increasing trend in life satisfaction in Korea is quite distinctive.

[Figure A3]

A.3. Auto-covariances of income, life satisfaction, and life satisfaction-income growth

In this section, we present the estimation results (1) auto-covariance of income growth in Table A2, (2) auto-covariance of life satisfaction growth in Table A3, and (3) covariance of life satisfaction-income growth in Table A4.

We report the moments required to estimate the life satisfaction insurance parameters. The estimation of the auto-covariance structure of income and life satisfaction removed the influences of the observables, which include year-fixed effects and time-varying characteristics—educational attainment, number of children, household size, employment status, and residence areas (province). We isolate the unexplained components of income ($y_{i,t}$) by estimating Equation (1). Likewise, we isolate the unexplained components of life satisfaction ($LS_{i,t}$). Table A2 reports the auto-covariance matrix of income innovation in Korea from 2001 to 2019. We find that the variance of the first difference in unexplained income is steadily going down from 0.458 in 2001 to 0.138 in 2019 but with slight variations. As such, the size of income risks has declined by more than half over the 20-year period. The second-order and third-order auto-covariances shown in Columns (2) and (3) of Table A2 suggest that the income process follows an MA(1) process.

We then proceed to the life satisfaction process and report the auto-covariance matrix of life satisfaction innovation in Table A3. Column (1) shows that the variance of the first difference in the unexplained component of life satisfaction steadily and almost monotonically goes down from 0.071 in 2001 to 0.028 in 2019. The reduction in this variation has decreased by one-half in the last 20 years. These estimates are useful in inferring the degree of life satisfaction insurance and the extent of measurement error. Column (2) shows that the first-order autocovariance of life satisfaction growth is decreasing

over time, likely reflecting improved life satisfaction insurance and reduced variances of unexplained income documented in Table A3. Column (3) shows the second-order auto-covariances of life satisfaction growth, which is small in magnitude and statistically insignificant.

Table A4 reports the auto-covariance matrix of life satisfaction and income growth. It investigates the relationship between components of income and life satisfaction innovations. In Column (1), the covariance between income and life satisfaction growth becomes steadily smaller with slight, yet insignificant, variations. In addition, we examine whether the future income difference would covary with the current life satisfaction difference in Column (2). The covariance should be zero unless information about future income shock is available to individuals in advance and only partial insurance exists for transitory shocks. The estimated magnitudes are small and statistically insignificant, implying that individuals are insured for transitory income shocks and that future income shock information is not available to individuals in advance. Column (3) shows that the current income growth covaries with future life satisfaction growth, which is small in magnitude. In short, we present evidence that the variances of unexplained components of income and life satisfaction decreased simultaneously and almost monotonically in Korea.

A.4. Identification of life satisfaction insurance parameters

The estimation of life satisfaction insurance parameters follows a methodology adapted from Blundell, Pistaferri, and Preston (2008). Full details can be checked in their paper. This approach decomposes observed changes in income and life satisfaction into their permanent and transitory components and estimates the degree of insurance available against these shocks. We use the notations as similar as Blundell, Pistaferri, and Preston (2008) to minimize confusion. Below, we outline the step-by-step procedure used in this study:

1. Decomposition of Income into Permanent and Transitory Components

We assume that log income ($log\ Y_{i,t}$) can be decomposed into three components:

$$log\ Y_{i,t} = Z_{i,t} \cdot \varphi_t + P_{i,t} + v_{i,t}. \quad (1)$$

where *Z* denotes observable characteristics such as age, gender, education, province of residence, household size, the number of children, and employment status. *P* denotes a permanent unobservable component, and *v* is a transitory unobservable component. We also assume that the permanent component (P) has the random walk process as follows:

$$P_{i,t} = P_{i-1,t} + \zeta_{i,t}\ , (2),$$

where ζ is an *i.i.d.* shock drawn from a normal distribution $N(0, \sigma_\zeta^2)$. The transitory component (v) is assumed to follow an MA (1) process:[19]

$$v_{i,t} = \sum_{j=0}^{q} \Theta_j \varepsilon_{i,t-j}\ , \quad (3),$$

with $\Theta_0 \equiv 1$.

According to the above-stated assumptions, the unexplained income innovation can be described as follows:

$$\Delta y_{i,t} = \zeta_{i,t} + \Delta v_{i,t}\ , \quad (4),$$

[19] We also conduct the same exercise using the MA(2) process. The results reported in Table A1 remain robust.

where $y_{i,t}$ is $logY_{i,t} - Z_{i,t}\phi_t$, that is, the unexplained log-transformed income.

2. Decomposition of Life Satisfaction

We similarly isolate the unexplained component of life satisfaction using equation (1)

$LS_{i,t} = Z_{i,t} \cdot \gamma_t + \omega_{i,t}$

where $\omega_{i,t}$ represents the unexplained variation in life satisfaction.

3. Derivation of the Unexplained Change in Life Satisfaction

Based on the above equations, we can express the unexplained change in life satisfaction as follows:

$$\Delta LS_{i,t} = \phi_{i,t} \cdot \zeta_{I,t} + \psi_{i,t} \cdot \varepsilon_{i,t} + \xi_{i,t}\,, \qquad (5),$$

where *ΔLS* is the unexplained change in log-transformed life satisfaction. The specification in Equation (5) implies that a one percent increase in the permanent income shock (ζ**)** and temporary income shock (ε) affects the change in residual life satisfaction by ϕ percent and ψ percent, respectively. $\xi_{i,t}$ is an *i.i.d.* error term.

4. Covariance Structure for Identification

The minimum distance estimator leverages the auto-covariance structure of the residuals to identify the variances of the income components (σ_ζ^2 for permanent income shocks and σ_ε^2 for transitory income shocks) and their corresponding insurance parameters:

$$\phi = \frac{Cov(\Delta LS_{i,t}, \Delta y_{i,t})}{Var(\Delta y_{i,t})},$$

$$\psi = \frac{Cov(\Delta LS_{i,t}, v_{i,t})}{Var(v_{i,t})}$$

These parameters represent the degree to which permanent (ϕ\phiϕ) and transitory (ψ\psiψ) income shocks affect life satisfaction.

5. Moment Conditions

We construct moment conditions based on the observed auto-covariances of income and life satisfaction growth. Specifically, from Equations (1)–(5), one can derive the following:

$$\text{cov}(\Delta y_t, \Delta y_{t+s}) = \text{var}(\zeta_t) + \text{var}(\Delta v_t) \text{ if s = 0} \quad \text{(A1)}$$

$$= \text{cov}(\Delta v_t, \Delta v_{t+s}) \text{ if s} \neq 0$$

where *s* refers to the time distance from t (e.g., t+1 or t+2), var(.) and cov(.) represent cross-sectional variances and covariances, respectively.

In addition, based on Equation (5), we can derive the formula for life satisfaction growth inequality as follows:

$$\text{cov}(\Delta ls_t, \Delta ls_{t+s}) = \phi_t^2 \text{var}(\zeta_t) + \psi_t^2 \text{ var}(\varepsilon_t) + \text{var}(\xi_t) \quad \text{(A2)}$$

for s=0, and zero otherwise.

This equation shows that consumption growth inequality is a function of (1) life satisfaction insurance parameters, (2) variance of permanent income shocks, (3) variance of temporary income shocks, and (4) variance of the i.i.d. life satisfaction shocks.

Using Equation (A2), one can also derive an additional moment as follows:

$$\Delta\text{var}(\Delta ls_t) = \Delta\phi_t^2 \text{var}(\zeta_t) + \phi_{t-1}^2 \Delta\text{var}(\zeta_t) + \Delta\psi_t^2 \text{ var}(\varepsilon_t) + \psi_{t-1}^2 \Delta\text{var}(\xi_t) \quad \text{(A3)}$$

This equation shows how the variance of life satisfaction innovation changes over time. The covariance between consumption innovation and income innovation can be written as follows:

$$\text{cov}(\Delta ls_t, \Delta y_{t+s}) = \phi_t \text{var}(\zeta_t) + \psi_t \text{var}(\varepsilon_t) \text{ if s = 0} \quad \text{(A4)}$$

$$= \psi_t \text{cov}(\varepsilon_t, \Delta v_{t+s}) \text{ if s >0}$$

6. Estimation

The estimation of the insurance parameters (ϕ for permanent shocks and ψ for transitory shocks) uses a minimum distance approach, which aligns the theoretical moments derived from the model with their empirical counterparts observed in the data. The process involves the following steps.

6.1. Empirical Moments

We compute the empirical moments of income and life satisfaction growth using the auto-covariance structure of their unexplained components as stated above. These moments include: 1) the variance of income growth and its lags, 2) the covariance between income growth and life satisfaction growth, 3) the variance and covariance of life satisfaction growth and its lags. These moments capture the joint dynamics of income and life satisfaction in the presence of permanent and transitory shocks.

6.2. Theoretical Moments

Using the model equations, we derive the theoretical expressions for the variances and covariances of income and life satisfaction growth. For example, the variance of income growth is $Var(\Delta y_{it}) = \sigma_\zeta^2 + \sigma_\varepsilon^2$, the covariance of life satisfaction growth and income

growth is $Cov(\Delta\, LS_{i,t}, \Delta y_{i,t}) = \phi\sigma_\zeta^2$, the variance of life satisfaction growth is: $Var(\Delta\, LS_{it}) = \phi^2\sigma_\zeta^2 + \varphi^2\sigma_\varepsilon^2 + \sigma_\omega^2$. These theoretical moments depend on the parameters of interest.

6.3.Objective Function

The minimum distance estimator minimizes the distance between the empirical moments and the theoretical moments. Specifically, the objective function is: $Q(\theta) = [\hat{m} - m(\theta)]'W[\hat{m} - m(\theta)]$,

where $\hat{m}$ is the vector of empirical moments. $m(\theta)$ is the vector of theoretical moments based on the parameter vector θ. W is a weighting matrix, typically chosen as the inverse of the covariance matrix of the empirical moments or equally-weighted one.

7. Standard Errors

Standard errors are computed standard errors are computed using the Hessian of the objective function or through bootstrap methods.

Table A1: Variance of transitory income (σ_ε^2)

	MA (1)	MA (2)
Year	(1)	(2)
2001	0.0077 (0.0007)	0.0003 (0.0004)
2002	0.0045 (0.0004)	0.0013 (0.0005)
2003	0.0059 (0.0007)	0.0004 (0.0004)
2004	0.0060 (0.0006)	0.0001 (0.0003)
2005	0.0056 (0.0006)	0.0004 (0.0004)
2006	0.0047 (0.0005)	0.0002 (0.0003)
2007	0.0042 (0.0003)	-0.0004 (0.0003)
2008	0.0087 (0.0010)	0.0006 (0.0003)
2009	0.0041 (0.0005)	0.0000 (0.0003)
2010	0.0036 (0.0003)	0.0003 (0.0002)
2011	0.0034 (0.0004)	0.0004 (0.0002)
2012	0.0035 (0.0004)	0.0004 (0.0002)
2013	0.0037 (0.0003)	0.0004 (0.0002)
2014	0.0033 (0.0004)	0.0002 (0.0002)
2015	0.0025 (0.0002)	0.0004 (0.0002)
2016	0.0038 (0.0004)	-0.0003 (0.0002)
2017	0.0042 (0.0004)	0.0001 (0.0002)
2018	0.0032 (0.0004)	NA

Table A2: Auto-covariance of income growth

	$\text{var}(\Delta y_t)$		$\text{cov}(\Delta y_{t+1}, \Delta y_t)$		$\text{cov}(\Delta y_{t+2}, \Delta y_t)$	
	(1)		(2)		(3)	
Year	*Coef.*	*Std. Err.*	*Coef.*	*Std. Err.*	*Coef.*	*Std. Err.*
2001	0.4604***	(0.0298)	-0.1498***	(0.0139)	-0.0063	(0.0079)
2002	0.3096***	(0.0174)	-0.0853***	(0.0080)	-0.0231**	(0.0082)
2003	0.2566***	(0.0123)	-0.1068***	(0.0121)	-0.0067	(0.0061)
2004	0.2697***	(0.0150)	-0.1046***	(0.0112)	-0.0022	(0.0056)
2005	0.2478***	(0.0162)	-0.0959***	(0.0101)	-0.0072	(0.0069)
2006	0.2560***	(0.0176)	-0.0817***	(0.0080)	-0.0029	(0.0056)
2007	0.2105***	(0.0102)	-0.0746***	(0.0060)	0.0064	(0.0053)
2008	0.2734***	(0.0196)	-0.1595***	(0.0187)	-0.0102*	(0.0051)
2009	0.2808***	(0.0189)	-0.0766***	(0.0096)	-0.0006	(0.0050)
2010	0.1908***	(0.0106)	-0.0662***	(0.0059)	-0.0056	(0.0039)
2011	0.1687***	(0.0099)	-0.0617***	(0.0066)	-0.0071	(0.0041)
2012	0.1641***	(0.0091)	-0.0629***	(0.0070)	-0.0063	(0.0034)
2013	0.1694***	(0.0091)	-0.0653***	(0.0060)	-0.0059	(0.0038)
2014	0.1616***	(0.0086)	-0.0596***	(0.0065)	-0.0032	(0.0029)
2015	0.1505***	(0.0089)	-0.0448***	(0.0041)	-0.0059	(0.0036)
2016	0.1464***	(0.0088)	-0.0678***	(0.0072)	0.0047	(0.0033)
2017	0.1736***	(0.0102)	-0.0744***	(0.0076)	-0.0019	(0.0036)
2018	0.1609***	(0.0096)	-0.0578***	(0.0074)	NA	NA
2019	0.1529***	(0.0116)	NA	NA	NA	NA

Note: *, **, *** denote p<0.1, <0.05, <0.01, respectively.

Table A3: Auto-covariance of life satisfaction growth

	$\text{var}(\Delta ls_t)$		$\text{cov}(\Delta ls_{t+1}, \Delta ls_t)$		$\text{cov}(\Delta ls_{t+2}, \Delta ls_t)$	
	(1)		(2)		(3)	
Year	*Coef.*	*Std. Err.*	*Coef.*	*Std. Err.*	*Coef.*	*Std. Err.*
2001	0.5199***	(0.0140)	-0.2272***	(0.0103)	-0.0228*	(0.0096)
2002	0.4613***	(0.0123)	-0.1849***	(0.0091)	-0.0089	(0.0090)
2003	0.4787***	(0.0128)	-0.2281***	(0.0106)	-0.0110	(0.0089)
2004	0.4870***	(0.0133)	-0.2081***	(0.0096)	-0.0054	(0.0084)
2005	0.4607***	(0.0118)	-0.2057***	(0.0096)	-0.0140	(0.0086)
2006	0.4411***	(0.0123)	-0.2113***	(0.0093)	0.0161*	(0.0077)
2007	0.4680***	(0.0118)	-0.2129***	(0.0095)	-0.0036	(0.0083)
2008	0.4347***	(0.0114)	-0.1942***	(0.0091)	-0.0090	(0.0084)
2009	0.4607***	(0.0122)	-0.2208***	(0.0095)	0.0062	(0.0081)
2010	0.4427***	(0.0115)	-0.1880***	(0.0084)	-0.0032	(0.0078)
2011	0.3942***	(0.0106)	-0.1793***	(0.0085)	-0.0089	(0.0074)
2012	0.3813***	(0.0103)	-0.1759***	(0.0080)	0.0069	(0.0071)
2013	0.3903***	(0.0108)	-0.1772***	(0.0086)	0.0069	(0.0069)
2014	0.3495***	(0.0100)	-0.1539***	(0.0071)	0.0043	(0.0067)
2015	0.3318***	(0.0092)	-0.1514***	(0.0072)	0.0031	(0.0066)
2016	0.3128***	(0.0091)	-0.1358***	(0.0069)	-0.0006	(0.0066)
2017	0.3170***	(0.0093)	-0.1528***	(0.0069)	0.0076	(0.0061)
2018	0.3161***	(0.0090)	-0.1376***	(0.0068)	NA	NA
2019	0.3161***	(0.0089)	NA	NA	NA	NA

Note: *, **, *** denote p<0.1, <0.05, <0.01, respectively.

Table A4: Auto-covariance of life satisfaction-income growth

	$\text{cov}(\Delta y_t, \Delta ls_t)$		$\text{cov}(\Delta y_{t+1}, \Delta ls_t)$		$\text{cov}(\Delta y_t, \Delta ls_{t+1})$	
	(1)		(2)		(3)	
Year	*Coef.*	*Std. Err.*	*Coef.*	*Std. Err.*	*Coef.*	*Std. Err.*
2001	-0.0006	(0.0098)	-0.0147*	(0.0071)	0.0367***	(0.0087)
2002	-0.0064	(0.0067)	-0.0046	(0.0064)	0.0349***	(0.0079)
2003	-0.0083	(0.0066)	-0.0143*	(0.0072)	0.0278***	(0.0068)
2004	0.0144*	(0.0065)	0.0009	(0.0062)	0.0185**	(0.0067)
2005	-0.0031	(0.0065)	0.0047	(0.0063)	0.0186**	(0.0062)
2006	0.0055	(0.0060)	-0.0079	(0.0053)	0.0214***	(0.0058)
2007	0.0001	(0.0055)	-0.0061	(0.0066)	0.0182***	(0.0054)
2008	0.0084	(0.0061)	-0.0092	(0.0071)	0.0218***	(0.0066)
2009	0.0008	(0.0072)	-0.0044	(0.0059)	0.0187**	(0.0066)
2010	0.0063	(0.0055)	-0.0063	(0.0051)	0.0093	(0.0051)
2011	0.0025	(0.0048)	-0.0006	(0.0046)	0.0099*	(0.0048)
2012	-0.0041	(0.0046)	0.0022	(0.0048)	0.0203***	(0.0051)
2013	-0.0002	(0.0048)	0.0007	(0.0047)	0.0090*	(0.0044)
2014	0.0043	(0.0045)	-0.0024	(0.0044)	0.0079	(0.0045)
2015	0.0051	(0.0045)	-0.0043	(0.0040)	0.0088*	(0.0039)
2016	-0.0025	(0.0040)	-0.0028	(0.0041)	0.0201***	(0.0038)
2017	-0.0000	(0.0044)	-0.0086	(0.0045)	0.0126**	(0.0045)
2018	0.0097*	(0.0045)	-0.0045	(0.0046)	0.0180***	(0.0047)
2019	0.0007	(0.0050)	NA	NA	NA	NA

Note: *, **, *** denote p<0.1, <0.05, <0.01, respectively.

Table A5: Life satisfaction insurance parameter estimates using alternative definitions of life satisfaction

	(1) Logarithm (log of life satisfaction score)	(2) Binary indicator (1 if satisfied or very satisfied and 0 otherwise)	(3) Standard deviation (life satisfaction score divided by its standard deviation)
φ (Permanent income shocks)	0.144 (0.017)	0.341 (0.040)	0.758 (0.085)
ψ (Transitory income shocks)	0.019 (0.005)	0.016 (0.012)	0.079 (0.256)

Note: Standard errors clustered at the individual level are reported in parentheses.

Table A6: Life satisfaction insurance parameter estimates over time

	Year	(1)
φ (Permanent income shocks)	2002–2008	0.595 (0.090)
	2009–2014	0.365 (0.083)
	2015–2019	0.355 (0.093)
ψ (Transitory income shocks)	2002–2008	0.043 (0.022)
	2009–2014	0.034 (0.031)
	2015–2019	0.092 (0.036)

Note: Standard errors clustered at the individual level are reported in parentheses.

Table A7: Domain-specific life satisfaction insurance parameter estimates

	Year	Family income	Leisure activities	Living environment	Relationship with family	Relationship with relatives	Relationship with other social
φ (Permanent income)	2002–08	1.199 (0.123)	0.407 (0.103)	0.492 (0.093)	0.612 (0.090)	0.485 (0.085)	0.420 (0.083)
	2009–19	0.823 (0.081)	0.528 (0.078)	0.239 (0.070)	0.237 (0.063)	0.208 (0.063)	0.181 (0.062)
ψ (Transitory income)	2001–08	0.050 (0.025)	0.018 (0.027)	-0.015 (0.025)	-0.046 (0.022)	-0.019 (0.022)	-0.018 (0.021)
	2009–19	0.058 (0.027)	0.020 (0.029)	0.053 (0.027)	0.033 (0.024)	0.013 (0.024)	0.024 (0.024)

Note: Standard errors clustered at the individual level are reported in parentheses.

Table A8: Life satisfaction insurance parameter estimates by demographic characteristics

	Year	(0) Baseline	(1) Age < 45	(2) Age ≥ 45	(3) College and above	(4) High school and below	(5) Male	(6) Female
φ (Permanent income)	2002–08	0.595 (0.090)	0.648 (0.126)	0.549 (0.127)	0.651 (0.176)	0.577 (0.104)	0.646 (0.120)	0.523 (0.133)
	2009–19	0.361 (0.063)	0.378 (0.105)	0.352 (0.078)	0.303 (0.089)	0.403 (0.087)	0.442 (0.086)	0.256 (0.091)
ψ (Transitory income)	2001–08	0.043 (0.022)	0.033 (0.031)	0.053 (0.030)	-0.005 (0.046)	0.058 (0.025)	0.028 (0.027)	0.069 (0.036)
	2009–19	0.056 (0.024)	0.069 (0.039)	0.049 (0.029)	0.014 (0.039)	0.082 (0.029)	0.032 (0.030)	0.092 (0.038)

Note: Standard errors clustered at the individual level are reported in parentheses.

Table A9: Life satisfaction insurance parameter estimates
(using equivalised household income)

	(1) All	(2) 2002–08	(3) 2009–19
Panel A. equivalised household income using the square root scale			
φ (Permanent income shocks)	0.467 (0.533)	0.588 (0.089)	0.357 (0.064)
ψ (Transitory income shocks)	0.043 (0.016)	0.044 (0.022)	0.043 (0.024)
Panel B. equivalised household income using the OECD equivalence scale			
φ (Permanent income shocks)	0.470 (0.055)	0.592 (0.090)	0.356 (0.067)
ψ (Transitory income shocks)	0.038 (0.016)	0.042 (0.022)	0.033 (0.023)

Notes: Standard errors clustered at the individual level are reported in parentheses. Panel A shows the results using the equivalised household income defined as household income divided by the square root of the number of household members. Panel B shows the results using the equivalised household income divided by the OECD equivalence scale, which assigns a value of 1 to the first household member, of 0.7 to each additional adults, and of 0.5 to each child.

Table A10: Domain-specific life satisfaction insurance parameter estimates by demographic characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
	Age < 45	Age ≥ 45	College and above	High school and below	Male	Female
Panel A. Overall life satisfaction						
φ (Permanent income)	0.520***	0.436***	0.421***	0.496***	0.539***	0.378***
	(0.0816)	(0.0692)	(0.0821)	(0.0681)	(0.0723)	(0.0770)
ψ (Transitory income)	0.0463*	0.0509**	0.0671***	0.0671***	0.0300	0.0790***
	(0.0243)	(0.0212)	(0.0189)	(0.0189)	(0.0201)	(0.0262)
Panel B. Life satisfaction about family income						
φ (Permanent income)	1.149***	0.893***	0.844***	1.078***	1.068***	0.907***
	(0.111)	(0.0909)	(0.106)	(0.0926)	(0.0966)	(0.102)
ψ (Transitory income)	0.0453	0.0597**	0.0726***	0.0726***	0.0324	0.0869***
	(0.0282)	(0.0245)	(0.0220)	(0.0220)	(0.0234)	(0.0304)
Panel C. Life satisfaction about leisure activities						
φ (Permanent income)	0.598***	0.381***	0.366***	0.525***	0.532***	0.389***
	(0.100)	(0.0821)	(0.0973)	(0.0826)	(0.0863)	(0.0936)
ψ (Transitory income)	0.0259	0.0132	0.0373	0.0373	0.0042	0.0420
	(0.0302)	(0.0264)	(0.0237)	(0.0237)	(0.0249)	(0.0329)
Panel D. Life satisfaction about living environment						
φ (Permanent income)	0.407***	0.323***	0.277***	0.399***	0.369***	0.342***
	(0.0900)	(0.0731)	(0.0883)	(0.0732)	(0.0761)	(0.0854)
ψ (Transitory income)	-0.0046	0.0286	0.0270	0.0270	-0.0052	0.0446
	(0.0274)	(0.0241)	(0.0215)	(0.0215)	(0.0226)	(0.0301)
Panel E. Life satisfaction about relationship with family						
φ (Permanent income)	0.345***	0.461***	0.271***	0.485***	0.394***	0.439***
	(0.0819)	(0.0689)	(0.0815)	(0.0683)	(0.0705)	(0.0789)
ψ (Transitory income)	0.0358	-0.0507**	-0.0100	-0.0100	-0.040**	0.0313
	(0.0251)	(0.0210)	(0.0193)	(0.0193)	(0.0203)	(0.0266)
Panel F. Life satisfaction about relationship with relatives						
φ (Permanent income)	0.332***	0.342***	0.277***	0.369***	0.353***	0.318***
	(0.0799)	(0.0672)	(0.0788)	(0.0666)	(0.0696)	(0.0759)
ψ (Transitory income)	0.0021	-0.0115	0.0089	0.0089	-0.0397*	0.0490*
	(0.0248)	(0.0216)	(0.0194)	(0.0194)	(0.0205)	(0.0266)
Panel G. Life satisfaction about relationship with others						
φ (Permanent income)	0.278***	0.304***	0.253***	0.314***	0.288***	0.301***
	(0.0786)	(0.0658)	(0.0792)	(0.0647)	(0.0678)	(0.0753)
ψ (Transitory income)	0.0222	-0.0176	0.0002	0.0002	-0.0036	0.0054
	(0.0243)	(0.0206)	(0.0186)	(0.0186)	(0.0198)	(0.0259)

Note: Standard errors clustered at the individual level are reported in parentheses.

Table A11: Regression analysis with individual and time fixed effects

	(1) life satisfaction	(2) life satisfaction
log (household income)	0.0968***	0.0961***
	(0.0059)	(0.0061)
Observations	99,235	99,235
R-squared	0.430	0.433
Control Variables	No	Yes
Year FE	Yes	Yes
Individual FE	Yes	Yes

Notes: Standard errors clustered at the individual level are reported in parentheses. Control variables include age, education attainment, province of residence, number of children, household size, and employment status. *** p<0.01, ** p<0.05, * p<0.1

Table A12: Life satisfaction insurance parameter after controlling for health status

	(1) Baseline	(2) Subjective health status	(3) Risky health behaviors (smoking, drinking)	(4) Subjective health status and risky health behaviors
φ (permanent income shocks)	0.471	0.395 (0.057)	0.429 (0.061)	0.375 (0.061)
	(0.053)			
ψ (transitory income shocks)	0.049	0.069 (0.017)	0.050 (0.019)	0.082 (0.018)
	(0.016)			

Notes: Standard errors clustered at the individual level are reported in parentheses. In columns (2) and (3), we report the parameter estimates where we control for self-reported health status and risky health behaviors (smoking and drinking) as a part of observable characteristics, respectively. In column (4), both subjective health status and risky health behaviors.

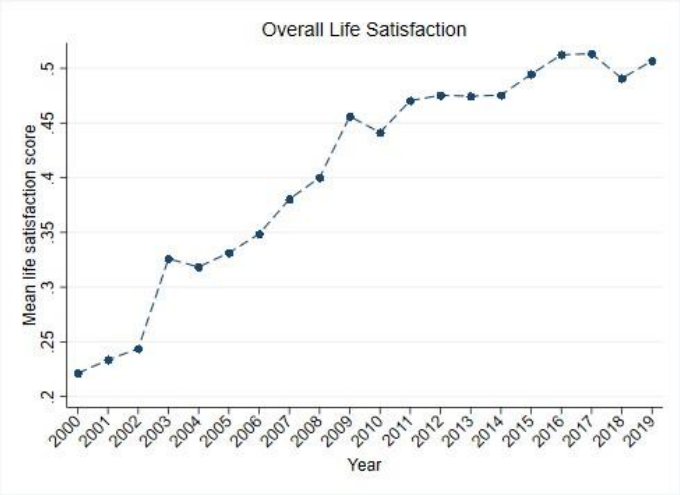
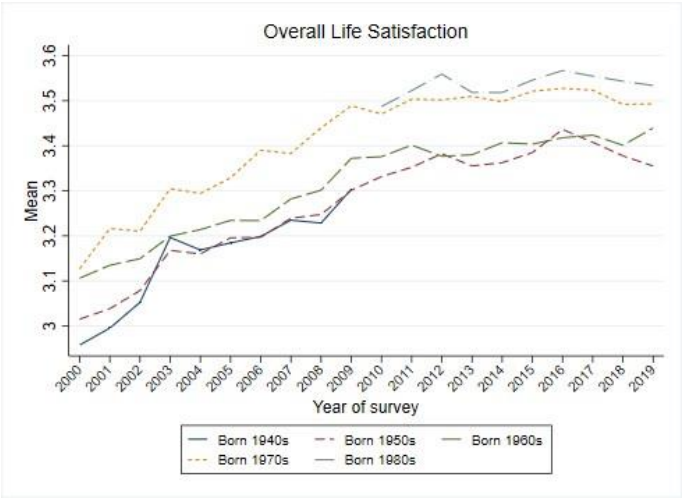
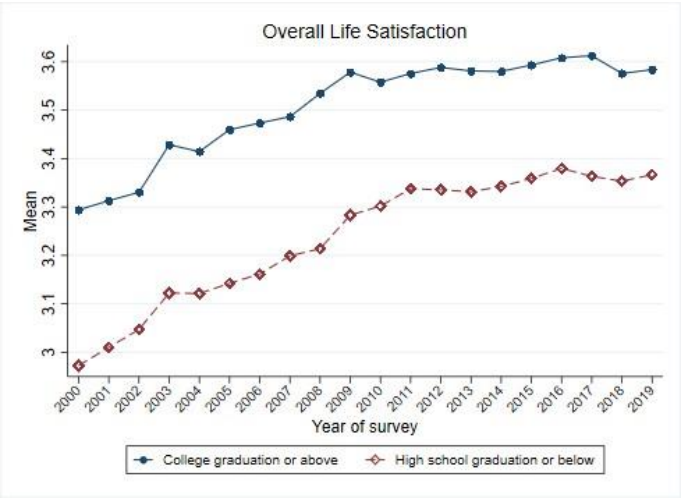


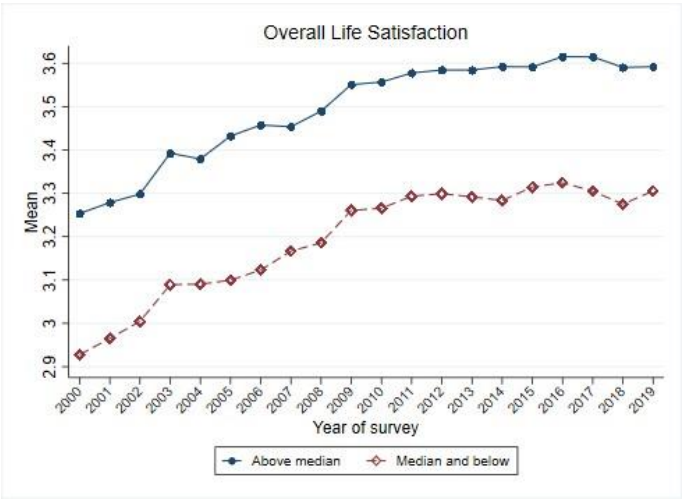
Figure A1: Trends of binary indicators whether satisfied or very satisfied



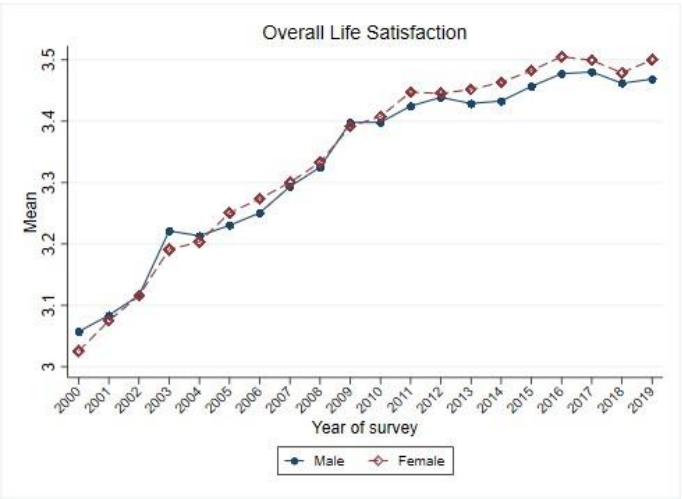
Panel A: Overall life satisfaction by birth cohort



Panel B: Overall life satisfaction by education level

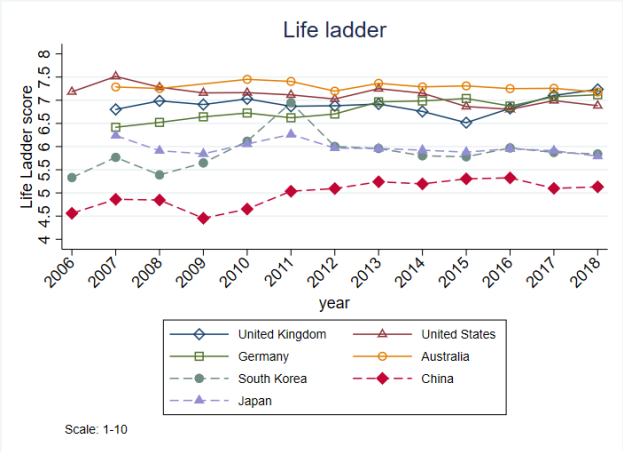


Panel C: Overall life satisfaction by net worth

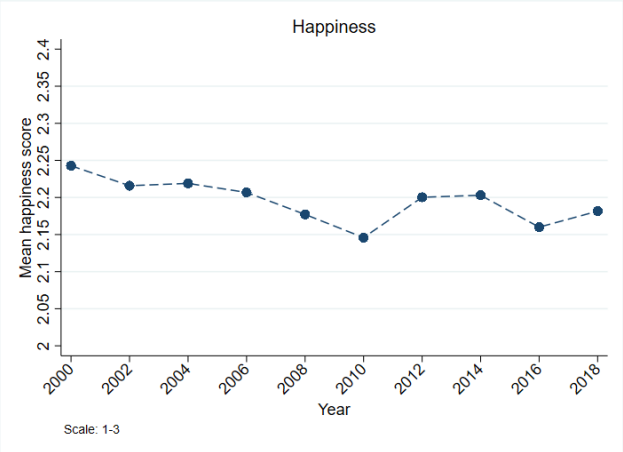


Panel D: Overall life satisfaction by gender

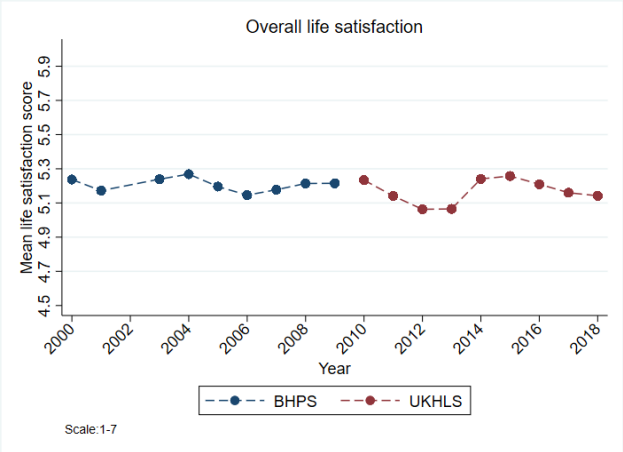
Figure A2: Trend in Overall life satisfaction by individual characteristics



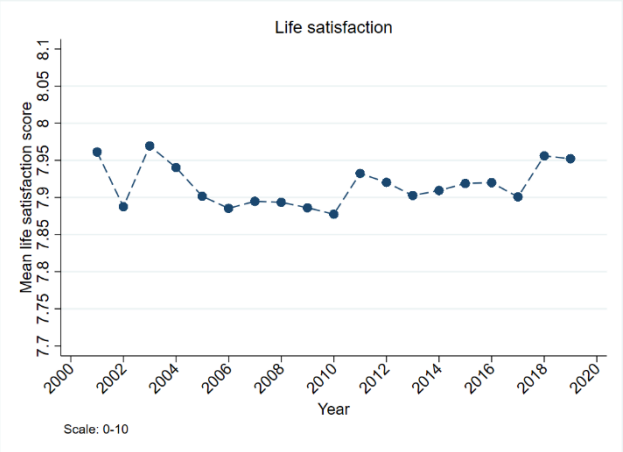
Panel A: Gallup World Poll



Panel B: General Social Survey, United States



Panel C: British Household Panel Survey, United Kingdom



Panel D: Household Income and Labour Dynamics, Australia

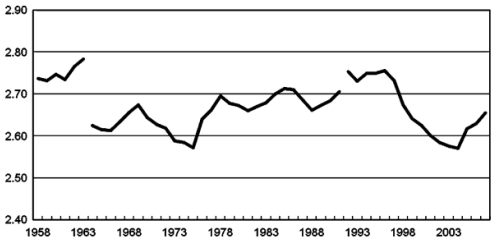


Fig. 2 Score of life satisfaction in the Survey of Life of the People, three-point moving average, 1958–2007. *Note*: Two-point moving average at the starts and the ends of the lines

Panel E: Survey of Life of the People, Japan
Source: Suzuki (2009, p.85)

Panel F: German Socio-Economic Panel, Germany

Figure A3: Life Satisfaction trends in selected other countries