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Economic Determinants of Mental Health and Well-Being:

Evidence from Income Dynamics, Public Health Shocks, and Fertility Policy Reform in China

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Abstract

Understanding the determinants of mental health and subjective well-being has become an increasingly important topic in economics. Although a growing body of research attempts to identify the factors influencing mental health and well-being, important empirical gaps remain in understanding how income dynamics, public health shocks, and fertility policy reform affect these outcomes. This thesis examines these topics through three distinct but interrelated studies.

The first study examines the causal impacts of the relaxation of fertility restrictions on mental health by using the implementation of China's Universal Two-Child Policy (UTCP) as a natural experiment and adopting a Difference-in-Difference approach. The results indicate that the relaxation of fertility restrictions significantly improves both mental and physical health among affected individuals. The observed improvements are particularly concentrated among younger individuals, married individuals, and those residing in less developed regions. Relative to affected men, affected women generally experienced weaker improvements in several specific emotions of mental health.

The second study examines mental health deterioration during the early stage of the Covid-19 pandemic in China and investigates the moderating role of personality traits in shaping individuals' mental health response to the public health crisis. The analyses show clear evidence of an increase in the prevalence of severe depression following the Covid-19 pandemic. Particularly, the results suggest that individuals with more open personality experience larger deterioration in mental health, while higher levels of neuroticism do not correspond to more mental health deterioration.

The third study investigates the relationship between income dynamics and life satisfaction using five waves of panel data. The results show that personal income and household income per capita are independently and non-linearly associated with life satisfaction. Specifically, the relationship between household income per capita and life satisfaction is positive and monotonic, with increasing marginal effects. In contrast, the relationship between personal income and life satisfaction follows a U-shaped trajectory. These patterns remain consistent across various population subgroups. Taken together, these studies provide further empirical evidence on the economic determinants of mental health and well-being and offer policy relevant insights into the role of enhanced reproductive autonomy, personality traits, and different measures of income in shaping individual well-being.

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Declaration

Author's Declaration

I declare that, except where explicit reference is made to the contribution of others, that this dissertation is the result of my own work and has not been submitted for any other degree at the University of Glasgow or any other institution.

Printed Name: Xiao Zhang

Signature:

Declaration of Generative AI Tools Usage

I acknowledge the use of Microsoft 365 Copilot (version ChatGPT-5) as a tool to proofread and improve the language of the final version of this work. After using this tool, I reviewed and edited the content as needed.

Chapter 1: Introduction

1.1 Overview and Research Motivation

For much of its history, neoclassical economics has rested on the core assumption that economic growth improves resource allocation and increases wealth. However, well-being as a measure of development has often been overlooked. This neglect of happiness in early twentieth-century economic thought has created significant limitations in addressing well-being-related issues and prompting societal happiness (Rojas, 2019). The Easterlin Paradox, introduced by Easterlin (1974), highlighted the complex and often non-linear relationship between economic growth and happiness. This finding sparked economists' interest in the determinants of happiness and laid the foundation for the field of happiness economics (Rojas, 2019). In parallel, decades of research have increasingly recognised the profound impact of mental disorders on both well-being and productivity, leading to a growing body of economic studies on psychiatry and mental health (Razzouk, 2017).

With the emergence of happiness economics and a growing interest in mental health as an alternative measurement of well-being, numerous studies have sought to identify the factors influencing happiness and mental health, drawing on interdisciplinary insights from psychology and health economics. Despite substantial progress, empirical research on well-being and mental health still faces significant gaps and challenges. Many studies remain constrained by reliance on cross-sectional datasets, difficulties in establishing causal relationships, and limited consideration of cultural and social diversity. With many countries facing recent economic difficulties, the lasting impacts of the COVID-19 pandemic on both the economy and mental health, and the widespread adoption of population policies to address accelerated demographic ageing, it has become increasingly urgent to examine how these factors influence well-being and psychological health.

This thesis consists of three chapters that contribute to the growing literature on subjective well-being and mental health by examining three distinct yet interrelated determinants. The next chapter examines the causal effect of relaxing fertility restrictions on mental health, emphasising the positive role of reproductive autonomy in enhancing psychological well-being. Chapter 3 examines the moderating role of personality traits in shaping mental health outcomes during a public health crisis, using the COVID-19 pandemic as a case study. The analysis highlights the importance of designing tailored policy interventions that account for personality heterogeneity. Chapter 4 explores the dynamic effects of personal and per capita

household income on life satisfaction, offering a longitudinal analysis of the relationship between wealth and happiness in China. These chapters together deepen our understanding of the factors that shape well-being. Using longitudinal micro-level data and applying rigorous empirical methodologies, the thesis provides robust evidence on how the relaxation of fertility policies, public health shocks, and income dynamics shape individual welfare.

1.2 Literature Review

1.2.1 Reproductive Autonomy, Fertility Restriction, and Mental Health

Reproductive autonomy, as a fundamental human right, plays a critical role in shaping well-being and mental health. Despite the widespread existence of fertility restrictions, their adverse consequences have long been neglected. If children can be considered as a source of psychic income or satisfaction (Becker, 1960), then unrestricted reproductive choice would allow couples to maximise the utility derived from having their ideal quantity and quality of children. Fertility restriction may compel couples to deviate from their preferred quantity and quality of children, potentially leading to negative effects on well-being and mental health. Conversely, relaxing such restrictions would provide couples with an opportunity to be closer to their ideal number of children, which is expected to pose positive effects on couples' well-being and mental health.

Several studies have examined the negative effects of fertility restrictions on mental health. As one of the earliest implemented and longest-lasting fertility control regimes, China's family planning policies imposed substantial constraints on reproductive autonomy. In particular, the subsequent implementation of the One Child Policy (OCP) initially forbade any couple who did not meet the exemption criteria from having more than one child. Focusing on an earlier fertility restriction policy that preceded the OCP, the "Later, Long, Fewer" (LLF) campaign, Chen and Fang (2021) provide evidence that fertility restrictions have persistent adverse effects on the mental well-being of elderly parents, particularly mothers. Several other studies present evidence of the adverse effects on mental health associated with the OCP for specific subgroups, including children who are the only child in families (Liu et al., 2005; Zeng et al., 2020) and parents who lost their only child (Yin et al., 2018; Wang et al., 2021a).

Abortion rates in China rose steadily in the late 1970s and early 1980s, with notable surges during periods of stringent enforcement of the national family planning policy, reaching 69.8% in 1983 and 62.4% in 1991 (Rodriguez, 2023). Although it is highly difficult to obtain official data due to the sensitivity and illegality of these issues, the potential rise in sex-selective abortion (Zhu et al., 2009; Hesketh et al., 2011; Zhou et al., 2012) and forced abortion

(Hesketh and Zhu, 1997; Mosher, 2012) associated with the OCP has received considerable attention from researchers. While the highest-quality studies tend to report neutral effects of abortion on mental health (Charles et al., 2008), abortions compelled by fertility restriction may still have adverse psychological consequences. This highlights the importance of further investigating how relaxing such restrictions affects mental health outcomes.

Additionally, the adverse effects of interference with reproductive autonomy on mental health could also arise from any involuntary deviations from couples' ideal number of children, including inaccessible contraception services, reproductive coercion, and infertility. Following the United States Supreme Court's decision to overturn the 1973 *Roe v. Wade* ruling and announcement of the cancellation of the first-trimester abortion constitutional right, women's mental health was detrimentally affected due to the restricted fertility rights and increased barriers to accessing abortion services (Liu et al., 2023). Women who experienced any form of interference with reproductive autonomy or deprivation of fertility health decision-making rights reported higher prevalences of mental health illness compared to those who did not (Price et al., 2022). Furthermore, women facing conception difficulties are more likely to use mental health medications, with this likelihood considerably higher among those suffering from persistent infertility (Bögl et al., 2024).

Despite existing evidence linking fertility restrictions to deteriorations in mental health, there remains limited empirical research on whether relaxing such restrictions leads to improvements in mental health. Chapter 2 of this thesis contributes the first empirical evidence of a causal relationship between the relaxation of fertility restrictions and enhanced mental health outcomes, using the implementation of China's Universal Two-Child Policy as a natural experiment and applying a Difference-in-Difference approach.

1.2.2 The Intermediation Effects of Personality Traits on Mental Health During Public Health Crisis

Public health crises and epidemics would adversely affect individuals' physical and mental health status. The rapid global spread of COVID-19 is the most recent example, disrupting the lives of billions of people and leading to a marked deterioration in mental health. Historical evidence has illustrated that certain population groups are disproportionately affected during such crises, with more significant deteriorations in specific aspects of mental health (O'Connor et al., 2021). Therefore, further identifying the specific groups most severely affected by the negative impacts of the COVID-19 pandemic, along with their personal characteristics, is essential for understanding the broader consequences of the public health crisis and for informing targeted mental health interventions in the post-COVID era.

To date, a substantial body of research has examined the effects of the COVID-19 pandemic and related isolation measures on mental health. These studies consistently find that COVID-19 has led to severe deterioration in mental health among patients and survivors (Bo et al., 2021; Gu et al., 2021; Mei et al., 2021; Liu et al., 2021; Jafri et al., 2022; Mazza et al., 2022), university and college students (Li et al., 2020; Liu et al., 2020; Wang et al., 2020; Son et al., 2020; Yang et al., 2021; Antwi et al., 2022; Kim et al., 2022), children and adolescents (Duan et al., 2020; Li et al., 2021b; Ma et al., 2021; Meade, 2021; Zhao et al., 2022; Panchal et al., 2023), and general population in the context of various countries (Xiong et al., 2020; Rossi et al., 2020; Wang et al., 2021b).

Economists have increasingly focused on the mediating role of personality in the relationship between the adverse impacts of the COVID-19 pandemic and mental health outcomes. Prior research has established a significant correlation between personality traits and mental health (Giuntella et al., 2021; McCann, 2011; Lamers et al., 2012; Hongmei and Jingwei, 2022). However, these mediating effects may vary under the unique conditions of a public health crisis such as the COVID-19 pandemic. It is important to identify whether individuals who are the most vulnerable during extreme public health crises share specific personality traits. Drawing on data from the UK and the Big Five personality framework, Proto and Zhang (2021) find that openness and extraversion are positively correlated with mental health deterioration during the COVID-19 pandemic, while the effect of neuroticism appears comparatively weak. Staneva et al. (2022) also provides evidence that higher levels of openness and extraversion are positively correlated with poorer mental health outcomes. Additionally, they find a significant negative correlation between neuroticism and mental health. However, several studies provide findings that diverge from those of Proto and Zhang (2021) and Staneva et al. (2022), suggesting that extraversion is correlated with better mental health outcomes while neuroticism remains significantly correlated with poorer mental health (Shokrkon and Nicoladis, 2021; López-Núñez et al., 2021; Nikčević et al., 2021; Wang et al., 2024; Li et al., 2021b).

As the first country to be affected by this vital disease and the one that implemented the most stringent disease-control and quarantine measures, China serves as a unique and valuable example for examining the mediating effects of personality traits on the mental health impacts of the COVID-19 pandemic. As of the completion of Chapter 3 of this thesis, research on the adverse impacts of the COVID-19 pandemic on mental health within the Chinese context remains limited. Existing studies have documented significant declines in the emotional well-being (Yang and Ma, 2020) and deterioration of mental health (Zhou et al., 2022). However, the mediating role of personality traits in these outcomes has yet to be explored.

1.2.3 Economic Determinants of Subjective Well-being

The emphasis on happiness and the scepticism about the link between material wealth and happiness can be traced back to Adam Smith, widely regarded as the father of economics. In *Theory of Moral Sentiments*, Smith expressed concerns that the pursuit of material wealth might be a deceptive route to happiness, leading to harder work rather than happier lives (Rojas, 2019). Despite the widespread interest in happiness among early economists, this topic was largely abandoned in economics research during the early twentieth century, while national wealth and happiness have been wrongly associated by many economists (Rojas, 2019).

Easterlin (1974) proposed the Easterlin Paradox, providing empirical evidence that income growth does not lead to sustained increases in happiness over time, despite the significant positive correlation between income and happiness within and among countries at a certain point in time. This finding renewed economists' interest in the complex relationship between wealth and happiness. Since the early twenty-first century, many economists have examined the relationship between broadly defined income and well-being from various perspectives. However, due to divergent and sometimes contradictory findings, a definitive consensus has not been established.

Economists initially sought to explain the Easterlin Paradox by examining the relationship between happiness and absolute income. However, empirical evidence across studies has produced mixed results. While most studies presented evidence of a positive relationship between happiness and income, opinions diverge regarding the long-term trajectory and persistence of this relationship. Several studies provide evidence of a significant positive link between income and both happiness and life satisfaction (Diener et al., 1993; Tella et al., 2003; Blanchflower and Oswald, 2004; Ball and Chernova, 2008; Caporale et al., 2009; Powdthavee, 2010). Kahneman and Deaton (2010) further distinguished between emotional well-being and life evaluation, proposing a positive but diminishing relationship between income and emotional well-being. Meanwhile, some economists have presented empirical evidence suggesting that, although happiness and income are positively related at a given point in time, this relationship becomes insignificant once factors such as hedonic adaptation and social comparison are considered (Easterlin, 2001; Diener and Biswas-Diener, 2002; Frey and Stutzer, 2002; Easterlin et al., 2010; Paul and Guilbert, 2013).

Economists' understanding of the relationship between wealth and happiness has gradually deepened as the roles of social comparison and hedonic adaptation have become evident, shifting the focus from absolute to relative income. Although some differences in perspective remain, the majority of studies provide evidence supporting the significant impacts of relative income on happiness. Due to social comparison, individuals tend to evaluate their absolute income against that of others within a similar reference group, and the perception of occupying

a relatively higher income position generally enhances happiness (Blanchflower and Oswald, 2004; Ferrer-i Carbonell, 2005; Luttmer, 2005; Clark et al., 2008; Senik, 2009; Boyce et al., 2010).

Meanwhile, economists have also examined the relationship between happiness and income inequality. While most studies find that lower levels of inequality are associated with greater happiness, some present evidence to the contrary. Given the widespread emphasis on social justice and equality, individuals tend to report higher levels of happiness when income inequality is relatively low (Graham and Felton, 2006; Oishi et al., 2011; Zagorski et al., 2014; Nguyen et al., 2015; Kollamparambil, 2020; Jin and Hong, 2022). Furthermore, several studies have identified an inverted U-shaped relationship between income inequality and happiness, suggesting that perceptions of social mobility play an important role (Wang et al., 2015; Yu and Wang, 2017; Ding et al., 2021). Surprisingly, other research provides evidence of a positive association between income inequality and income (Clark et al., 2003; Berg and Veenhoven, 2010; Rözer and Kraaykamp, 2013).

As a unique example of fast-growing countries, China offers economists a valuable context for examining the dynamic relationship between income and happiness. Despite its remarkable economic growth over a relatively short period, the reported happiness level has either declined (Kahneman and Krueger, 2006; Brockmann et al., 2009; Li and Raine, 2014) or followed a U-shaped trajectory (Cai et al., 2023; Easterlin et al., 2021), implying the complexity of the relationship between income and happiness. To date, several studies have investigated the relationship between income and happiness in the context of China. Although the evidence generally suggests a positive and significant relationship, opinions differ regarding its magnitude and linearity. Studies by Yang et al. (2022) and Ye et al. (2023) indicate that personal income is positively and significantly associated with happiness. Furthermore, Li and Shi (2019) provides evidence of a non-linear relationship between personal income and happiness, emphasising the role of individual characteristics and contextual factors in shaping this association. Luo (2017) notes that despite the positive link between income and happiness, this relationship exhibited a diminishing trend from 2002 to 2013.

Although substantial studies have examined the relationship between income and happiness, most do not distinguish between personal and household income. Household income per capita may have an independent effect on individual happiness, particularly for those who rely on other family members for financial support. As the only study that explored the independent effects of household income and personal income on life satisfaction, Wu (2021) finds that both household income per capita and personal income are associated with life satisfaction, with the former having a stronger influence. Evidence presented by Wu (2021) suggests a monotonic positive relationship between household income per capita and life satisfaction, whereas personal income exhibits a concave association with life satisfaction.

These findings further emphasise the importance of separately examining how changes in household income and personal income are associated with happiness.

1.3 Data and Methodology

This thesis uses data from the China Family Panel Studies (CFPS), a nationally representative longitudinal dataset that collects biennial information from a panel of tracked respondents. Since its launch in 2010, six waves of the CFPS have been conducted. The specific waves used in each chapter vary, depending on the relevance to the research question and methodological requirements. Chapter 2 primarily utilises three waves of CFPS data beginning in 2014, deliberately excluding earlier waves to reduce potential bias from the implementation of China's Selective Two-Child Policy in 2013 and to address concerns regarding relatively high attrition rates in the initial survey waves. Chapter 3 uses the 2018 and 2020 waves of the CFPS to capture within-individual changes in mental health before and after the onset of the COVID-19 pandemic. Chapter 4 employs five waves of CFPS data from 2010 onward, deliberately excluding the 2020 wave to avoid potential confounding effects associated with the pandemic.

This thesis employs a Difference-in-Differences (DiD) approach in Chapter 2, and applies Ordinary Least Squares (OLS) regression and fixed-effects models in Chapters 3 and 4. In Chapter 2, the implementation of China's Universal Two-Child Policy is used as a natural experiment, utilising a novel identification strategy to estimate the causal impact of fertility policy relaxation on mental health. By leveraging longitudinal data and using fixed-effects estimators, the analysis controls for unobserved time-invariant individual characteristics, thereby enhancing the rigour and credibility of the empirical findings. Detailed descriptions of the data and methodologies applied in each chapter are provided in the respective sections.

1.4 Contribution to the Literature

This thesis contributes to the economic literature on mental health and subjective well-being by providing robust empirical evidence across three key dimensions: the causal relationship between the relaxation of fertility restrictions and mental health outcomes; the moderating role of personality traits during a major public health crisis; and the independent effects of dynamic changes in personal and household income on life satisfaction.

First, this thesis provides the first empirical evidence of a causal link between the relaxation of fertility restrictions and improvements in mental health. The findings highlight the importance of reproductive autonomy in promoting psychological well-being and offer important impli-

cations for demographic policy design, particularly in addressing the previously overlooked mental health consequences of fertility control measures.

Second, the thesis identifies the moderating effects of personality traits on the adverse mental health impacts of the COVID-19 pandemic. These findings offer valuable insights for policymakers by identifying particularly vulnerable groups during public health emergencies, thereby informing the design of targeted mental health interventions in the post-COVID era. The study also contributes to the growing literature on the role of personality in shaping mental health outcomes.

Third, this thesis provides the first longitudinal evidence of the independent effects of household income per capita and personal income on life satisfaction. It further clarifies the distinct roles these two income measures play in linking monetary resources and subjective well-being, highlighting the need to account for household and personal income separately in well-being research. Together, these studies provide empirical evidence and policy-relevant insights to advance research in this field.

Chapter 2: The Impact on Mental Health of Relaxing Fertility Restrictions—Evidence from China's Universal Two-Child Policy

2.1 Introduction

Over the past decades, policies that aim to regulate fertility and reproductive behaviour have been widely implemented around the world. Reproductive autonomy is recognised as a an essential constitute of basic human rights and refers to individuals' ability to freely and responsibly decide the number, interval, and timing of children without discrimination, coercion, and violence (OHCHR, United Nations, 2023). Nevertheless, policies related to fertility restriction remain common across countries. According to the World Population Policies report, more than 140 governments had implemented policies affecting fertility decisions by 2019, of which 68 countries implemented policies that support family planning directly or indirectly. While the economic and demographic consequences of such policies have been extensively studied, their implications for wellbeing and mental health have received relatively limited attention in the economics literature.

China provides a particularly important context in which to study these issues. Its family planning policies are among the earliest and most strict implemented worldwide and have resulted in substantial demographic and socioeconomic changes. While these policies contributed to poverty reduction and improvements in maternal health, they also placed constrains on reproductive choice and led to unintended social outcomes, including the emergence of numerous families who lost their only child and a severely imbalanced sex ratio at birth due to female fetus abortions (Hesketh et al., 2015; Yin et al., 2018). Given the scale of the population affected and the long duration of these policies, understanding how changes in fertility restrictions influence mental health outcomes is of considerable policy and academic relevance.

Although the relaxation of fertility restrictions has strengthened reproductive autonomy and granted couples greater freedom in their fertility choices, the effects of such policy changes on mental health remain insufficiently explored. This study is the first to examine the causal relationship between the relaxations of fertility restrictions and mental health status by using the enactment of China's universal two-child policy (UTCP) as a natural experiment and applying the difference-in-differences method. It provides the first empirical evidence demonstrating that this policy relaxation can improve the mental health of the

general population, as indicated by notable reductions in severe mental health issues and improvements in overall health status.

This chapter aims to identify the causal effects of fertility-restriction relaxation on mental health by applying the difference-in-differences method, classifying respondents into treatment and control groups based on whether they were affected by the policy change. Respondents are assigned to the treatment group only if they were affected by the policy change, as indicated by not qualifying for any exemptions that permitted a second child prior to the UTCP. Conversely, respondents are classified into the control group if they remained unaffected by the relaxation, as indicated by meeting the criteria for exemptions that allowed a second child before the UTCP. This classification is jointly determined by the demographic characteristics required for exemptions eligibility, the number of children a respondent had already, and the number of children a respondent ideally desired.

The enactment of China's UTCP formally marked the end of the one-child policy, one of the most stringent and influential family planning policies in the world, and granted all couples in China permission to have a second child for the first time in over 36 years (Zeng and Hesketh, 2016). Following the formal implementation of the UTCP on January 1, 2016, the considerable number of couples who have previously been subject to strict fertility restrictions under the one-child policy were permitted to have a second child, thereby bringing some of them closer to their ideal number of children. Consequently, the UTCP offers a unique opportunity to examine the broader social implications of fertility restrictions and their relaxation, particularly with respect to mental health status.

Fertility restrictions can negatively affect mental health by compelling parents to deviate from their preferred number of children. Since children are often a source of psychic income and emotional satisfaction, they may be viewed as durable consumption goods that provide utility (Becker, 1960). The utility parents expect to receive from having children is determined by their preferences, which are further determined by various demographic characteristics including religion, race, age, as well as the quality and quantity of children (Becker, 1960). Therefore, disregarding other demographic characteristics, parents' expected utility from having children is jointly determined by the quality and quantity of children they ideally desire. In the absence of any external fertility restrictions, parents have the opportunity to achieve maximum expected utility by having the ideal quality and quantity of children that perfectly align with their preferences.

The utility parents expect to receive from childbearing can be maximised if fertility decisions, such as having fewer children and investing more in the children they have already had to improve their quality, or having more children with reduced investment per child, are made voluntarily based on parents' preferences. However, if fertility decisions are forced to be made by external fertility restrictions, parents' expected utility from childbearing cannot

be maximised, as they are forced away from their preferred quality-quantity combination. Such constraints could further result in deteriorated mental health due to the reduction in psychic income and satisfaction. Therefore, relaxing fertility restrictions is expected to lead to improvements in mental health by reducing violations of reproductive rights, enhancing autonomy, and enabling parents to be closer to their fertility preferences.

Amid a series of revisions to China's family planning policy, some couples were granted permission to have a second child before the formal implementation of the UTCP, provided that their demographic characteristics met the relevant exemption criteria. China's one-child policy was formally launched in 1979, initially prohibiting any couple from having more than one child, regardless of whether they resided in urban or rural areas (Attane, 2002; Zeng and Hesketh, 2016; Zhang, 2017). In the 30 years following its implementation, in response to strong resistance particularly from rural residents and adverse consequences such as an increasingly aging population and imbalanced sex ratio, fertility restrictions were gradually and cautiously relaxed. Specifically, prior to the formal implementation of the UTCP, couples were permitted to have a second child if they belonged to an ethnic minority, were registered as agricultural residents and had a girl as their firstborn child, or were themselves the only child of their parents.

In addition to couples who are unaffected by the UTCP because they satisfy these demographic criteria, individuals who already have more than one child, have given birth to the number of children they desire, or whose ideal number of children[1] is zero or one are also not classified into the treatment group. These individuals are not necessarily similar to the those who qualified for exemptions under the one-child policy, as they were never granted permission to have a second child and thus may be liable if they did so. However, once they meet any of the aforementioned conditions, they will not seek permission to have a second child and, consequently, will not benefit from the UTCP. Therefore, respondents who meet any of the exemption criteria, already have more than one child, or have reached their ideal number of children are considered unaffected by the UTCP and are placed in the control group.

As the UTCP was formally implemented on January 1, 2016, this chapter treats data collected before 2016 as pre-treatment and data collected from 2016 onward as post-treatment. Based on this framework, the analysis controls for time-invariant unobservable heterogeneity using the difference-in-differences approach and provides clear evidence of the causal relationship between the UTCP and changes in individuals' mental health.

This chapter uses data from a nationally representative data set, the China Family Panel Studies (CFPS). Thanks to the panel structure of the CFPS data, I am able to compare changes in mental health for the same individual before and after the UTCP. This chapter finds that the

[1]The CFPS collected data on respondents' preferences regarding the ideal number of children with the following question: "How many children do you think would be ideal, regardless the policy restrictions?"

UTCP leads to significant improvements in both mental and physical health among individuals affected by the policy change. Specifically, the UTCP implementation is associated with a substantial reduction in the risk of severe mental health illness and a significant improvement in physical health status as observed by interviewers.

The relaxation of fertility restrictions could have differential effects on mental and physical health outcomes across subgroups as its relevance to reproductive autonomy, family responsibilities, and practical feasibility of raising additional children may vary across individuals. Examining these heterogeneous effects is therefore crucial for understanding the potential mechanisms underlying the improvements in health outcomes following the UTCP implementation. In particular, the effects of the policy change may differ between women and men, as women typically bear a disproportionate share of responsibilities related to childbirth and childcare. Women simultaneously hold a public identity as material producers and a private identity as social reproducers, while disproportionately shouldering household and caregiving responsibilities than men (Yingchun and Zhenzhen, 2020). The burden associated with this dual identity exposes women to negative consequences of childbearing, such as disadvantages in the labour market (He et al., 2023), as well as pressure from male partners regarding the number, gender composition, and birth interval of children (Qian and Jin, 2018).

Moreover, the effects of the relaxation of fertility restrictions on health outcomes could also differ by age, marital status, and the level of development of the regions in which individuals live. Middle-aged and older individuals are generally less affected by changes in fertility opportunities but are expected to assume greater childcare responsibilities in Chinese culture, while unmarried individuals are less directly and immediately exposed to childbearing decisions. At the same time, individuals from more developed regions may be less affected by the policy change as practical barriers that prevent them from having additional children may also include financial burdens of child raising in addition to fertility restrictions. Therefore, the relaxation of fertility restrictions could lead to limited gains in reproductive autonomy for these individuals, which may generate heterogeneous effects on their health outcomes.

To examine whether the effects of the relaxation of fertility restrictions on health outcomes differ across varying subgroups, this chapter conducts a series of heterogeneity analyses by gender, age cohort, marital status, and regional development level. The findings suggest meaningful heterogeneity in the effects of the relaxation of fertility restrictions. In particular, women tend to experience weaker improvements than men as the observed reductions in the frequency of several negative emotions among affected women are weaker, and even offset in some cases. Moreover, the findings indicate that the improvements in mental and physical health are primarily concentrated among younger individuals, married individuals, and individuals from less developed regions.

Taken together, these findings suggest that the effects of relaxing fertility restrictions are highly heterogeneous across groups with varying demographic characteristics and socio-economic conditions. These findings are broadly consistent with the interpretation that the relaxation of fertility restrictions improves health outcomes by enhancing perceived reproductive autonomy and reducing psychological constraints. The results further highlight the importance of complementary support that addresses burdens of raising children and economic stress alongside the relaxation of fertility restrictions.

To the best of my knowledge, this chapter is the first to examine the causal relationship between the relaxation of fertility restriction and mental health outcomes. By using China's UTCP as a natural experiment and employing a novel identification strategy, it provides empirical evidence of the positive effects of such relaxations on individuals' mental health, thereby addressing a notable gap in the existing literature. While previous studies have offered qualitative or descriptive insights suggesting that fertility restrictions can negatively affect mental health, this chapter is the first to conduct a systematic analysis using a representative sample and to establish a clear causal link between policy relaxations and improvements in mental health .

Although no prior study has examined the causal effects of relaxing fertility restrictions on mental health, existing evidence suggests that restrictive fertility policies can adversely affect mental health. As an earlier fertility restriction policy in China, the "Later, Long, Fewer" (LLF) campaign has been documented to have persistent adverse effects on mental wellbeing of elderly parent, with stronger impacts on mothers (Chen and Fang, 2021). The subsequent introduction of the One-Child Policy (OCP), one of the longest-lasting family planning policy worldwide, prohibited most couples from having more than one child unless they qualified for specific exemptions. The severe restriction on reproductive autonomy and the resulting involuntary deviation from couples' ideal number of children caused deterioration in mental health status and higher risk of mental illness among children who are the only child in their family (Liu et al., 2005; Zeng et al., 2020) and parents who lost their only child (Wang et al., 2021a; Yin et al., 2018).

Mental health can deteriorate in response to fertility-related constrains, which include not only formal family planning policies but also any factor that forces couples to deviate involuntarily from their desired number of children, such as inaccessible contraception, interference with reproductive autonomy, and infertility. For example, the revocation of the constitutional right to first-trimester abortion in the United States, following the Supreme Court's overturning of the 1973 *Roe v. Wade* decision, has been shown to negatively affect women's mental health (Liu et al., 2023). Women who have experienced reproductive coercion, defined as interference with reproductive autonomy and the denial of decision-making rights over reproductive health, report a higher prevalence of mental health issues compared to those who have not (Price et al., 2022). Additionally, women who have experienced conception failure are more likely

to use psychiatric medication, with the likelihood significantly higher among those suffering from persistent infertility (Bögl et al., 2024).

While the studies discussed above offer evidence of the adverse effects of fertility restrictions on mental health, their findings are largely limited to descriptive analyses or specific population cohorts. As a result, the impact of relaxing fertility restriction relaxations on the mental health of the general population remains unclear. These studies consistently show that involuntary deviations from couples' ideal number of children—whether due to reproductive coercion, infertility, or policy imposed restrictions—are associated with deterioration in mental health. However, no research has yet determined whether easing such restrictions could improve mental health by reducing the involuntary deviation. This chapter addresses this gap by presenting the first empirical evidence of the positive effects of fertility restrictions relaxation on mental health.

The remainder of this chapter is structured as follows: Section 2 introduces the identification strategy, data sources, and empirical model. Section 3 presents the regression results, based on the difference-in-differences approach and fixed-effects models. Section 4 concludes the chapter and outlines potential avenues for future research.

2.2 Data

This chapter uses data from the 2014 to 2018 waves of the CFPS to examine the causal effects of the UTCP on mental health. The choice of these survey waves is intended to avoid potential confounding effects from the introduction of the Selective Two-child Policy in 2013 and the emergence of the COVID-19 pandemic in 2020. The 2010 and 2012 waves are included only to assess the parallel trends between treatment and control groups prior to the policy implementation. The CFPS is a nationally representative biennial survey that collects comprehensive data on both economic and non-economic aspects of individuals' lives in China (Xie and Hu, 2014). To maintain balance in the panel data set, this chapter excludes the respondents who dropped out midway through the survey. Considering the potential impacts on mental health of confounding factors driving changes in fertility preferences, respondents who reported a change in their ideal number of children in 2018 are also excluded to enhance the validity and credibility of the causal inference. After excluding these respondents, the final sample comprises 13,918 observations per wave, totaling 41,754 observations. Due to missing data, some variables contain fewer observations.

To assess whether the sample restrictions introduce systematic differences between the initial sample from the CFPS dataset and the final sample used in the analyses, an attrition analysis has been conducted by comparing the basic characteristics across the two samples. The results are reported in Table S2-1 in the Appendix. Several variables exhibit statistically significant

differences between the two samples. Specifically, respondents who remain in the final sample are more likely to be affected by the implementation of the UTCP, exhibit slightly better mental and physical health, are less likely to be single, and are more likely to be employed. Additionally, these respondents tend to have slightly lower levels of education and lower personal income, while the differences in age and Hukou status are not statistically significant. Although the results of the attrition analysis suggest the existence of several statistically significant differences, their magnitudes are generally modest relative to the baseline means and small in absolute terms. Furthermore, an additional robustness check that reintroduces respondents who reported a change in their ideal number of children after the implementation of the UTCP yields qualitatively similar estimates, supporting the stability of the results and alleviating concerns that the main findings are driven by the sample restrictions.

2.2.1 Treatment Group and Post-Treatment Dummy Variables

China's family planning policy has undergone a series of changes since the formal launch of the one-child policy in 1979, which prohibited any couple from having more than one child, regardless of whether they resided in urban or rural areas (Attane, 2002; Zeng and Hesketh, 2016; Zhang, 2017). The policy was later relaxed in response to strong resistance, particularly from rural residents, due to the importance traditional Chinese culture places on males as both workers and objects of affection (Attane, 2002; Zeng and Hesketh, 2016; Zhang, 2017). By the mid-1980s, most regions in mainland China had gradually eased the fertility restriction, allowing rural couples whose first child was a girl, as well as individuals from minority ethnic groups, to have a second child (Yi, 2007; Zeng and Hesketh, 2016; Zhang, 2017).

Nearly three decades after the start of the one-child policy, its negative consequences—such as the increasingly aging population and imbalanced sex ratio—began to outweigh the benefits brought by the reduction in fertility and mortality (Zeng and Hesketh, 2016). Facing the threats of slow economic growth and demographic decline, the government cautiously and gradually adjusted the family planning policy (Zeng and Hesketh, 2016). Beginning in 2007, couples were permitted to have a second child if both the husband and wife were the only child of their parents. This "selective two-child policy" was further relaxed in November 2013, allowing couples to have a second child if either spouse was an only child (Zeng and Hesketh, 2016).

By the beginning of 2014, couples were permitted to have a second child if they met one of the following conditions: they belonged to one of the minority ethnic groups; they resided in a rural area (with agricultural residential registration) and had a girl as their firstborn child; or either of them was an only child. These couples were not affected by the UTCP, as they were already eligible to have a second child. However, they were not the only individuals unaffected by the UTCP.

Couples who did not satisfy any of the above conditions may also have been unaffected by the UTCP if they already had more than one child or had as many children as they wanted. Specifically, couples who already had more than one child were unaffected by the UTCP, as there was no longer a need for permission once a second child was born. Similarly, couples who had as many children as they wanted were unaffected, since they were no longer constrained by the family planning regulations and would not opt to have more children, regardless of whether permission was granted.

Moreover, respondents who reported that their ideal number of children was one or zero are considered unaffected by the UTCP, as they could choose to have their desired number of children regardless of the policy. The CFPS collects data on respondents' preferred number of children through the following question: "How many children do you think would be ideal, regardless the policy restrictions?"

This chapter classifies respondents into a control group and a treatment group based on the policy-related demographic characteristics, the number of children they have already had, and the number of children they would ideally have. Specifically, respondents are classified into the treatment group only if they do not belong to a minority ethnic group, either do not hold an agricultural residential registration or hold one but have a boy as their firstborn child, are not an only child, have no more than one child, and prefer to have more children. A respondent is classified into the control group if they meet any of the previously outlined conditions.

In addition, eligibility criteria exhibited modest variation across provinces prior to the implementation of the UTCP. To construct a more refined classification of the treatment and control groups, I refer to the province-level exemption criteria documented in Giorgi and Raiber (2025), which summarise provincial differences in eligibility for a second child permit in 2013. However, as the further relaxed "selective two-child policy" had been implementation nationwide by mid-2014 and all the provinces had granted couples in which either spouse was an only child to have a second child, individuals meeting this criterion are classified as unaffected by the UTCP regardless of the provinces they belong to. I define the variable *UTCP Affected* as a treatment dummy indicator, taking the value 1 if the respondent is affected by the UTCP and 0 otherwise. In the estimation sample, 7866 respondents (18.84%) are affected by the UTCP and form the treatment group, while the remaining 33888 respondents (81.16%) constitute the control group.

As noted, since the UTCP was formally implemented on January 1, 2016, data collected prior to 2016 are considered pre-treatment, while data collected in the 2016 and 2018 waves are classified as post-treatment. The binary variable *Post Treatment (Year)* indicates whether the data were collected before or after the implementation of the UTCP.

2.2.2 Mental Health Variables

The CFPS uses different scales to assess respondents' mental health status across various waves of the survey. In the 2012 wave, the 20-item Centre for Epidemiologic Studies Depression Scale (CES-D-20) is used, while the 2014 wave employs the 6-item version of the Kessler Psychological Distress Scale (K6). The CFPS then returned to using the CES-D-20 in the 2016 wave, followed by the 8-item version of the Centre for Epidemiologic Studies Depression Scale (CES-D-8) in the 2018 wave. The exact wording of the mental health questions used in the CFPS is reported in Table S2-2 in Appendix.

The K6 uses a five-point scale (0–4) to measure individuals' psychological distress through six questions about emotional states, where 0 indicates "never" and 4 indicates "all of the time" (Kessler et al., 2002). Both the CES-D-20 and CES-D-8 employ a four-point scale (0–3) to assess respondents' depression symptoms, covering areas such as depression moods, negative feelings, loss of appetite, and sleep disturbance (Radloff, 1977). Given the limitations on data and the different scales and cutoffs used in the K6 and CES-D, my analyses of changes in mental health status before and after the UTCP's implementation can only be conducted after recoding the different scales.

The variation in mental-health-status measurement scales used by the CFPS complicates the analysis of changes in respondents' mental health over time. However, several questions in the K6 and CES-D-20/CES-D-8 are approximately identical, with similar phrasing and measuring the same emotional aspects. The first emotion measured by both the K6 and CES-D is depression. The K6 assesses individuals' depression with the following question: "During the past 30 days, about how often did you feel so depressed that nothing could cheer you up?" while the CES-D measures depression with the question "During the past week, how often you have felt depressed?"

Second, both the K6 and the CES-D scales include questions about whether individuals feel that everything they do requires effort. In the K6, the question is "During the past 30 days, how often did you feel that everything was an effort?" Similarly, the CES-D asks "During the past week, how often you have felt that everything you did was an effort?"

The third shared question between the K6 and CES-D pertains to the frequency of feeling restless. In the K6, respondents are asked "During the past 30 days, about how often did you feel restless or fidgety?" In contrast, the CES-D asks "During the past week, how often you have felt your sleep was restless?"

Additionally, there is a question about the frequency of feeling hopeless that appears on both the K6 and the 20-item CES-D but does not exist on the 8-item CES-D scale. In the K6, the question is "During the past 30 days, about how often did you feel hopeless?" The

corresponding CES-D question is "During the past week, how often you have felt hopeful about the future?" As the question in the CES-D 20-item scale regarding hope was phrased to assess respondents' positive affections, the responses to this question are reverse-coded to ease comparison with the question in the K6 and maintain consistency in my analyses (Radloff, 1977).

The scale on the K6 runs from 0 (None of the time) to 1 (A little of the time), 2 (Some of the time), 3 (Most of the time), and 4 (All of the time), while the CES-D scale runs from 0 (Almost never) to 1 (Sometimes), 2 (Often), and 3 (Most of the time). I recode the K6 responses to match the CES-D's 0–3 scale to harmonize the data across these scales. Specifically, 0 is recoded as 0 (Rarely or none of the time), 1 and 2 are combined and recoded as 1 (Some or a little of the time), and 3 and 4 are recoded as 3 (Most or all of the time).

Furthermore, this analysis constructs a binary indicator, *Mental Health Symptom*, to represent the risk of severe mental health illness based on the corresponding cutoff values of the K6 scale and the CES-D 8-item scale. The cutoff of high risk of severe mental health illness on the K6 scale is 13 out of 24 (Prochaska et al., 2012), and the cutoff on the CES-D 8-item scale is 12 out of 24 (calculated based on the 28/60 ratio from the CES-D 20-item version). The analyses based on the risk of experiencing severe mental health illness are likely to be more reliable than analyses based on any single aspect of mental health status, as the validity of the cutoffs, the strong correlation, and the similarity of the mathematical distribution between the K6 and CES-D scales have been confirmed in previous studies (Sakurai et al., 2011; Tomitaka et al., 2017).

Table 2-1 presents the descriptive statistics for all variables used in the analysis.

Table 2-1: Descriptive Statistics

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	Mean	SD	min	max
UTCP Affected	41,754	0.188	0.391	0	1
Post Treatment 1 (Year 2016)	41,754	0.333	0.471	0	1
Post Treatment 2 (Year 2018)	41,754	0.333	0.471	0	1
Mental Health Symptom	39,193	0.0574	0.233	0	1
Depression	39,257	0.686	0.768	0	3
Needs Effort	39,273	0.631	0.812	0	3
Restless	39,284	0.672	0.870	0	3
Hopeless	15,329	0.393	0.752	0	3
Interviewer-Observed Health	35,437	5.613	1.215	1	7
Residential Area	40,101	0.263	0.441	0	1

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VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
Age	41,752	47.22	15.24	16	99
Education	41,730	2.753	1.492	1	9
Single	40,202	0.148	0.355	0	1
Employment	41,754	0.732	0.443	0	1
Urban	40,742	0.474	0.499	0	1
log Personal Income	40,931	3.054	4.497	0	13.85

Note: The table presents the descriptive statistics for the variables used in the analysis. *UTCP Affected* indicates whether a respondent was subject to the UTCP. *Post Treatment (Year)* denotes whether the data were collected after the policy's implementation. Respondents' mental health status is captured through a series of measures. *Mental Health Symptom* identifies respondent with a high likelihood of severe depression, based on the corresponding cutoffs of the Kessler-6 scale and the CES-D scale. *Depression*, *Needs Effort*, *Restless*, and *Hopeless* represent the four specific affections that were measured in both the Kessler-6 scale and the CES-D scale. *Interviewer-Observed Health* reflects respondents' health status as observed by interviewers. The analysis also controls for demographic characteristics, including personal income, residential registration, age, education, marital status, and employment status. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.

2.3 Estimation Strategy

I employ the following empirical model based on the difference-in-differences method to explore the causal effects of the UTCP on mental health:

$$Y_{it} = \alpha + \beta_1 UTCP\ Affected_i \times Post\ Treatment\ (Year)_t + \beta_2 X_{it} + \lambda_i + \upsilon_t + \varepsilon_{it} \quad (1)$$

Here, i indexes individuals and t denotes time periods. The dependent variables across different empirical analyses include mental health status—measured using the K6 and CES-D scales—and physical health status as assessed by interviewers. The main explanatory variable is the interaction term *UTCP Affected*×*Post-treatment (Year)*. X_{it} is a vector of demographic characteristics, including age, marital status, education, residential-area type, employment status, and income. The terms λ_i and υ_t represent individual and time fixed-effects, respectively. In addition, province fixed-effects are included to control for persistent regional differences that may affect mental and physical outcomes. Individual fixed-effects absorb all time-invariant characteristics at the individual level, including stable provincial attributes for individuals who do not migrate. However, province fixed-effects remain relevant in the presence of inter-provincial migration, as it may expose individuals to different regional environments and institutional context that are not fully captured by individual fixed-effects alone.

While the Difference-in-Difference approach enables identification of the causal effects of the UTCP on mental health outcomes, it relies on the assumption that the treatment and control

groups would have followed parallel trends in the absence of the policy change. Potential limitations and the results of the parallel trends test are discussed at the end of the Results section.

2.4 Results

This section presents the results of regressions examining the impact of the UTCP's implementation on individuals' mental and physical health status. All regressions have controlled for individual, year, and province fixed-effects. Table 2-2 displays the baseline regression results.

The results indicate that respondents who were affected by the UTCP reported a significantly lower risk of severe mental health illness compared with unaffected individuals. Specifically, the UTCP reduced the mental health symptoms score of affected respondents by -0.013 (95% CI = -0.024 to -0.002). This effect persisted for two years after the UTCP's implementation, with a coefficient of -0.021 (95% CI = -0.033 to -0.010).

Table 2-2: Regression Results of Baseline Difference-in-Differences Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
UTCP Affected×	-0.013**	-0.002	-0.032	-0.010	-0.005	0.090***
Post Treatment 1 (Year 2016)	(0.006)	(0.021)	(0.022)	(0.023)	(0.064)	(0.032)
UTCP Affected×	-0.021***	-0.025	-0.071***	0.016		0.021
Post Treatment 2 (Year 2018)	(0.006)	(0.021)	(0.021)	(0.024)		(0.037)
Constant	-0.052	-0.232	0.492	0.325	-4.043***	5.048***
	(0.224)	(0.622)	(0.711)	(0.598)	(0.367)	(1.157)
Observations	38,798	38,860	38,876	38,887	15,085	35,140
R-squared	0.016	0.006	0.041	0.060	0.382	0.014
Number of pid	13,442	13,442	13,443	13,443	12,914	13,282

Note: The table presents empirical results from difference-in-differences regressions that include individual, year, and province fixed-effects. The dependent variables differ across specifications and cover *Mental Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *UTCP Affected×Post Treatment (Year)* represents the interaction between the *UTCP Affected* dummy and the *Post Treatment (Year)* indicator within the difference-in-differences framework. Here, *UTCP Affected* denotes whether a respondent was subject to the policy change, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2-1. Full regression results including all covariates are reported in Table S2-3 in the Appendix.
Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 90% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 99% confidence interval.

The results displayed in the sixth column indicate that the UTCP implementation also significantly improved the physical health of affected respondents. The interviewer-observed

physical health status of respondents in the treatment group increased by 0.090 (95% CI = 0.027 to 0.153) in the first year following the UTCP implementation. However, two years after the policy change, the estimated effect remain positive in magnitude but is no longer statistically significant. These findings suggest that the implementation of the UTCP has a sustained effect on mental health, while its impact on physical health may be short-term.

There is limited evidence that the implementation of the UTCP affects specific dimensions of negative emotions. While the policy led to significant improvements in overall mental health by reducing the risk of severe mental health illness, the disaggregated results show that most negative emotions are not significantly affected. In particular, none of the estimated effects on negative emotions is statistically significant in the first year following the policy change. Two years after the UTCP implementation, a statistically significant reduction is only observed in the frequency of feeling everything needs effort. These results suggest that the improvement in mental health are not driven by broad-based reductions across negative emotions, but rather reflects concentrated effects on psychological well-being.

The magnitude of the estimated effects in the baseline analyses is economically meaningful. Relative to baseline prevalence, the risk of severe mental illness among affected respondents declined by approximately 23% in the first year and 37% two years after the implementation of the UTCP. By contrast, the magnitude of the estimated effects for most specific emotions are relatively small and not statistically significant. The only significant reduction observed is in the frequency of feeling everything needs effort, corresponding to approximately 11% of its sample mean. The improvement in interviewer-observed physical health in the first year following the policy change is equivalent to roughly 0.07 standard deviations, suggesting a modest short-term effect of UTCP implementation on physical health. The estimated effect is considerably smaller and statistically insignificant two years after, suggesting that the impact does not persist over time. Directly comparable literature remains scarce, as this chapter is the first study to examine the causal effects of fertility restrictions relaxation on mental health. However, a broader body of research shows that reproductive constraints, including inaccessible contraception, fertility coercion, and infertility, are associated with modest to moderate deterioration in mental health (Liu et al., 2023; Price et al., 2022; Bögl et al., 2024).

Next, this chapter examines gender heterogeneity in the effects pf the UTCP implementation on mental and physical health status by estimating regressions that include an interaction term of *Gender*, *Treatment Group*, and *Post Treatment (year)*. In the analysis, men are used as the reference group, such that the triple interaction term captures the differential effects of the policy for women relative to men. The results from these regressions, which use the same empirical model with the added interaction term, are presented in Table 2-3. All regressions control for individual, year, and province fixed-effects to mitigate the impacts of unobserved factors that do not vary over time or across geographic location.

Table 2-3: Regression Results of Difference-in-Differences Analysis with Interactions of Gender and Treatment Group

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
(Male) UTCP Affected×	-0.020***	-0.007	-0.045	-0.044	0.019	0.071
Post Treatment 1 (Year 2016)	(0.007)	(0.029)	(0.030)	(0.030)	(0.094)	(0.046)
(Male) UTCP Affected×	-0.029***	-0.064**	-0.122***	-0.082***		0.061
Post Treatment 2 (Year 2018)	(0.007)	(0.029)	(0.028)	(0.031)		(0.052)
Female×UTCP Affected×	0.013	0.010	0.024	0.065	-0.043	0.033
Post Treatment 1 (Year 2016)	(0.010)	(0.038)	(0.038)	(0.041)	(0.116)	(0.057)
Female×UTCP Affected×	0.014	0.072*	0.094**	0.182***		-0.071
Post Treatment 2 (Year 2018)	(0.010)	(0.037)	(0.038)	(0.043)		(0.067)
Constant	-0.054	-0.239	0.482	0.305	-4.043***	5.060***
	(0.224)	(0.621)	(0.713)	(0.600)	(0.367)	(1.155)
Observations	38,798	38,860	38,876	38,887	15,085	35,140
R-squared	0.016	0.006	0.041	0.061	0.382	0.014
Number of pid	13,442	13,442	13,443	13,443	12,914	13,282

Note: The table presents empirical results from difference-in-differences regressions that include individual, year, and province fixed-effects. The dependent variables differ across specifications and cover *Mental Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *Female×UTCP Affected×Post Treatment (Year)* represents a triple interaction among the *Female* indicator, the *UTCP Affected* dummy, and the *Post Treatment (Year)* indicator in the difference-in-differences framework. Here, *Female* denotes whether a respondent is female, *UTCP Affected* denotes whether a respondent was subject to the policy change, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2-1. Full regression results including all covariates are reported in Table S2-4 in the Appendix. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 90% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 99% confidence interval.

Among affected men, the implementation of the UTCP resulted in significant improvements in mental health outcomes. Specifically, affected men experienced a significant reduction in the risk of severe mental illness in the first year following the UTCP implementation. This improvement persists two years after the policy change, with larger magnitude. Affected men also reported significantly lower frequencies of depression, feeling that everything needs effort, and restlessness two years after the policy change, although the estimated effects for these emotions are not statistically significant in the first year of the policy change. By contrast, no statistically significant difference is observed for feelings of hopeless and interviewer-observed physical health among affected men compared to unaffected men.

Compared with affected men, affected women do not exhibit significant differences in overall improvements in mental health, as measured by the risk of severe mental illness. There is no significant difference observed in the improvements in interviewer-observed physical health between affected men and women as well. However, clear gender heterogeneity emerges in several specific dimensions of negative emotions. Specifically, the estimated

coefficients for depression, feeling that everything needs effort, and restlessness are positive and statistically significant in the second post-treatment period, indicating that the reduction in these specific emotions observed among men is much smaller for affected women. In particular, the differential effects for women in depression and restlessness are economically meaningful. The estimated coefficients on the triple interaction term (0.072, 95% CI = −0.001 to 0.146 for depression and 0.182, 95% CI = 0.098 to 0.266 for restlessness) largely offset the reductions observed among affected men (−0.064, 95% CI = −0.121 to −0.008 for depression and −0.082, 95% CI = −0.143 to −0.021 for restlessness). Overall, these results indicate pronounced gender heterogeneity in the effects of the UTCP on specific emotions, suggesting that women benefit less from the relaxation of fertility restrictions.

As affected women exhibit relative increases in the frequency of depression and restlessness compared with men only two years after the implementation of the UTCP, this pattern may reflect women's disproportionate burden of housework and fertility-related pressure (Qian and Jin, 2018; Yang and Zheng, 2020). Compared with their partners, women are expected to assume greater responsibility for household chores, caregiving, and childbearing. At the same time, they face discrimination and disadvantages in the labour market, lower salaries, reduced interpersonal interaction, and fewer social activities (Killewald, 2013; Roeters et al., 2016; Qian and Jin, 2018; Yang and Zheng, 2020; He et al., 2023). Consequently, Women are overwhelmed by pressures from both familial expectations and societal responsibilities, which may contribute to the weaker improvements in specific emotions among women, particularly in depression and restlessness.

This chapter also explores the heterogeneity in the effects of the UTCP across different age cohorts by introducing triple interaction terms between *Age*, *Treatment Group*, and *Post Treatment (year)*. Table 2-4 presents the regression results, estimated using the same empirical framework as before. Individual, year, and province fixed-effects are again included.

Table 2-4: Regression Results of Difference-in-Differences Analysis with Interactions of Age Cohorts and Treatment Group

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
(Age 18-30) UTCP Affected×	-0.021**	-0.060	-0.097**	-0.113***	-0.093	0.021
Post Treatment 1 (Year 2016)	(-2.340)	(-1.579)	(-2.504)	(-2.843)	(-0.840)	(0.357)
(Age 18-30) UTCP Affected×	-0.028***	-0.056	-0.195***	-0.187***		0.160**
Post Treatment 2 (Year 2018)	(-2.735)	(-1.345)	(-4.924)	(-3.613)		(2.066)
Age 31-40×UTCP Affected×	-0.011	0.018	0.007	0.027	-0.068	0.084
Post Treatment 1 (Year 2016)	(-0.795)	(0.350)	(0.141)	(0.496)	(-0.424)	(0.997)
Age 31-40×UTCP Affected×	0.017	0.060	0.102**	0.138**		-0.051
Post Treatment 2 (Year 2018)	(1.216)	(1.170)	(2.041)	(2.206)		(-0.513)

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VARIABLES	(1) Mental Health Symptom	(2) Depression	(3) Needs Effort	(4) Restless	(5) Hopeless	(6) Observed Health
Age 41-60×UTCP Affected×	0.021*	0.066	0.118**	0.154***	0.138	0.101
Post Treatment 1 (Year 2016)	(1.796)	(1.417)	(2.463)	(3.101)	(0.984)	(1.422)
Age 41-60×UTCP Affected×	0.004	0.027	0.145***	0.296***		-0.159*
Post Treatment 2 (Year 2018)	(0.340)	(0.542)	(2.974)	(4.916)		(-1.760)
Age Over 60×UTCP Affected×	0.010	0.185***	0.105	0.244***	0.252	0.027
Post Treatment 1 (Year 2016)	(0.612)	(2.904)	(1.635)	(3.522)	(1.324)	(0.286)
Age Over 60×UTCP Affected×	0.006	0.033	0.225***	0.267***		-0.266**
Post Treatment 2 (Year 2018)	(0.337)	(0.565)	(3.683)	(3.656)		(-2.388)
Constant	-0.063	-0.290	0.505	0.345	-4.052***	5.055***
	(-0.280)	(-0.461)	(0.710)	(0.578)	(-11.153)	(4.354)
Observations	38,798	38,860	38,876	38,887	15,085	35,140
R-squared	0.016	0.007	0.041	0.061	0.383	0.014
Number of pid	13,442	13,442	13,443	13,443	12,914	13,282

Note: The table presents empirical results from difference-in-differences regressions that include individual, year, and province fixed-effects. The dependent variables differ across specifications and cover*Mental Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *Age Cohort×UTCP Affected×Post Treatment (Year)* represents a triple interaction among the *Age cohort* indicator, the *UTCP affected* dummy, and the *Post Treatment (Year)* indicator in the difference-in-differences framework. Here, *Age Cohort* denotes whether a respondent falls within a specific age group, *UTCP Affected* denotes whether a respondent was subject to the policy change, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2-1. Full regression results including all covariates are reported in Table S2-5 in the Appendix. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 90% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 99% confidence interval.

Results in Table 2-4 indicate that the effects of the UTCP on health outcomes are most pronounced among respondents aged 18 to 30, who serve as the reference group in this heterogeneous specification. Following the implementation of the UTCP, affected individuals in this age cohort experienced a significant reduction in the risk of severe mental health symptoms of -0.021 (95% CI = -0.039 to -0.003). This reduction persisted two years after the implementation, with an estimated effect of -0.028 (95% CI = -0.048 to -0.008). Additionally, respondents in this age group reported significant reductions in the frequency of feeling that everything needs effort and restlessness. These respondents also exhibited a significant improvement in interviewer-observed physical health in the second post-treatment period, while the corresponding estimate is relatively small in magnitude and statistically insignificant in the first year following the policy change.

Compared with respondents aged 18 to 30, respondents aged 31 to 40 do not exhibit statistically significant differences in health outcomes in the first year following the implementation of the UTCP. Two years after the policy change, significant differences are observed for the frequency of feeling that everything needs effort and restlessness but not for the remaining

health outcomes. The estimated coefficients of the interaction term for these emotions are positive and statistically significant, suggesting that the reductions observed among the youngest cohort are smaller for respondents aged 31 to 40.

For respondents aged 41 to 60 and those over 60, the improvements in several health outcomes are significantly weaker than those observed among the 18 to 30 age cohort. Compared with the youngest group, these respondents exhibited significantly worse interviewer-observed physical health status two years after the UTCP implementation. In particular, the reduction in the frequency of feeling that everything needs effort and the frequency of restlessness observed among the youngest group are largely offset in these older age cohorts. In certain cases, the positive coefficients are large enough to fully offset the improvements observed among the youngest group, indicating no net reduction in these emotions for older respondents. These findings are not surprising, given the influence of traditional cultural norms and contemporary social conditions in China, where middle-aged and older adults often assume a greater share of childcare responsibilities following the birth of additional grandchildren. Overall, these results suggest clear age-related heterogeneity in the effects of the UTCP implementation, with improvements in mental and physical health concentrated among younger individuals and progressively weaker or absent among older cohorts.

This chapter further explores the effects of the UTCP on mental health of respondents from regions with varying levels of development. The more developed regions include China's four municipalities and five other provinces that ranked in the top 10 in per capita GDP and per capita disposable income in 2016.[2] Table 2-5 presents the regression results based on the original empirical model, with Panel A covering respondents from less developed regions and Panel B covering respondents from more developed regions.

Table 2-5: Regression Results of Difference-in-Differences Analysis on Areas with Different Development Levels

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
			Panel A: Less Developed Areas			
UTCP Affected×	-0.021***	-0.035	-0.046*	-0.029	0.015	0.077**
Post Treatment 1 (Year 2016)	(0.007)	(0.027)	(0.027)	(0.029)	(0.076)	(0.039)
UTCP Affected×	-0.025***	-0.042	-0.090***	-0.018		0.008
Post Treatment 2 (Year 2018)	(0.007)	(0.027)	(0.027)	(0.030)		(0.046)
Constant	-0.106	0.135	0.653	0.162	-11.639	5.696***
	(0.254)	(0.701)	(0.825)	(0.669)	(7.185)	(1.128)

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[2]In 2016, the regions in China that ranked in the top 10 in both per capita GDP and per capita disposable income included the four municipalities (Beijing, Shanghai, Tianjin, and Chongqing) and five provinces (Jiangsu, Zhejiang, Fujian, Guangdong, and Shandong).

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	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
Observations	28,567	28,601	28,611	28,616	11,164	25,959
R-squared	0.018	0.006	0.040	0.055	0.373	0.015
Number of pid	9,996	9,996	9,997	9,997	9,577	9,868
	Panel B: More Developed Areas					
UTCP Affected×	0.007	0.066*	-0.013	0.012	-0.070	0.074
Post Treatment 1 (Year 2016)	(0.009)	(0.036)	(0.035)	(0.040)	(0.114)	(0.057)
UTCP Affected×	-0.012	-0.003	-0.028	0.075*		-0.017
Post Treatment 2 (Year 2018)	(0.009)	(0.036)	(0.036)	(0.042)		(0.064)
Constant	1.057**	-0.054	2.750**	0.688	-4.479***	3.616
	(0.443)	(1.167)	(1.086)	(1.511)	(0.447)	(2.663)
Observations	10,231	10,259	10,265	10,271	3,921	9,181
R-squared	0.017	0.011	0.044	0.079	0.403	0.016
Number of pid	3,665	3,665	3,665	3,665	3,343	3,462

Note: The table presents empirical results from difference-in-differences regressions by regions with development levels. Panel A reports the results for less developed areas and Panel B reports the results for more developed areas. The dependent variables differ across specifications and cover*Mental Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *UTCP Affected*×*Post Treatment (Year)* represents the interaction between the *UTCP Affected* dummy and the *Post Treatment (Year)* indicator in the difference-in-differences framework. Here, *UTCP Affected* denotes whether a respondent was subject to the policy change, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2-1. Full regression results including all covariates are reported in Table S2-6 in the Appendix. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 90% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 99% confidence interval.

The results indicate that the positive effects on mental health are more pronounced among respondents from less developed regions. Following the implementation of the UTCP, affected respondents from less developed regions reported a statistically significant reduction in the risk of severe mental health illness (-0.021, 95% CI = -0.035 to -0.007), with this improvement in mental health persisting two years after the relaxation of fertility restrictions (-0.025, 95% CI = -0.040 to -0.011). In addition, a statistically significant reduction is observed in the frequency of feeling that everything needs effort among these respondents in both post-treatment periods. These respondents also experienced a significant improvement in interviewer-observed physical health status in the first year following the UTCP implementation, although this effect did not persist two years later.

Improvements in mental health were not observed among respondents from more developed regions. Affected respondents from these regions showed no significant changes in the risk of severe mental health illness or in the interviewer-observed physical health. However, some adverse changes in specific emotions are observed among these respondents. Specifically, affected respondents from more developed regions reported a significant increase in the

frequency of depression in the first year following the implementation of the UTCP, as well as a significant increase in the frequency of restlessness two years after the policy change.

The varying effects of the UTCP on the mental health of respondents from regions with different development levels may be attributable to the differing magnitude of the enhancement in reproductive autonomy as perceived by respondents after the policy change. Although all affected respondents from different regions were granted permission to have a second child, the practical feasibility of doing so differ by regional development level. For affected respondents from less developed areas, the UTCP created a genuine opportunity to have additional children as desired, since the primary barrier had been the fertility restrictions.

However, for affected respondents from more developed regions, barriers to having additional children extended beyond fertility restrictions to include practical concerns, such as the financial cost of raising another child. These practical concerns made having more children a less feasible option even after the relaxation of the fertility restrictions. This finding suggests that the improvements in mental health may stem from enhanced reproductive autonomy. If relaxing fertility restrictions only marginally enhance this autonomy—because of other factors, such as economic pressures, remain significant—the resulting mental health benefits would likely be limited.

To explore the mechanism underlying the health improvement resulting from the implementation of the UTCP, this chapter conduct a heterogeneity analysis by respondents' marital status[3]. Table 2-6 presents the results of marital status heterogeneity analysis based on the original empirical specification, with Panel A presenting the results for unmarried individuals and Panel B presenting the results for married individuals.

As shown in Panel A, no statistically significant changes in health outcomes are observed among unmarried individuals. By contrast, the improvements in mental health resulting from the UTCP appear more evident among married individuals. The results in Panel B indicate that, although the estimated effect is not statistically significant in the first post-treatment period, married individuals experienced a statistically significant reduction in the risk of severe mental health illness two years after the policy change (-0.019, 95% CI = -0.031 to -0.006). The improvement in mental health among married individuals is also reflected in a statistically significant reduction in the frequency of feeling that everything needs effort. Married individuals also exhibited a significant improvement in interviewer-observed physical health following the UTCP implementation, though this improvement did not persist two years later.

[3]Respondents' marital status in the CFPS dataset includes five categories. In this chapter's heterogeneity analysis by marital status, respondents who reported "Never married" are classified as "Unmarried" and who reported "Married (having a spouse)" are classified as "Married". Respondents who reported marital status as cohabitation, divorced, and widowed are excluded from the analysis.

Table 2-6: Regression Results of Difference-in-Differences Analysis by Marriage Status

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
			Panel A: Unmarried Sample			
UTCP Affected×	-0.017	0.052	0.019	0.010	-0.062	-0.017
Post Treatment 1 (Year 2016)	(0.014)	(0.061)	(0.062)	(0.071)	(0.175)	(0.107)
UTCP Affected×	-0.014	0.066	-0.058	-0.074		-0.030
Post Treatment 2 (Year 2018)	(0.016)	(0.068)	(0.066)	(0.084)		(0.145)
Constant	-0.053	-3.652***	-2.685**	-1.150	0.502	6.913*
	(0.365)	(1.263)	(1.177)	(1.447)	(5.758)	(3.708)
Observations	3,571	3,572	3,572	3,572	1,403	2,738
R-squared	0.020	0.048	0.027	0.043	0.359	0.026
Number of pid	1,406	1,407	1,407	1,407	1,254	1,325
			Panel B: Married Sample			
UTCP Affected×	-0.010	-0.018	-0.039*	-0.011	0.006	0.104***
Post Treatment 1 (Year 2016)	(0.006)	(0.023)	(0.023)	(0.025)	(0.070)	(0.035)
UTCP Affected×	-0.019***	-0.038	-0.071***	0.023		0.038
Post Treatment 2 (Year 2018)	(0.006)	(0.023)	(0.023)	(0.026)		(0.040)
Constant	0.073	-0.148	1.066	0.770	-20.699***	5.114***
	(0.166)	(0.755)	(0.793)	(0.615)	(0.812)	(1.329)
Observations	33,261	33,309	33,324	33,332	12,967	30,550
R-squared	0.016	0.006	0.047	0.064	0.382	0.014
Number of pid	11,638	11,638	11,638	11,638	11,054	11,474

Note: The table presents empirical results from difference-in-differences regressions by marital status. Panel A reports the results for unmarried respondents and Panel B reports the results for married respondents. The regressions follow the baseline difference-in-differences specifications reported in Table 2-2. The dependent variables differ across specifications and cover*Mental Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *UTCP Affected*×*Post Treatment (Year)* represents the interaction between the *UTCP Affected* dummy and the *Post Treatment (Year)* indicator in the difference-in-differences framework. Here, *UTCP Affected* denotes whether a respondent was subject to the policy change, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2-1. Full regression results including all covariates are reported in Table S2-7 in the Appendix. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 90% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 99% confidence interval.

The results reported in Table 2-6 are consistent with the interpretation that the relaxation of fertility restrictions leads to improvements in mental health by enhancing perceived reproductive autonomy. Compared with unmarried individuals, married individuals are more directly exposed to childbearing decisions and fertility restrictions. The relaxation of fertility restrictions may therefore enhance reproductive autonomy and reduce pressure related to family planning among married individuals. As a result, the implementation of the UTCP may have more direct effects on married individuals and contribute to improvements in their mental health. By contrast, unmarried individuals are less directly affected by the implementation of the UTCP in the short run, as childbearing decisions may be less immediately relevant. Their

perceived relevance to the policy may emerge in the future, which may explain the absence of statistically significant effects among unmarried individuals.

This chapter further explores the heterogeneous effects of the implementation of the UTCP on health outcomes across regions with different levels of fertility. The provinces in China that fall into the upper half of the fertility rates distribution in 2014 are defined as regions with higher levels of fertility, while the remaining provinces are classified into regions with lower fertility.[4] Table 2-7 reports the results of the heterogeneity analysis by regional fertility levels. Panel A presents the results for respondents from areas with lower fertility rates and Panel B presents the results for respondents from areas with higher fertility rates.

The results reported in Table 2-7 indicate that the effects of the implementation of the UTCP on health outcomes vary across regions with different levels of fertility. As shown in Panel A, respondents from regions with lower fertility rates experienced a statistically significant reduction in the risk of severe mental health illness two years after the UTCP implementation, although the corresponding estimate is not statistically significant in the first year following the policy change. These respondents also exhibited modest but statistically significant improvements in the interviewer-observed physical health in both post-treatment periods. In addition, statistically significant reductions are observed in the frequency of depression and feeling that everything needs effort among these respondents two years after the UTCP implementation.

Table 2-7: Regression Results of Difference-in-Differences Analysis by Regional Fertility Levels

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
	Panel A: Areas with Lower Fertility Rates					
UTCP Affected×	-0.008	0.003	-0.043	0.015	-0.064	0.074*
Post Treatment 1 (Year 2016)	(0.007)	(0.027)	(0.027)	(0.029)	(0.080)	(0.039)
UTCP Affected×	-0.023***	-0.052*	-0.060**	0.040		0.086*
Post Treatment 2 (Year 2018)	(0.008)	(0.027)	(0.028)	(0.030)		(0.045)
Constant	0.303	0.097	1.110	1.297*	-3.624***	6.785***
	(0.206)	(0.846)	(0.949)	(0.663)	(0.256)	(1.281)
Observations	23,030	23,068	23,081	23,088	8,961	20,822
R-squared	0.017	0.007	0.042	0.063	0.375	0.026
Number of pid	8,094	8,094	8,095	8,095	7,667	7,886
	Panel B: Areas with Higher Fertility Rates					

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[4]The classification is based on provincial fertility rates reported by the National Bureau of Statistics. In 2014, the provinces in China that fall into the upper half of the fertility rates distribution were Xinjiang, Tibet, Qinghai, Hainan, Shandong, Guangxi, Fujian, Hunan, Jiangxi, Hebei, Ningxia, Guizhou, Anhui, Henan, and Yunnan.

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VARIABLES	(1) Mental Health Symptom	(2) Depression	(3) Needs Effort	(4) Restless	(5) Hopeless	(6) Observed Health
UTCP Affected×	-0.020**	-0.017	-0.019	-0.065*	0.102	0.103*
Post Treatment 1 (Year 2016)	(0.009)	(0.037)	(0.036)	(0.039)	(0.105)	(0.057)
UTCP Affected×	-0.019**	0.012	-0.095***	-0.038		-0.053
Post Treatment 2 (Year 2018)	(0.009)	(0.036)	(0.034)	(0.041)		(0.065)
Constant	-0.457	-0.219	-0.505	-0.977	-10.477	4.045***
	(0.406)	(0.801)	(0.754)	(1.035)	(14.839)	(1.250)
Observations	15,768	15,792	15,795	15,799	6,124	14,318
R-squared	0.018	0.006	0.039	0.056	0.392	0.005
Number of pid	5,551	5,551	5,551	5,551	5,251	5,440

Note: The table presents empirical results from difference-in-differences regressions by regional ferility levels. Panel A reports the results for respondents from areas with lower fertility levels and Panel B reports the results for respondents from areas with higher fertility levels. The regressions follow the baseline difference-in-differences specifications reported in Table 2-2. The dependent variables differ across specifications and cover*Mental Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *UTCP Affected*×*Post Treatment (Year)* represents the interaction between the *UTCP Affected* dummy and the *Post Treatment (Year)* indicator in the difference-in-differences framework. Here, *UTCP Affected* denotes whether a respondent was subject to the policy change, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2-1. Full regression results including all covariates are reported in Table S2-8 in the Appendix. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 90% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 99% confidence interval.

For respondents from regions with higher fertility rates, a significant reduction in the risk of severe mental health illness is observed in both post-treatment periods. In addition, these respondents experienced a significant improvement in the interviewer-observed physical health in the first year following the UTCP implementation, though this improvement did not persist over two years. In terms of specific emotions, these respondents experienced significant reductions in the frequency of restlessness in the first year following the UTCP implementation, as well as a significant reduction in the frequency of feeling that everything needs effort two years after the policy change.

While the patterns of the estimated effects are not uniform between regions with different fertility levels, there is no clear evidence of a systematic difference in the magnitude of the observed improvements in health outcomes. These findings do not contradict the previously mentioned interpretation. Regardless of the regional fertility levels, the implementation of the UTCP could enhance the perceived reproductive autonomy among affected individuals, which may contribute to improvements in mental and physical health.

Under the identification strategy used in the baseline analyses, the treatment group is jointly determined by policy exemption prior to the implementation of the UTCP, the number of children a respondent would ideally have, and the number of children they have already had. Individuals who did not satisfy any pre-UTCP policy exemption but would ideally have no

more than one child or already had more than one child are considered not affected by the implementation of the UTCP as the permission to have a second child and the consequent enhanced reproductive autonomy are assumed to be less relevant to them. However, these individuals should not necessarily be treated equivalent to those who were already eligible to have a second child prior to the UTCP implementation.

To further explore whether the UTCP has any effects on health outcomes among these individuals, I conduct additional analyses using a broader treatment definition based solely on the eligibility for the policy exemption prior to the UTCP and restricting the sample to respondents of reproductive age (aged 16~45). The variable *Exemption Ineligible* is defined as the treatment dummy indicator for the following analysis, taking the value 1 if the respondent is not eligible for any exemptions to have a second child prior to the implementation of the UTCP and 0 otherwise. Table 2-8 reports the results.

The results in Table 2-8 suggest that respondents whose ideal number of children is less than or equal to one experienced statistically significant reductions in the risk of severe mental health illness in the first year following the implementation of the UTCP and in the frequency of restlessness two years after the policy change. Statistically significant changes for the remaining health outcomes are not observed. For respondents who did not satisfy any exemption prior to the UTCP but had already had more than one child, statistically significant reductions in mental health outcomes are not observed. However, the estimated coefficients for interviewer-observed health are negative and statistically significant, suggesting that these respondents experienced a deterioration in the physical health following the policy change.

Table 2-8: Regression Results of Difference-in-Differences Analysis by Fertility Preferences and Existing Number of Children

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
	Panel A: Respondents with Ideal Number of Children $\leq$ 1					
Exemption Ineligible×	-0.028**	-0.045	-0.065	-0.108	-0.217	-0.026
Post Treatment 1 (Year 2016)	(0.014)	(0.062)	(0.059)	(0.069)	(0.187)	(0.097)
Exemption Ineligible×	-0.004	0.035	-0.024	-0.171**		0.021
Post Treatment 2 (Year 2018)	(0.017)	(0.068)	(0.061)	(0.068)		(0.116)
Constant	-0.982	-3.628	-0.432	-1.506	-12.231***	14.784
	(0.619)	(2.756)	(1.955)	(2.923)	(2.266)	(9.927)
Observations	2,439	2,440	2,440	2,440	1,032	2,079
R-squared	0.038	0.045	0.037	0.079	0.449	0.034
Number of pid	927	928	928	928	909	921
	Panel B: Respondents Already Have More than One Child					
Exemption Ineligible×	-0.017	0.003	-0.029	-0.036	-0.041	-0.167***

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	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
Post Treatment 1 (Year 2016)	(0.012)	(0.042)	(0.041)	(0.043)	(0.112)	(0.059)
Exemption Ineligible×	-0.007	0.045	-0.008	0.042		-0.233***
Post Treatment 2 (Year 2018)	(0.013)	(0.045)	(0.043)	(0.047)		(0.071)
Constant	0.399	-0.532	-0.589	-0.657	-15.070***	0.005
	(0.467)	(1.653)	(1.470)	(1.562)	(1.593)	(3.182)
Observations	6,766	6,769	6,773	6,773	3,085	6,086
R-squared	0.019	0.012	0.034	0.036	0.357	0.010
Number of pid	2,776	2,777	2,777	2,777	2,698	2,744

Note: The table presents empirical results from difference-in-differences regressions for respondents with different fertility preference and existing number of children. Panel A reports the results for respondents who would ideally have no more than one child and Panel B reports the results for respondents who already have more than one child. The analyses use broader treatment definition based only on the policy exemption prior to the UTCP implementation. The sample is restricted to respondents of reproductive age (16~45). The dependent variables differ across specifications and cover*Mental Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *Exemption Ineligible*×*Post Treatment (Year)* represents the interaction between the *Exemption Ineligible* dummy and the *Post Treatment (Year)* indicator in the difference-in-differences framework. Here, *Exemption Ineligible* denotes whether a respondent was ineligible for any exemptions of having a second child prior to the implementation of the UTCP, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2-1. Full regression results including all covariates are reported in Table S2-9 in the Appendix. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 90% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 99% confidence interval.

These results suggest that the relaxation of fertility restrictions has limited effects on health outcomes among respondents who would ideally have no more than one child. The relaxation of fertility restrictions may still enhance perceived reproductive autonomy and reduce psychological constraints among them, which may contribute to the observed improvements in the mental health symptom index and restlessness. At the same time, the deterioration in the interviewer-observed health among respondents who had already had more than one child may reflect changes in behavioural or physical conditions that were not captured by mental health measures. However, identifying the underlying mechanism would require more direct evidence on the channels through which the policy affected health outcomes among these respondents.

Since older respondents generally have limited fertility, the implementation of the UTCP is expected to be less relevant to them than to respondents of reproductive age. However, the relaxation of fertility restrictions may still affect older respondents indirectly through expansion in their younger family members' fertility opportunities, such as by increasing the likelihood of having additional grandchildren. To examine whether older family members were indirectly affected by the UTCP implementation through younger family members, I conduct an additional analysis using a broader household-based treatment definition and restricting the sample to respondents aged 50 or above. Older respondents are defined as potentially affected if they belong to the same family as respondents of reproductive age who

were classified into the treatment group under the baseline specification. Table 2-9 presents the results.

Table 2-9: Regression Results of Difference-in-Differences Analysis for Older Family Members

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
Older Family Linked×	0.003	-0.099**	-0.003	-0.049	-0.222	-0.034
Post Treatment 1 (Year 2016)	(0.015)	(0.050)	(0.053)	(0.056)	(0.152)	(0.079)
Older Family Linked×	0.026	-0.109**	-0.028	0.058		-0.142
Post Treatment 2 (Year 2018)	(0.017)	(0.052)	(0.056)	(0.058)		(0.090)
Constant	1.150**	3.163	-0.953	2.958***	-4.650***	7.282***
	(0.534)	(2.175)	(1.827)	(1.021)	(0.969)	(2.383)
Observations	5,730	5,745	5,751	5,755	1,963	5,488
R-squared	0.026	0.016	0.061	0.087	0.416	0.015
Number of pid	2,322	2,322	2,322	2,322	1,665	2,275

Note: The table presents empirical results from difference-in-differences regressions for older family members aged 50 or above. The dependent variables differ across specifications and cover *Mental Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *Older Family Linked*×*Post Treatment (Year)* represents the interaction between the *Older Family Linked* dummy and the *Post Treatment (Year)* indicator within the difference-in-differences framework. Here, *Older Family Linked* denotes whether a respondent is considered an older family member linked to a respondent of reproductive age who was affected by the UTCP, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2-1. Full regression results including all covariates are reported in Table S2-10 in the Appendix. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 90% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 99% confidence interval.

The results reported in Table 2-9 suggest that the implementation of the UTCP appear to have very limited effects on health outcomes among older family members. Older respondents who were potentially linked to the policy through younger family members exhibited statistically significant reductions only in the frequency of depression, while no significant changes are observed for the remaining health outcomes. These findings suggest that the mental health improvements identified in the baseline analyses may primarily reflect enhanced reproductive autonomy among respondents of reproductive age. Furthermore, they imply that the intergenerational effects of relaxation of fertility restrictions on older are likely to be limited and indirect.

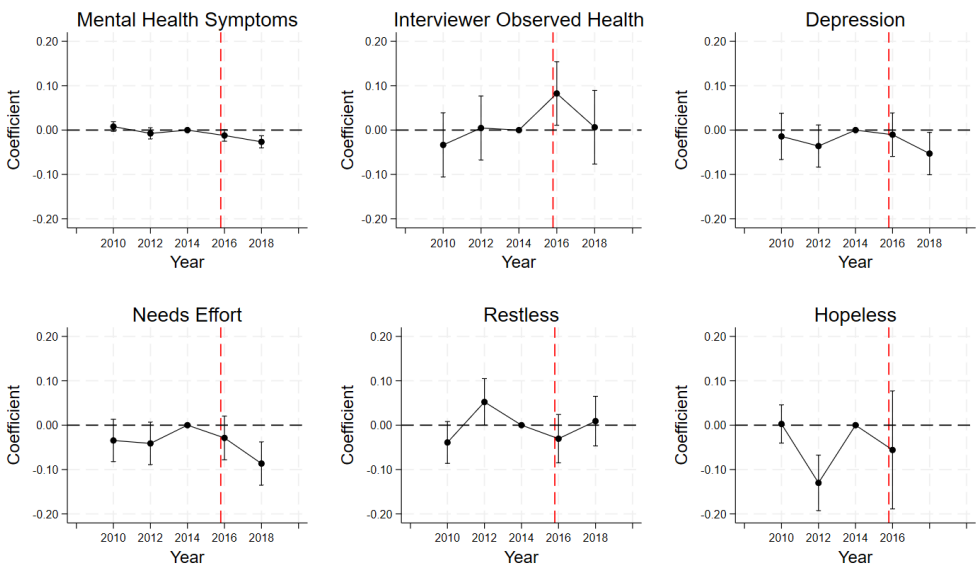
Test of Parallel Trends

I conduct a series of event-study analyses to examine the plausibility of the parallel trending assumption underlying the DiD approach. Figure 2-1 presents the estimated treatment effects for the mental and physical health outcomes.

For mental health symptoms, the pre-treatment coefficients are very close to zero and statistically insignificant, showing no evidence of systematic divergence between the treatment and control groups prior to 2016. These patterns are consistent with the parallel trends assumption. Following the implementation of the UTCP, individuals affected by the permission to have a second child experienced a significant improvement in mental health, as evidenced by a reduction in the risk of severe mental health illness—a pattern not observed among individuals unaffected by the UTCP. The improvement persists for two years after the policy change, suggesting a potential long-term effect on mental health.

A similar trend is also observed for interviewer observed health status, as there is no differential pre-trend between the treatment and control groups prior to the UTCP. After the policy implementation, individuals in the treatment group exhibit an improvement in physical health relative to the control group. By 2018, however, these differences are no longer statistically significant , suggesting that the UTCP's impact on physical health may not be sustained in the long term.

Figure 2-1: Parallel-Trends Test with Event-Study Estimation



Note: The figure plots the estimated coefficients in event-study for mental and physical health outcomes before and after the implementation of the UTCP. The year 2014 is the omitted reference period in each specification. The dots represent the estimated coefficients for different periods with 95% confidence interval and robust standard errors. All regressions control for individual, year, and province fixed effects. The estimated coefficient for *Hopeless* is not reported for 2018, as the 8-item CES-D scale used in that wave does not include a question on the frequency of feeling hopeless. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.

For specific emotions related to mental health, the estimated pre-treatment coefficients are generally close to zero and do not exhibit systematic trends prior to the UTCP, although the coefficient for Hopeless in 2012 is statistically different from zero. Affected respondents generally experienced reductions in the frequency of depression and in the frequency of feeling that everything needs effort two years after the UTCP implementation, although the coefficients are not statistically significant in 2016. Overall, the absence of consistent or

monotonic pre-treatment divergence suggests that the parallel pre-trends assumption does not appear to be violated, although the evidence is weaker for hopelessness.

The deviations observed in 2012 for hopelessness could be partly attributable to differences in mental health measurement scales across waves. In particular, the 2014 CFPS employs the K6 scale rather than the CES-D scale used in the other waves. Although the K6 scale also contains questions that measure the same negative emotions, these questions are phrased slightly differently and refer to different lengths of time compared with those in the CES-D eight-item scale. Moreover, although I attempted to convert the 0–4-point K6 scale to the 0–3-point CES-D eight-item scale, the measures of specific emotions in 2014 cannot be considered fully comparable to those in other waves of the CFPS.

Robustness Checks

I conduct several robustness checks to assess whether the baseline results are sensitive to alternative sample definitions or alternative choice of reference year. The corresponding results are presented in Tables S2-11, S2-12, and S2-13 in the Appendix. Overall, the results remain qualitatively consistent with the baseline findings.

As the classification of treatment and control groups partly depends on the number of children a respondent would ideally have, the respondents who reported changes in their ideal number of children after the UTCP implementation were excluded from the baseline sample to ensure that treatment status is determined solely by pre-policy characteristics rather than post-policy responses. In the first robustness check, I reintroduce these respondents to the analysis. Moreover, because ethnic minorities in China differ systematically from the Han majority in fertility preferences, policy eligibility, and socio-cultural characteristics, I conduct a second robustness check that excludes ethnic minority respondents. The results remain robust under both alternative samples. The sign, magnitude, and statistical significance of the estimated coefficients are similar to those in the baseline specification. These results indicate that the estimated effects in the baseline analyses are unlikely to be driven by sample selection or compositional differences.

In the third robustness check, I re-estimated the model using 2012 as the reference year instead of 2014. As reported in Table S2-12, the interaction terms between the treatment indicator and the 2014 dummy are not statistically significant for mental health symptom index and interviewer-observed health, suggesting that affected and unaffected individuals did not differ significantly in the risk of severe mental health illness and in physical health in 2014 relative to the 2012 baseline. By contrast, significant pre-treatment differences are observed for several specific emotions, indicating that the treatment and control groups already differed

in these emotional dimensions before the implementation of the UTCP when 2012 is used as the reference year.

Affected individuals also exhibited a statistically significant improvement in the interviewer-observed health in the first post-treatment period and a statistically significant reduction in the risk of severe mental health illness in the second post-treatment period, suggesting the effects of the UTCP implementation on health outcomes remained when 2012 is used as the reference year in the analyses. However, the estimates for specific negative emotions are generally not statistically significant in the post-treatment periods relative to the 2012 baseline. Taken together, these results are broadly consistent with the findings in the baseline estimates but also suggest that 2012 is a less suitable reference year for the main analysis.

2.5 Conclusion

Despite the prevalence of various fertility restrictions worldwide, their impact on mental health has received only limited attention from researchers. Moreover, none of the existing studies have examined the effects of relaxing fertility restrictions on mental health. The UTCP, the first major relaxation of China's stringent family planning policy after 35 years, is expected to have profound impacts on various aspects of China, providing a valuable opportunity to investigate its effect on mental health. For the first time, this chapter examines the causal relationship between the relaxation of fertility restrictions and mental health by using the implementation of the UTCP through a difference-in-differences approach and a unique identification strategy.

This chapter presents empirical evidence showing that the risk of severe mental illness among individuals affected by the policy relaxation declined significantly compared with that of individuals in the control group. The relaxation of fertility restrictions reduced the frequency of feeling that everything needs effort among affected individuals, though no significant changes are observed for other specific negative emotions. Moreover, this chapter provides evidence indicating that the relaxation has led to significant improvements in physical health.

Moreover, this chapter finds clear gender differences in the health response to the UTCP. Relative to affected men, affected women generally experience weaker improvements in mental health. While affected women did not differ significantly in mental health symptom and interviewer-observed health from affected men, they exhibited differences in the changes in several specific negative emotions. In particular, while the frequency of depression, feeling that everything needs effort, and restlessness declined among affected men following the policy change, these reductions are substantially smaller for affected women and largely offsets the improvement observed among men two years after the implementation of the UTCP.

This chapter demonstrates that the mental health improvements resulting from the relaxation of fertility restrictions are most pronounced among individuals aged 18–30, as reflected in sustained and significant reductions in the risk of severe mental illness, the frequency of feeling that everything needs effort, and the frequency of restlessness. Individuals aged 31 to 40 did not exhibit significant differences in mental health symptoms index and interviewer-observed health relative to the youngest group, though the the reductions in the frequency of feeling that everything needs effort and restless appear to be weaker among them. Additionally, this chapter finds that the observed reductions in the frequency of feeling that everything needs effort and restlessness and the improvements in the interviewer-observed health among the youngest cohort are largely offset among middle-aged and older individual, potentially because they bear greater responsibility for caring for younger children in the family.

This chapter indicates that the positive effects on mental health of relaxing fertility restrictions are primarily concentrated among individuals from less developed regions and married individuals. In contrast, significant improvements were not observed among affected individuals from more developed regions and unmarried individuals following the policy change. These findings are consistent with the interpretation that the relaxation of fertility restriction may improve mental health by enhancing the perceived reproductive autonomy.

Although the results from a series of heterogeneity analyses provide supportive evidence for the interpretation that the improvements in mental health outcomes following the relaxation of fertility restrictions may be attributed to the enhanced reproductive autonomy, the underlying mechanism still requires further identification. On one hand, increased autonomy may lead affected couples to feel more entitled and empowered to make beneficial decisions regarding education, career, and family planning. The perceived control can reduce anxiety and depression that were previously stemmed from uncertainty and externally imposed constraints. While the former One-Child Policy may not have been the only barrier to having a second child, and such decisions are not necessarily made immediately, the permission alone may provisionally improve mental health by fostering a more optimistic outlook for the future.

On the other hand, mental health consequences of having an additional child are complex, particularly for women. Childbearing can enhance women's well-being through expectations of future emotional and financial support from children (Yang and Zheng, 2020). However, several studies document deteriorations in mental health among women after childbirth (Brown and Lumley, 1998; Saurel-Cubizolles et al., 2000; Woolhouse et al., 2014; Shi and Shen, 2023). Due to data limitations, it is difficult to determine the specific mechanisms behind the observed improvements in mental health following the UTCP. Further research is planned to explore these channels in greater detail.

This study is subject to several additional limitations. Due to limited data availability, the use of different psychiatric scales to measure respondents' mental health may have influenced the

outcomes. Additionally, further exploration of the causal effects of the relaxation of fertility restrictions on mental health across different national contexts is essential for drawing more generalisable conclusions.

Chapter 3: COVID-19 and mental health in China: the effects of personality [5]

3.1 Introduction

The effects of the COVID-19 pandemic on mental health in China, particularly regarding the stringent procedures put in place to control the spread of the virus, have received relatively little attention. A recent Lancet editorial emphasizes that mental health in China is a particularly compelling issue "because it plays out against the wider backdrop of mental health disorders in China, which remain largely unaddressed" (Lancet, 2022).

Therefore, given the size of the country and the potential extent of the problem, there are several reasons it is crucial to identify how individuals with different personalities may have experienced mental health effects associated with the pandemic. First, this can lead to identification of at-risk groups, as well as more personalized psychological or psychiatric treatments, especially for the post-COVID period (Aknin et al., 2022). Second, understanding how different personalities are affected in China, and comparing this reaction with individuals in other countries, may improve our understanding of how extreme situations affect mental health and the link between personality and mental health.

We analyze mental health deterioration in China during the first part of the pandemic thanks to the availability of a national representative dataset, the China Family Panel Studies (hereinafter CFPS). The panel structure of the CFPS dataset allows us to compare the same individuals over time (i.e., before and during the pandemic). Our analysis shows clear evidence of an increase in the prevalence of serious cases of depression between 2018 and 2020.

The CFPS dataset includes a set of standard personality questions derived from the "Big Five" model (Costa and McCrae, 2008), which gives us the opportunity to test how personality interacts with the pandemic to affect mental health. We find that openness is associated with more severe negative effects from the pandemic. Our findings are roughly in line with the previous analyses of the pandemic's effect on mental health, based on very different contexts and environments but with some interesting differences, as we discuss in the last section. We

[5] I declare that Chapter 3 is based on joint work with Professor Eugenio Proto (University of Glasgow) and Professor Michele Battisti (University of Glasgow). I contributed to data analysis, drafting the original manuscripts, and subsequent review and editing. Professor Eugenio Proto and Professor Michele Battisti contributed to conceptualisation, data analysis, drafting the original manuscripts, and subsequent review and editing. All other chapters in this thesis are my own independent work.

also provide further insights into the large amount of literature analyzing the link between personality and mental health (e.g., Kotov et al. (2010) for a comprehensive meta-analysis).

Moreover, using information on the province of residence at the time of the pandemic, we find that individuals that have been subject to strict lockdowns report a higher level of mental health deterioration; the observed deterioration during lookdown is largely due to changes among individuals who reported some depression symptoms before the pandemic rather than among individuals who did not report any symptoms in the prepandemic wave from 2018.

To the best of our knowledge, there are only two country-representative studies on how the COVID-19 pandemic affects well-being in China. Yang et al. (2020) compare emotional well-being from before the pandemic to the pandemic period and find that the beginning of the pandemic led to a 74% drop in overall emotional well-being. Zhou et al. (2022) use the CFPS dataset to examine how COVID-19 affects the mental health of individuals in different provinces. Their results are fully consistent with ours, although Zhou et al. (2022) do not analyze how personality affects mental health deterioration.

There are few country-representative contributions analyzing the mediating role of personality during the pandemic. Proto and Zhang (2021), like this, focus on how personality affects mental health deterioration, but in the UK; Cai and Zhou (2022) use the CFPS dataset to measure how COVID-19 pandemic restrictions affect smoking and how personality mediates this behavior. Giuntella et al. (2021) find that attitudes and, arguably, personality mediate how the restrictions affect mental health. In the last section, we discuss how the existing contributions on personality and restrictions during the pandemic relate to this study.

Focusing on specific groups of individuals, several studies find some mental health deterioration in China during the pandemic. However, these studies are limited by nonrepresentative data (Bo et al., 2021; Mei et al., 2021; Li et al., 2021a; Duan et al., 2020; Li et al., 2020; Guo et al., 2022; Wang et al., 2021b, among others). Finally, this study belongs to the large and growing amount of literature that uses data from several countries to investigate the effects of the pandemic on mental health (Proto and Zhang, 2021; Giuntella et al., 2021; Banks and Xu, 2020; Davillas and Jones, 2021; Etheridge and Spantig, 2020; Proto and Quintana-Domeque, 2021; Daly et al., 2021; Blanchflower and Bryson, 2022; Graham et al., 2020; Min et al., 2022; Brodeur et al., 2021, among others).

3.2 Materials and Methods

3.2.1 Data

The China Family Panel Studies

This chapter primarily uses the 2018 and 2020 waves of the CFPS (we report mental health data from the 2016 wave in only one figure). The CFPS is a large panel dataset representative of the Chinese population. The CFPS collected data for respondents of the 2018 wave from June 2018 to May 2019, and it collected data for respondents of the 2020 wave from July to December 2020. Though the data from the 2018 wave is collected across 12 months, more than 97% respondents (17626 observations out of 18127 observations) were interviewed between July and December 2018. We present the details of the cross-sectional and longitudinal dimensions in Table S3-1, while in Tables S3-2, S3-3, S3-4, S3-5 and S3-6 of the Supplementary Information for Chapter 3 (SI henceforth) in the Appendix we present the descriptive statistics of the variables used.

The 2018 wave had 37,354 total individual respondents; the 2020 wave had 28,590. After removing individual data with missing mental health information on the CES-D questionnaire (9,160 in total) and those who were part of the survey in 2018 but not in 2020 for various reasons, we have 18,127 respondents in both waves, as reported in Table S3-1 of the SI. We only consider respondents appearing in both waves in all our analyses, and we use the appropriate weights from the 2020 panel as the CFPS recommends.

Among individuals interviewed in 2018 for whom we have information on the CES-D and weights, 60.1% were reinterviewed in 2020. Although an attrition rate of around 40% is substantial, it compares favorably with previous work on the topic (Benzeval et al., 2020). To cope in part with the attrition, we use the suggested weights when using both waves. In Table S3-7 of the SI, we perform a simple attrition analysis showing that using data from the 2020 wave results in a younger sample. This is to be expected because older respondents from 2018 are less likely to appear in the 2020 wave. The average symptoms of depression slightly decrease in a consistent manner (the difference is nonsignificant at the 5% level). Average education and household income are also slightly higher, which is consistent with the age differences in this context.

China imposed two lockdowns at the province level in 2020. The first one was in the Hubei province from January 23 to April 8, 2020; the second one was in the Xinjiang province in July and August 2020. All residents in the Hubei and Xinjiang provinces were required to stay indoors and prohibited from leaving the region. All schools in Wuhan closed and switched to

online teaching; only authorized public service providers were permitted to leave home for work. Other provinces in China were less strict, and normal daily work and life continued as much as possible, but the residents of these provinces were still required to follow a series of containment measures that were inconvenient in many aspects (Ke and Hsiao, 2022).

There are two groups of respondents who experienced the strict lockdown. The first group includes respondents in the Hubei province for the entire 2020 wave, who experienced lockdown before the interview; the second group includes respondents in the Xinjiang province in lockdown during the interview, in July and August 2020. Due to the small sample size of the second lockdown, we group both lockdowns together in our analysis.

The Eight-item Centre for Epidemiologic Studies Depression Scale

To identify changes in mental health in the 2018 and 2020 waves, we use two measures based on the eight-item Center for Epidemiologic Studies Depression Scale, or CES-D scale. The eight-item CES-D scale is a well-known instrument for evaluating mental health, where the respondent reports the extent to which each of the eight symptoms is present in the few weeks before the survey takes place. The respondent can pick from a few possibilities for each of these symptoms, based on weekly frequencies: rarely (less than 1 day), a little (one or two days), occasionally (three or four days), or often (five-seven days). The eight-item CES-D scale is derived from the original 20-item scale, which is a commonly used self-rating scale to measure depressive symptomatology and is widely considered a valid instrument for screening for depression in older adults (Radloff, 1977). The reduced eight-item scale is also a valid and reliable instrument to detect depression (Karim et al., 2015).

Following common practice, we use a measure based on a binary indicator of risk of presenting with mental health problems (CES-D "caseness" score). In the 20-item questionnaire, each answer is coded between 0 (no symptoms) and 3 (frequent symptoms); the sum of the coded responses results in a score that falls between 0 and 60. If the total score is 28 or above, the subject is considered likely to have severe depression (Radloff, 1991; Wu, 2014). Accordingly, in the eight-item version (with a score ranging from 0 to 24) we classify an individual with a score of 12 and above (calculated using the 28/60 ratio from the 20-item version) as severely depressed. In the SI we will also show results considering a score of 8 or above, classified as mild depression. This corresponds to 20 in the 20 item questionnaire (this follows Vilagut et al. (2016) suggesting that using 20 points as cutoff is better than 16 points, originally classified as mild depression(Radloff, 1991)).

To measure the level of mental deterioration between the two waves, for each respondent we calculate the difference in symptoms between waves, where a symptom is present every time a respondent feels a specific way either occasionally (three or four days in a week) or often

(five-seven days in a week) as described in the questionnaire. We assume the total number of symptoms is a cardinal measure and therefore the level of deterioration (or the difference between the sum of symptoms in the pre-pandemic and pandemic waves) can be considered a cardinal measure, so we can use a simple linear OLS estimator for the regression. The mental health data, the other variables and further description of the data are in the SI (Tables S3-2, S3-3, and S3-4).

Big Five Personality Traits and Cognitive Skills

The 2018 wave of the CFPS dataset includes a set of standard personality questions derived from the most widely used taxonomy of personality, the "Big Five" model as measured by the Revised NEO Personality Inventory (NEO-PI-R) (Costa and McCrae, 2008). The five personality traits in the "Big Five" model are neuroticism (or emotional stability), extraversion, conscientiousness, agreeableness, and openness. Instead of using the origin NEO-PI-R with 60 items (12 items per domain), the CFPS measures relevant data with a shorter, 15-item questionnaire (three for each of the Big Five traits), as it is customary in large surveys (as Kotov et al. (2010) argues). Scale-development studies show that it is possible to assess the Big Five personality traits reliably using fewer items and the 15-item version in particular (Gosling et al., 2003; Benet-Martínez and John, 1998; Hahn et al., 2012).

The 2018 wave includes two measures of cognitive skills (a math test and verbal test). We average the two scores to have a unique measure of cognitive skills. In Table S3-5 of SI, we present the descriptive statistics of personality and cognitive variables, and in Table S3-6 we present the correlation matrix between each single personality trait and the measure of cognitive skills. The correlation among personality traits is the expected 1, with Openness, Conscientiousness, Extraversion, and Agreeableness correlating positively, Neuroticism correlates negatively.

Regression Analysis

The main empirical model we use in this study is a simple OLS regression of this form:

$$\Delta y_i = \alpha + \beta \cdot \text{lockdowns} + \pi X_i + \rho Z_i + e_i$$

where Δy_i is the change in the number of symptoms individual i reports using the CES-D as defined, between the 2018 and 2020 waves; *lockdowns* is a dummy that equals 1 if the respondent has experienced lockdown before the interview or is interviewed during a lockdown; X_i is a vector of demographic variables, and Z_i is an employment status indicator

in 2018. Finally, e_i is the error term of the regression. All regressions are estimated using 2020 weights and heteroskedasticity-robust standard errors.

3.3 Results

The left-hand panel of Figure 3-1 shows a significant increase in the prevalence of serious depression symptoms between the prepandemic years (2016 and 2018) and the first pandemic year (2020). We will refer to this difference as mental health deterioration. The prevalence of severe depression over our weighted sample is 7.86% (95% CI 7.44, 8.29) in 2020, which is a significant increase compared to 6.68% (95% CI 6.28, 7.07) in 2018 and to 6.74% (95% CI 6.30, 7.18) in 2016. The right-hand panel of Figure 3-1 investigates differences in the average symptoms of depression, which are measured using the eight-item CES-D scale. They rise from 1.09 (95% CI 1.07, 1.12) in 2016 and 1.16 (95% CI 1.13, 1.18) in 2018 to 1.22 (95% CI 1.19, 1.24) in 2020. This implies a significant difference of 0.060 (95% CI 0.034, 0.086) between 2020 and 2018.

The fact that the prevalence of serious depression is significantly higher in the pandemic year than in the previous two waves of data seems to rule out the possibility that these differences are because individuals are older in 2020. We nevertheless address this concern by estimating the effect of the COVID-19 pandemic on our mental health indicators (serious depression and symptoms) by controlling for Age and Age Squared for the 2018 and 2020 waves. The result is in Figure 3-2 (the full regression estimation is in Table S3-8 of the SI). From the top panel we note that the difference of effect before and after controlling for age is quite small (from 1.2% to 0.9%). From the bottom panel, we note a more substantial difference in terms of symptoms (from 0.061 to 0.038) that becomes nonsignificant at the 95% confidence interval (p-value = 0.065). Therefore, these results suggest that age has a larger effect on symptom reporting in the extensive margin (i.e., respondents with symptoms report more of them) than in the intensive margin (i.e., respondents report symptoms for the first time), but the opposite is true in the COVID-19 period. Hence, respondents who do not report symptoms previously begin to report them significantly more in the COVID-19 period, independently from their ages.

As a robustness checks: we consider a smaller cut-off point to define depression (which we define mild depression), and we report these results in the SI (Figure S3-1 and Table S3-9), where we can see that the pandemic year features an equally significant increase using this different cut-off; we also restricted all observation to the the same set of months (July-December), as we can observe from Figure S3-2 in the SI, the outcome is almost identical.

Figure 3-1: Depression before and during the pandemic

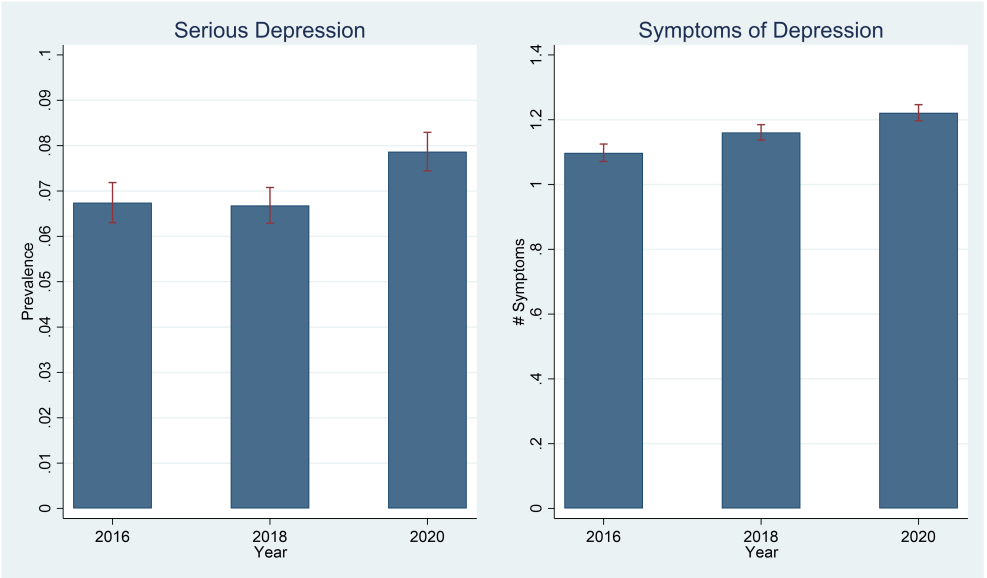


Figure 3-1: **Depression before and during the pandemic** In the left panel, serious depression occurs when respondents score 12 or more in the CES-D questionnaire. The right panel reports the average number of symptoms reported. The bars represent the 95% confidence intervals. Statistics are weighted using the survey sample weights. Data source: CFPS dataset, 2016, 2018, and 2020 waves. All statistics are produced using a weighted sample. Source: Isss.pku.edu.cn. 2023. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.

Figure 3-2: Estimated differences in depression before and during the pandemic, controlling by age

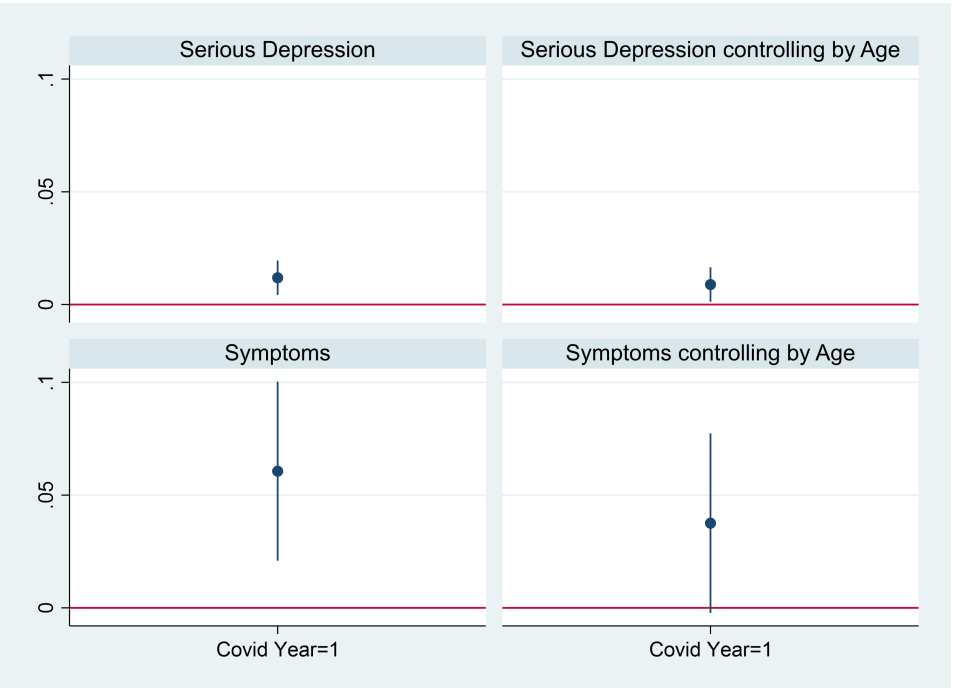


Figure 3-2: **Estimated differences in depression before and during the pandemic, controlling by age**. The figure reports the OLS coefficients of the COVID wave dummy in four separate regressions. In the top panels, the dependent variable is serious depression. In the bottom panels, the dependent variable is the symptoms reported. Data source: CFPS dataset 2018 and 2020 waves. The regressions in the right panels include the variables Age and Age Squared (unreported in the figure); the regressions in the left panels do not include the variables. The complete estimation of the two regressions is in Table S3-8 of the SI. The bars represent 95% confidence intervals with robust standard errors clustered at the individual levels. The four regressions include the same respondents, and the data sample is weighted to generate a population-representative estimation. Source: Isss.pku.edu.cn. 2023. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.

3.3.1 Mental Health Deterioration and Personality Traits

Next, we analyze whether individuals experience mental health deterioration more acutely if they have certain personality traits. Before delving into the mental health deterioration analysis, we estimate the correlations between mental health symptoms and personality traits in the 2018 wave (the only wave reporting personality data) using a simple linear cross-sectional regression, with and without other control variables. The results are in Table S3-10 of the SI. The effects are quite natural and in line with what is observed in other analyses (see e.g., Kotov et al. (2010) for an exhaustive meta-analysis). Neuroticism is a strong predictor of poor mental health (one standard deviation more predict 0.371 more symptoms of depression).

In Figure 3-3, we present the results of the estimation of how personality traits affect mental health deterioration (i.e., changes in mental health between 2018 and 2020) using a multivariable econometric model as outlined earlier with and without control variables for demographic factors (the full regressions are in Table S3-11 of the SI). From both regressions we note a strong effect of openness (see left panel of Figure 3-3, corresponding to column 1 of Table S3-11 of the SI), where a one-standard-deviation change in Openness corresponds to about 0.08 more symptoms (with and without control variables). Neuroticism is the other significant coefficient, negative and equal to -0.087, which may look surprising but is roughly in line with other studies analyzing how different personalities react to the pandemic, as argued in Proto and Zhang (2021) and in the final section of this article.

3.3.2 Mental Health Deterioration, Lockdowns, and Basic Demographic Variables

We analyze whether respondents subject to stricter lockdown measures experience mental health deterioration more acutely by estimating a multiple linear regression model. Figure 3-4 reports the estimated coefficients of the regression presented in our Materials and Methods section. It includes the 95% confidence intervals (see Table S3-12 in the SI for more details).

First, from the left panel, we note that individuals under lockdown measures (i.e., those living in the provinces of Hubei and Xinjiang) reported report over 0.4 more symptoms (hence, more than 1 in 2.5 individuals), compared to the central and the right panels. By comparing the central and the right panels of Figure 3-4, we note that individuals already reporting symptoms in the 2018 wave are more affected.

Second, in Figure 3-4 and Table S3-12 in the SI section, we note that females seem to experience less deterioration (about 0.09 fewer symptoms). Individuals with tertiary education report significantly less deterioration than individuals with only primary education (more than 0.2 symptoms fewer), and that deterioration increases among those with less education.

Figure 3-3: Mental health deterioration for individuals with different personalities

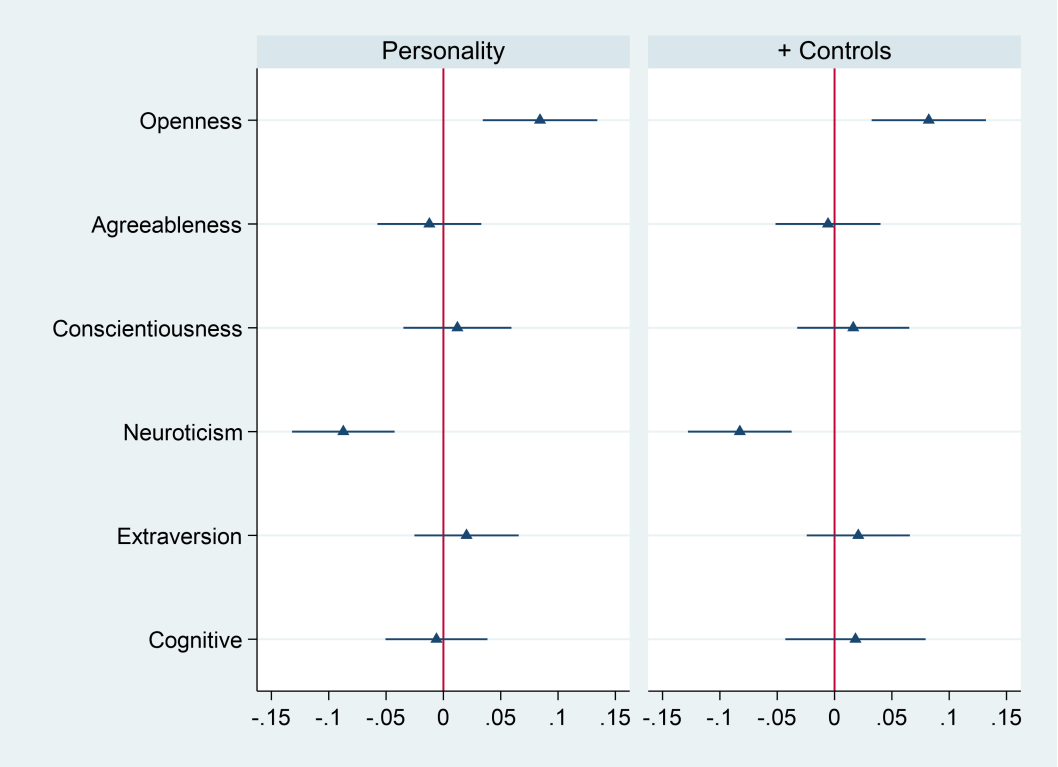


Figure 3-3: **Mental health deterioration for individuals with different personalities**. This figure reports the OLS coefficients of the two regressions where the dependent variable is the difference between the number of symptoms in 2018 and 2020. The personality trait measures are standardized. The bars represent 95% confidence intervals with robust standard errors. Data are weighted to generate a population-representative estimation. Gender, age group, urban residence, family size, and months of the interview are included in the regression related to the right panel but omitted in the figure. The complete estimation of the two regressions is in Table S3-11 of the SI. Source: Isss.pku.edu.cn. 2023. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.

This finding is perfectly in line with Zhou et al. (2022), using the same set of data we do. Younger adults between 18 and 39 constitute the most affected age group. In particular, the central panel of figure 4 shows that mental health deterioration tends to decline with age among subjects over 18, especially among those that did not report any symptoms in 2018 (about 0.24 symptoms). This effect, however, can be due at least in part to a normal increase in mental health problems when individuals in this cohort age.

Finally, column 4 of Table S3-12 presents differences with respect to job status. Individuals unemployed and employed in the agrarian sector report significantly smaller increases in symptoms than the baseline group (i.e., those employed in the industry and in the other nonagricultural sectors). Column 5 of the same table in the supplementary information outlines no significant differences arising from provincial GDP per capita, provincial public expenditures, or provincial population density.

3.4 Discussion

There is widespread evidence that mental health has been severely affected by the COVID-19 pandemic (Banks and Xu, 2020; Daly et al., 2022; Brodeur et al., 2021), and it will likely be a major issue in the post-COVID world (Aknin et al., 2022). Our analysis shows that cases

Figure 3-4: Mental health deterioration among different groups

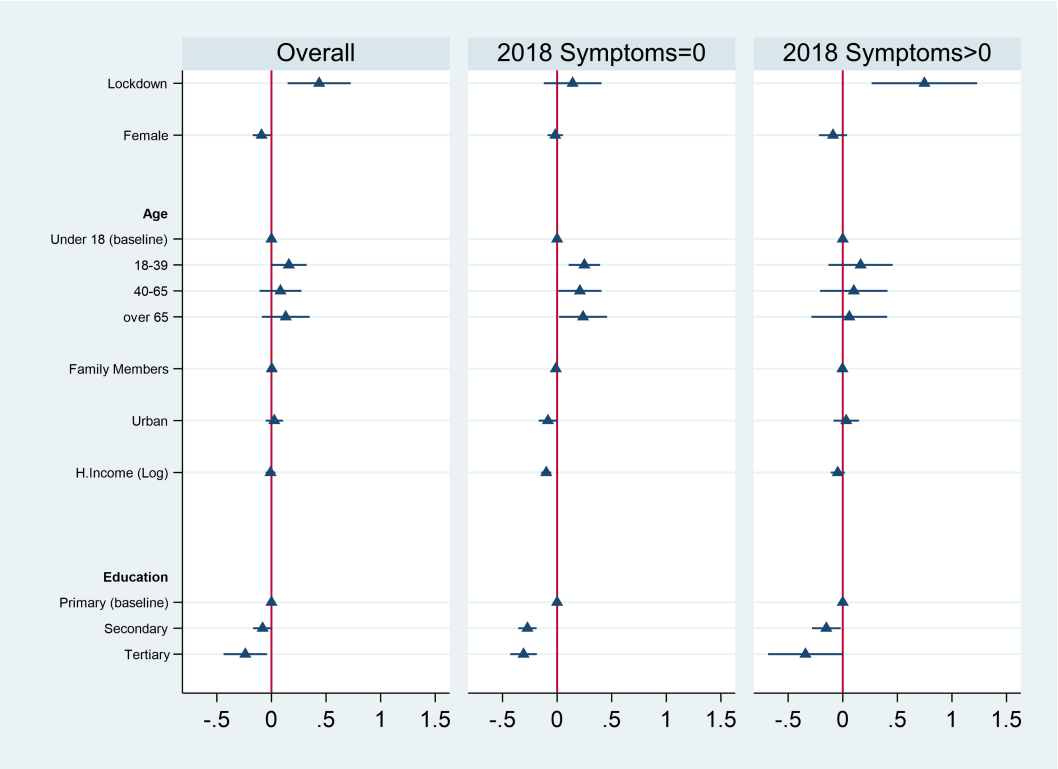


Figure 3-4: **Mental health deterioration among different groups**. The figure reports the OLS coefficients of the three regressions where the dependent variable is the difference between number of symptoms in 2018 and 2020. The bars represent the 95% confidence intervals with robust standard errors. Data is weighted to generate a population-representative estimation. Marriage status and months of the interview are included in the regression but omitted in the figure. The complete estimation of the three regressions is presented in Table S3-12 of the SI. Source: Isss.pku.edu.cn. 2023. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.

of serious depression in China increase by about 0.9 percentage points (an increase of over 10%) after controlling for age. It is difficult to compare this to Europe and the United States, which use other scales. To provide an idea of the possible differences, we calculated an index of mild depression defined as a number of symptoms larger or equal to 8 (as opposed to serious depression, where the threshold was 12). This demonstrates a significant increase of about 1.3 percentage points (reported in Figure S3-1 and Table S3-9 of the SI). We can compare this figure with Daly et al. (2022), who find an increase of 13.5 percentage points in the UK from 24.3% in 2017-2019 to 37.8% in April 2020, based on GHQ-12 score ≥ 3. While the assessment method is based on different questionnaires, the increase in mental health problems in the UK seems to be much higher than in China, according to our data.

As noted above, it is crucial to identify at-risk groups and design personalized treatments, particularly in large countries such as China. People with more open personalities seem significantly worse off, consistent with the view that certain personalities may be more likely to suffer from limitations on personal contacts and social life due to COVID-19. Openness is the trait that reflects preferences for exploration and new experiences (see e.g., DeYoung and Gray (2009)); in fact, this trait is often called “openness to experience”. Individuals with this type of personality seem to suffer more during a pandemic period, which is characterized by many constraints on individual freedom and restrictions on socializing with others at work

and during leisure time. Proto and Zhang (2021) and Rettew et al. (2021) find similar results in the UK population and among Canadian students, respectively.

On the other hand, neuroticism does not predict more deterioration in mental health. Neuroticism is linked to individuals' higher sensitivity to negative outcomes and threats (see e.g. DeYoung and Gray (2009)) of the sort that have been pervasive in the current pandemic.) As argued in Proto and Zhang (2021), individuals with highly neurotic personalities normally experience several negative shocks during their lives; hence, there might be a sort of habituation effect at play. The pandemic's mental health effects on people with different personalities are remarkably consistent with the rest of the literature on the subject, and we refer to Proto and Zhang (2021) for a detailed discussion of this small but growing literature.

Conscientiousness does not appear to have a significant effect; this is different from Proto and Zhang (2021). It would be natural to expect conscientiousness to have a negative effect on mental health deterioration given that conscientiousness implies more controlled behavior, which Giuntella et al. (2021) show is conducive to less depression during the pandemic. In fact, Cai and Zhou (2022), using our same dataset, find that this significantly mediates a decrease in smoking. We do not find an effect of extraversion, but Giuntella et al. (2021) and Proto and Zhang (2021) find a negative effect. This lack of effect of conscientiousness and extraversion on mental health deterioration is an interesting difference in personality traits in the UK and in China, and it deserves further investigation.

The Big Five traits-based personality questionnaire used in the CFPS is derived from the most widely used taxonomy of personality, as measured by the Revised NEO Personality Inventory (Costa and McCrae, 2008). The remarkably similar effects of the different traits on mental health during the pandemic across so different culture lends more support to the notion that they are invariant across European, North American, and East Asian samples, then suggesting their universality (DeYoung and Gray, 2009; Yamagata et al., 2006).

Considering the effect of pandemic across different ages, our finding that individuals who belong to the younger cohort are more affected compared with individuals in the older cohort is generally consistent with many country-representative studies. For the United States, Daly et al. (2021), Blanchflower and Bryson (2022), Vahratian (2021), and Ettman et al. (2020) report more severe deterioration of mental health among younger individuals compared with older individuals. For the UK, Banks and Xu (2020), Daly et al. (2022), and Davillas and Jones (2020) show evidence that younger individuals report more severe mental health deterioration compared with older individuals. Min et al. (2022) finds similar results in a study taking place in South Korea. However, it is worth noticing that some non-representative studies on the Chinese population find a higher prevalence of depression and more symptoms of mental health issues in individuals who are older than 60 (Yang and Ma, 2020; Wu et al., 2020; Zhou et al., 2020).

With respect to the gender differences, our finding that males report only slightly and statistically insignificant more mental health problems than females is not conflicting with other studies based on the Chinese population (Wang et al., 2021b; Wu et al., 2020; Zhou et al., 2020). This finding is also in line with Daly et al. (2021) and Blanchflower and Bryson (2022), using data from the United States, they do not report any significant difference between men and women. On the other hand, Vahratian (2021) and Ettman et al. (2020) find that women are more affected by COVID-19 compared with men in the United States, and Banks and Xu (2020), Daly et al. (2022), Etheridge and Spantig (2020), and Proto and Quintana-Domeque (2021) show that women's mental health seem more affected by the pandemic in the UK. Overall, these mixed findings related to gender are in line with Dal Santo et al. (2022), who in an international meta-analysis did not find clear gender differences when comparing the mental health effects of the pandemic.

We find that individuals who have lower educational backgrounds and lower incomes are affected by COVID-19 more compared with individuals who have higher educational backgrounds and higher income, which is consistent with other studies that are based on the Chinese population (Yang and Ma, 2020; Zhou et al., 2022; Wang et al., 2021b; Wu et al., 2020; Zhou et al., 2020). However, the evidence on the differential effect on education are mixed in US-based studies. While Blanchflower and Bryson (2022) and Vahratian (2021) present evidence that the group with the highest increase rate in symptoms of anxiety and depression are the individuals with educational backgrounds lower than high school, Daly et al. (2021) does not find a significant difference between individuals with and without college degrees, and Ettman et al. (2020) showed that individuals with secondary educational backgrounds reported the highest prevalence of depression during COVID-19. In addition, Ettman et al. (2020) find that individuals with lower income suffered more from COVID-19. Finally, UK-based studies typically find that the most significant mental health deterioration is among higher income and education groups (Banks and Xu, 2020; Daly et al., 2022; Etheridge and Spantig, 2020; Proto and Quintana-Domeque, 2021). These different findings on the effect of the pandemic among different genders and educational attainments in different countries would represent an interesting puzzle for further investigation.

Chapter 4: Exploring Life Satisfaction in China—Evidence from Panel Data on Personal and Household Income

4.1 Introduction

China has achieved remarkable economic growth since the Reform and Opening-up. The Reform and Opening-Up refers to a series of economic system reforms and structural transformations initiated after the Third Plenary Session of the Eleventh Central Committee in 1978 (Tisdell, 2009). The relevant policies and initiations include the transition toward a socialist market economy, the establishment of special economic zones, and expansion of economic cooperation with other countries (Tisdell, 2009; Ploberger, 2016; Lu et al., 2019; Opening-up, 2025). Alongside the economic growth, Chinese citizens have experienced steadily rising personal incomes and considerable improvements in material living standards. However, evidence from various studies suggests that life satisfaction in China has not increased monotonically since the late 20^{th} century, despite China's continuous economic progress. Particularly, whether individuals' life satisfaction in China increased correspondingly with the soaring income still requires further exploration.

It is essential to further explore the association between income and life satisfaction to better understand whether individuals truly benefit from rising material wealth. Governments often prioritise income growth and design policies accordingly, while overlooking factors that may prevent higher income from translating into greater life satisfaction. If the relationship between life satisfaction and income is not monotonic and positive, policies aimed solely at increasing income may fail to improve well-being as intended and could even have unintended negative effects.

This chapter explored the independent associations of individuals' life satisfaction with personal income and household income per capita using data from five released waves of the China Family Panel Studies (CFPS) since it launched in 2010. Leveraging the panel structure of the CFPS data, the analysis employs a fixed effects model as the primary econometric approach to estimate the longitudinal effects of personal income and household income per capita on life satisfaction with the potential influence of individual-related time-invariant factors being eliminated.

This chapter finds that there is a convex relationship between personal income and life satisfaction, whereas the relationship between household income per capita and life satisfaction is monotonic and positive, with increasing marginal effects. These findings suggest that individuals may assign different weights to personal income and household income per capita when evaluating their overall life satisfaction. To the best of my knowledge, this is the first study to use longitudinal analysis to simultaneously examine the independent role of personal income and household income per capita in shaping life satisfaction in China. It provides further evidence of the U-shaped relationship between life satisfaction and personal income with longitudinal data that covered the longest span of time.

This chapter also proposed several possible explanations for the U-shaped relationship between life satisfaction and personal income. One possible explanation is that individuals with limited personal income may benefit from reduced work pressure and shorter working hours. Alternatively, some individuals with lower personal income may receive non-monetary benefits from their employers, particularly for employees of state-owned enterprises. The last possible explanation of individuals demonstrating a decrease in life satisfaction with the increase in their personal income is that they were affected by social comparison and hedonic adaptation and then developed perceptions of their being at a low position of relative income. A more detailed discussion of the potential drivers of the U-shaped relationship between life satisfaction and personal income will be provided in the Discussion section.

Most studies reported a positive association between life satisfaction and income. However, opinions vary on the statistical significance and magnitude of this effect. Some studies find that personal income has a positive and statistically significant impact on life satisfaction (Diener and Biswas-Diener, 2002; Caporale et al., 2009; Ball and Chernova, 2008; Powdthavee, 2010). In contrast, other studies suggest that although income positively affects happiness, the effect is not statistically significant (Easterlin et al., 2012; Paul and Guilbert, 2013).

Moreover, several studies indicate that the relationship between happiness and personal income is non-linear, with individuals at higher personal income levels experiencing diminishing effects as income rises (Kahneman and Deaton, 2010; Kudrna and Kushlev, 2022). Using nationally representative data of Azerbaijan, Aliyev et al. (2022) confirmed the "wave formation" hypothesis, suggesting that the relationship between life satisfaction and income follows a wave-like pattern rather than a linear one. Specifically, individuals may experience a decline in life satisfaction when an increase in income leads to moving up from the top of a reference group to the bottom of another (Aliyev et al., 2022). These empirical results not only provide evidence of the non-linear relationship between life satisfaction and income but also reinforce the reference income hypothesis.

Driven by interest in China's rapid economic growth over recent decades, many studies have examined trends and determinants of subjective well-being in the Chinese context. However,

only a few have focused on the relationship between income and life satisfaction, and these are generally limited by small sample sizes, short time spans, and ordinary quantitative analysis methods. Moreover, the conclusions from these studies vary regarding both the magnitude and linearity of the relationship between income and subjective well-being.

One of the studies finds that household income has a positive and statistically significant effect on happiness, although this effect demonstrates a diminishing from 2002 to 2013 (Luo, 2017). Another study reports that the relationship between economic growth and subjective well-being is non-linear and depends on individual characteristics and contextual factors (Li and Shi, 2019).

As the only study that simultaneously explored the independent effects of personal income and household income on life satisfaction, Wu (2021) finds that personal income is associated with life satisfaction in a U-shaped pattern, whereas household income shows a monotonic and positive relationship. While Wu (2021) provides initial evidence that personal income and household income are independently associated with life satisfaction, the analysis is primarily based on the baseline wave of the CFPS. This research extends the existing literature by using multiple waves of pre-pandemic CFPS panel data and adopting an individual fixed-effects framework. This approach allows the identification to rely on within-individual income variation over time and provides further evidence on the long-term relationship between life satisfaction and different measures of income. Overall, existing research provides evidence of a non-linear relationship between personal income and life satisfaction, though this finding still requires confirmation through more rigorous analysis.

The inconsistent findings on the effects of income on life satisfaction in China pose potential risks for research on its determinants, as many studies have overlooked the distinct impacts of personal and household income. This omission may undermine the reliability and credibility of their conclusion. Therefore, it is essential to identify the effects of income on life satisfaction before further examining the influence of other aspects of economic development.

The remainder of this chapter is organised as follows. Section 2 describes the data and the estimation strategy used for the empirical analysis. Section 3 presents the results and their interpretations. Section 4 provides further discussions of the findings and possible explanations of the convex relationship between life satisfaction and personal income.

4.2 Method

4.2.1 Data

This chapter draws on data from five waves of the China Family Panel Studies (CFPS), a national representative, large-scale longitudinal survey. The CFPS launched the first wave of survey in 2010 and has conducted multiple tracking surveys on a biennial basis to date (Xie and Hu, 2014). As one of the largest micro-level surveys in China, each wave includes interviews with over 30,000 individuals. In addition to detailed demographic information, the CFPS collects data on respondents' behaviors, social relationships, subjective attitudes, and physical and mental health.

Table 4-1: Decriptive statistics

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	mean	sd	min	max
Life Satisfaction	151,873	3.630	1.059	1	5
Gender	166,056	0.501	0.500	0	1
Urban	162,262	0.468	0.499	0	1
Age	163,714	45.86	17.01	16	110
Education	162,732	2.543	1.324	1	8
Married	166,062	0.760	0.427	0	1
Employed	152,211	0.625	0.484	0	1
Family Member	166,062	4.296	1.959	1	26
Have Medical Insurance	166,062	0.852	0.355	0	1
Have Endowment Insurance	166,062	0.321	0.467	0	1
Social Position	151,240	2.918	1.016	1	5
Migrant	166,062	0.222	0.416	0	1
Log Personal Income	131,338	5.078	4.771	0	16.18
Log Household Income	159,351	8.825	1.523	0	14.41
GDP pc (10k CNY)	165,723	4.521	2.437	1.288	15.10

Note: Table 4-1: Descriptive Statistics presents the summary statistics of the variables used in the empirical analysis. *Life Satisfaction* is a self-reported measure on a five-point scale, where higher values indicate greater life satisfaction. The remaining variables capture respondents' demographic characteristics, including gender, age, education, marital status, employment status, number of family members, and subjective social position. *Urban* is a binary indicator of whether a represents resides in an urban area, while *Migrant* identifies rural-to-urban migrants, defined as individuals registered with an agricultural(rural) Hukou but reporting residence in an urban areas. Finally, *Have Medical Insurance* and *Have Endowment Insurance* indicate whether the respondent is enrolled in any medical insurance or endowment insurance scheme, respectively. Source: Isss.pku.edu.cn. 2023. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.

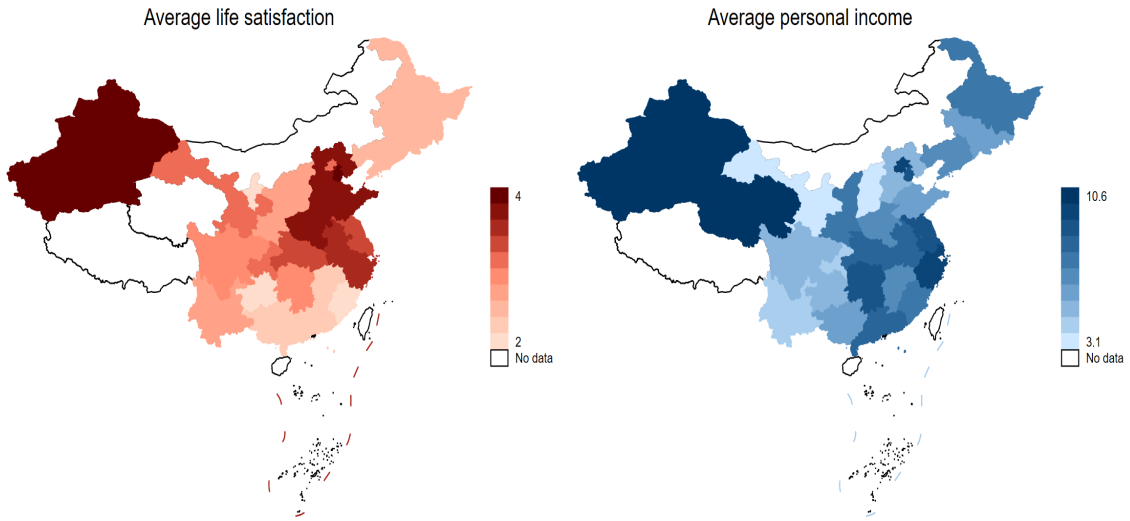
Subjective well-being in the CFPS is measured by asking respondents *"Where 1 represents very unsatisfied, 5 represents very satisfied, how satisfied you are about your life?"*. The

nationally representative sample and biennial tracking surveys make the CFPS a highly reliable source for examining changes in subjective well-being in China over the past decade. Table 4-1 reports the descriptive statistics for the variables included in the empirical analyses.

Distribution of Life Satisfaction in China

Data from the National Bureau of Statistics of China show that income inequality, measured by the Gini coefficient, has gradually declined since 2010. However, researchers widely acknowledge that regional inequality rebounds sharply after an initial decline in the early stage of economic reform, and inter-provincial inequality, measured by GDP per capita, has reached an alarming level (Hao and Wei, 2009). Although there is still no consensus on the exact turning point or trend of inter-provincial inequality, there is no denying that China's eastern coastal regions maintain significantly higher levels of development and per capita GDP than the western inland regions. Figure 4-1 illustrates the provincial distribution of life satisfaction and contrasts it with average personal income across provinces.

Figure 4-1: Provincial patterns of life satisfaction and average personal income in China



Note: Figure 4-1: Provincial patterns of life satisfaction and average personal income in China contrasts the provincial distribution of average life satisfaction (left panel) with that of average personal income (right panel). Life satisfaction is measured as the provincial mean of self-reported life satisfaction. Personal income is measured as the provincial mean of the logarithm of personal income, calculated after adding 1 to all observation, and is winsorized to reduce the influence of extreme values. Darker shades represent higher values. Provinces shown in white indicate missing data. The data are drawn from the China Family Panel Studies (CFPS), 2010-2018. Source: Isss.pku.edu.cn. 2023. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.

In Figure 4-1, the left panel illustrates the provincial distribution of average life satisfaction and the right panel presents the average personal income across provinces. The colour shading represents the value of corresponding indicators, with darker shades indicating higher values. Among the 34 provincial-level administrative regions in mainland China, the life satisfaction data for Tibet, Qinghai, and Inner Mongolia, and the personal income data for Tibet and Inner Mongolia are missing because the CFPS does not include relevant data for these provinces. Among the remaining provinces, Xinjiang appears to be one of the provinces with the highest average life satisfaction and average personal income. However, these results should be interpreted with caution, as the sample size for Xinjiang is relatively small, only 77 observations out of nearly 170,000.

Other provinces reporting relatively high average life satisfaction are those surrounding the capital, Beijing. While these provinces exhibit higher average personal income than some south-western regions, their income levels remain noticeably lower than those of the eastern and south-eastern coastal provinces. Interestingly, among the most economically advanced provinces, Guangdong and Fujian province reported an average life satisfaction level that is below average. By contrasting provincial average of life satisfaction and personal income, Figure 4-1 further highlights the complex and non-monotonic relationship between income and life satisfaction at the macro level.

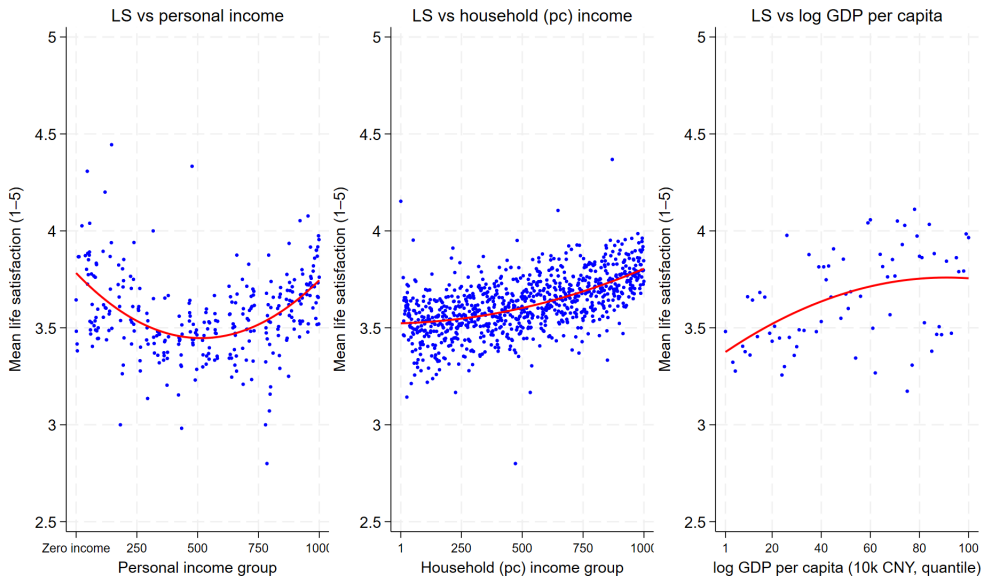
Relationship Between Life Satisfaction and Income

The relationship between life satisfaction and provincial economic development is not immediately evident from Figure 4-1. In order to further investigate, Figure 4-2 illustrates the association between life satisfaction and different quantiles of personal income, household income per capita, and the logarithm of provincial GDP per capita.

It is worth noticing that approximately 40% of respondents reported zero as their personal income. Without adjustment, this would place respondents with the lowest positive incomes at roughly the 40th percentile, leaving a large gap between individuals with no income and those with very low income in the figure. To address this and better visualise the relationship between life satisfaction and personal income, I constructed 1,000 quantiles for respondents with positive income and assigned those reporting zero income to the lowest quantile.

The left panel in Figure 4-2 demonstrates that there is a U-shaped relationship between life satisfaction and personal income. Interestingly, the lowest life satisfaction is not observed among respondents in the lowest quantile of personal income, but among those in the middle of the thousandth quantiles. However, this pattern may not reflect the true association between income and life satisfaction, as individuals who are still in school or have retired may exhibit high life satisfaction due to financial support from their families. Therefore, it is important to

Figure 4-2: Correlation between life satisfaction and different quantiles of personal income, household income per capita, and log GDP per capita



Note: Figure 4-2: Correlation between life satisfaction and different quantiles of personal income, household income per capita, and log GDP per capita illustrates the relationship between life satisfaction and different measures of economic development. In the left panel, because about 40% of respondents reported zero as their personal income, they are assigned to the lowest quantile, while the remaining individuals are divided into one thousand quantiles. In the middle panel, household per capita income is divided into one thousand quantiles. In the right panel, provinces are divided into one hundred quantiles based on log GDP per capita (10,000 CNY). For each case, mean life satisfaction is plotted by quantile with a quadratic fit to better visualise non-linear patterns. Source: Isss.pku.edu.cn. 2023. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.

further examine life satisfaction in relation to household income per capita, which may more accurately reflect the economic circumstances of respondents within the same family.

The middle panel in Figure 4-2 illustrates the relationship between life satisfaction and household income per capita. Different from personal income, household income per capita displays a monotonic positive relationship with life satisfaction. The relationship is relatively more consistent and positive, with life satisfaction increasing gradually across the distribution. At the province level, life satisfaction is also positively associated with log GDP per capita, though the relationship is relatively flatter. The right panel in Figure 4-2 illustrates that life satisfaction tends to be higher when GDP per capita is at a higher level, though the marginal effect is diminishing.

As described, life satisfaction exhibits a U-shaped relationship with personal income and a monotonically increasing relationship with household income per capita. This suggests that individuals with higher incomes tend to report higher life satisfaction, regardless of whether income derives from personal earnings or family support. The relationship between life satisfaction and log GDP per capita is positive but diminishing, suggesting that regional economic development is only weakly correlated with life satisfaction compared to household income. The next section further examines the relationship between life satisfaction and monetary income through empirical analyses.

4.2.2 Estimation Strategy

The regression model estimated in this chapter is specified as follows:

$$\begin{aligned} Life\ Satisfaction = & \alpha_1 Log\ Personal\ Income_{it} + \alpha_2 Log\ Personal\ Income\ Squared_{it} OR/AND \\ & \alpha_3 Log\ Household\ Income\ per\ capita_{it} + \alpha_4 Log\ Household\ Income\ per\ capita\ Squared_{it} \\ & + \sum_{j=1}^{k} \beta_j X_{it} + year_t + province_i + \varepsilon \end{aligned} \tag{2}$$

The dependent variable is the respondents' self-reported life satisfaction. The key independent variables include the logarithm of personal or household income per capita, its quadratic term, and a set of demographic control variables. The selection of the demographic control variables follows prior research on the influencing factors of life satisfaction. These control variables include an urban dummy, a rural-urban migrant dummy, gender, age and squared age, medical insurance dummy, endowment insurance dummy, education, marital status, employment status, number of family members, perceived social position, and provincial GDP per capita (measured in 10000 CNY) . Table 4-2 reports the results of the baseline regressions.

The coefficients of the linear terms (α_1 and α_3) represent the marginal effects of personal income and household income per capita on life satisfaction, respectively, holding the other factors constant. The quadratic terms (α_2 and α_4) are included to capture potential non-linear relationships, indicating whether the marginal effects of the two income measures increase or decrease at different income levels. It is worth noticing that when both personal income and household income per capita are included in the same model, each set of coefficients should be interpreted as the effect of one income type while holding the other constant. Specifically, α_1 and α_2 (or α_3 and α_4) reflect the marginal and non-linear effects of personal income (or household income per capita) on life satisfaction, conditional on household income per capita (or personal income).

The main specification is an individual fixed-effects model, which examines the relationship between life satisfaction and different income measures by exploiting within individual income variation over time. By controlling for individual fixed-effects, the model absorbs all time-invariant individual characteristics, including stable preferences, personality traits, and early life backgrounds, thereby eliminating potential bias arising from unobserved individual heterogeneity. All specifications additionally include year fixed-effects to control for common macroeconomic shocks and long-term time trends. Province fixed-effects are also included to control for persistent regional differences that may affect life satisfaction, such as stable insti-

tutional and cultural factors. This specification also helps mitigate potential confounding from the relationship between life satisfaction and income that arises from regional environmental differences, particularly in the presence of inter-provincial mobility.

4.3 Results

Column 1 and 2 in Table 4-2 report the correlations between life satisfaction and personal income and household income per capita, respectively. Column 3 and 4 present the Ordinary Least Square (OLS) regression results. Column 5 and 6 show estimates from fixed-effects models that control for individual fixed effects, as well as year and province fixed-effects to eliminate time and regional heterogeneity. Column 7 reports results from a fixed-effects model that simultaneously includes the logarithm personal income, the logarithm household income per capita, and their quadratic terms, controlling for individual, year, and province fixed effects. This specification tests whether the relationship between life satisfaction and personal income remains robust when the household income per capita is included. Detailed interpretations of these results follow.

Column 1 of Table 4-2 reports the fixed-effects regression results, including only the logarithm of personal income and its quadratic term as independent variables. The coefficient on log personal income is negative, while the squared term is positive, and both coefficients are statistically significant. These results indicate a clear U-shaped relationship between life satisfaction and personal income, consistent with the pattern shown in Figure 4-2. Column 2 presents the fixed-effects regression results for log household income per capita, which also suggest a convex relationship as the linear term is negative and the quadratic term is positive.

Table 4-2: Regression results with the OLS estimator and the fixed-effects model of life satisfaction in China, 2010-2018

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	FE	FE	OLS	OLS	FE	FE	FE
VARIABLES	LS	LS	LS	LS	LS	LS	LS
Log Personal Income	-0.044***		-0.016***		-0.033***		-0.031***
	(0.00)		(0.00)		(0.00)		(0.00)
Log Personal Income Squared	0.004***		0.001***		0.004***		0.003***
	(0.00)		(0.00)		(0.00)		(0.00)
Log Household Income		-0.206***		-0.136***		-0.017**	-0.014
per capita		(0.01)		(0.01)		(0.01)	(0.01)
Log Household Income		0.016***		0.011***		0.002***	0.001**
per capita Squared		(0.00)		(0.00)		(0.00)	(0.00)

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Continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	FE	FE	OLS	OLS	FE	FE	FE
VARIABLES	LS	LS	LS	LS	LS	LS	LS
Constant	3.645***	4.147***	2.464***	3.007***	3.179***	3.504***	3.028***
	(0.00)	(0.02)	(0.03)	(0.04)	(0.42)	(0.37)	(0.40)
Observations	122,886	146,630	115,288	135,561	115,288	135,561	111,212
R-squared	0.002	0.008	0.192	0.186	0.191	0.171	0.192
Year Fixed Effects	No	No	No	No	Yes	Yes	Yes

Note: Table 4-2: Regression results with the OLS estimator and the fixed-effects model of life satisfaction in China, 2010-2018 presents the empirical results of linear regressions estimated using the OLS and fixed-effects models. The dependent variable in all specifications is life satisfaction (LS). The independent variables logarithm personal income and logarithm household income per capita were calculated by adding 1 to all observations, as approximately 40% of respondents reported zero personal income. Standard errors are presented in parentheses. Full regression results including all covariants are reported in Table S4-1 in the Appendix. Source: Isss.pku.edu.cn. 2023. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 99% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 90% confidence interval.

Column 3 of Table 4-2 presents the OLS regression results, including the logarithm of personal income, its quadratic term, and a set of control variables. Column 4 reports results from the same specification, replacing logarithm personal income with the logarithm household income per capita. In column 3, the coefficient on log personal income is negative, while the quadratic term is positive, indicating a U-shaped relationship between life satisfaction and personal income, consistent with earlier findings. Similarly, in Column 4, the coefficients on the linear and quadratic terms of the log household income per capita remain negative and positive, respectively. These results continue to suggest a convex relationship between life satisfaction and household income per capita, consistent with the pattern shown in Figure 4-2.

Column 5 and 6 present fixed-effects regression results that include all explanatory variables and control for individual, years, and provinces fixed effects. Column 5 includes log personal income and its quadratic term as the independent variables, while Column 6 replaces these with log household income per capita and its quadratic term. The U-shaped relationship between life satisfaction and personal income persists in the fixed-effects model, with larger coefficient magnitudes compared to previous specifications. Similarly, Column 6 confirms a convex relationship between life satisfaction and household income per capita, consistent with the results from the regression using the OLS estimator.

Column 7 reports the fixed-effects model results, where logarithm personal income, logarithm household income per capita, and their quadratic terms are included simultaneously. Both the linear term and the quadratic term of log personal income are statistically significant, indicating that the convex relationship between life satisfaction and personal income persists. However, the coefficient on the linear term of log household income per capita is no longer statistically significant, likely due to multicollinearity arising from the high correlation between these two

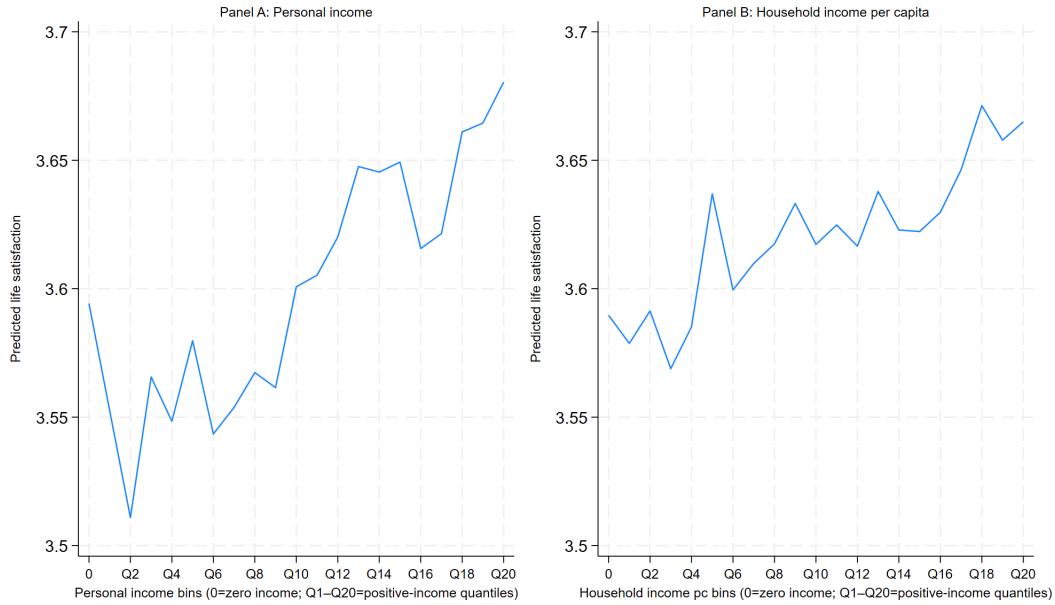
income measures. The results suggest that the linear effect of household income per capita is largely absorbed by personal income, leaving its distinct contribution to life satisfaction primarily reflected in the quadratic term.

As additional control variables were introduced, the U-shaped relationship between life satisfaction and personal income remain stable across both OLS estimation and fixed-effects model. Conversely, the effects of household income on life satisfaction diminished but generally remained statistically significant after controlling for individual characteristics, year and province fixed effects. When log personal income and its quadratic term were included alongside household income per capita, the magnitude and significance of the coefficients on log household income per capita and its quadratic term both decreased, which is perhaps caused by the potential multicollinearity between personal income and household income per capita.

Evaluated at the sample mean, the marginal effects from the main fixed-effects specification indicate that a 10% increase in personal income corresponds to an increase of approximately 0.00024 points (Column 5), while a comparable increase in household income per capita is associated with an increase in life satisfaction of around 0.0021 points (Column 6) on the 1-5 life satisfaction scale. Although these magnitudes are modest in size, both effects are statistically significant. The larger effect of household income per capita suggests that shared household resources play a more important role in shaping overall life satisfaction compared to individual earnings once time-invariant individual heterogeneity is considered.

Most existing studies rely on household-level income measures when investigating the relationship between life satisfaction and income, and studies examining the role of personal income and life satisfaction using comparable fixed-effects estimation are limited. Focusing on household income per capita, the estimated magnitude is smaller but remains within the range reported in existing literature. Specifically, studies using linear income specifications typically suggest that the increase in life satisfaction is around 0.003 to 0.004 for a 10% increase in household income (FitzRoy and Nolan, 2020, 2022), while another study reports a larger effect (Budría and Ferrer-I-Carbonell, 2019). The differences in magnitude are expected considering variations in the model specifications, including the treatment of income nonlinearity, the inclusion of reference income effects, and differences in the measurement scales of life satisfaction.

Figure 4-3: Predicted Life Satisfaction Across Personal Income and Household Income per capita Bins



Note: Figure 4-3: Predicted Life Satisfaction Across Personal Income and Household Income per capita Bins presents the predicted levels of life satisfaction across income bins based on the baseline fixed-effects regressions. Panel A displays personal income and Panel B displays household income per capita. Zero income is treated as a separate category and placed at zero, while positive income is divided into 20 quantiles. Predicted life satisfaction is calculated using the specifications reported in Columns 5 and 6 of Table 4-2. Source: Isss.pku.edu.cn. 2023. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.

To better understand the relationship between different income measures and life satisfaction, Figure 4-3 plots the predicted levels of life satisfaction across income bins for personal income and household income per capita. Zero income is treated as a separate category and placed at zero, while positive income is divided into 20 quantiles. As shown in Panel A, predicted life satisfaction fluctuates across lower personal income bins and then increases more steadily as personal income rises after approximately the 10^{th} income quantile. Panel B shows a generally increasing relationship between predicted life satisfaction and household income per capita. Although some fluctuations are observed in the lower income bins before Q3, the overall pattern is positive and monotonic. Overall, the patterns shown in Figure 4-3 are consistent with the baseline regression results and help illustrate the relationship between income and life satisfaction.

Several control variables also showed significant correlations with life satisfaction, and their patterns are generally consistent with previous studies on the determinants of subjective well-being. As the focus of this chapter is on the relationship between life satisfaction and different income measures, the detailed discussion of these covariates is not presented here. Moreover, it is important to note that the results reported in this chapter should be interpreted as associations rather than causal effects. Although this chapter includes a rich set of control variables into the regressions, the relationship between life satisfaction and income may still be influenced by factors that are not captured in the data. These factors may include, but are not limited to, working hours, stress of work, and social comparisons. However, as these

omitted variables are not consistently available in the CFPS dataset, they cannot be explicitly controlled for in the analyses.

To further examine whether the observed U-shaped relationship between life satisfaction and personal income could be attributed to individuals who have limited personal income and benefit from the high income of parents or spouses, I conducted a series of consequent fixed-effects regressions using the very same regression model on subsamples defined by age cohort, employment status, residential area type, and marital status.

Table 4-3: Regression results of the fixed-effects model with sub-samples on life satisfaction in China, 2010–2018

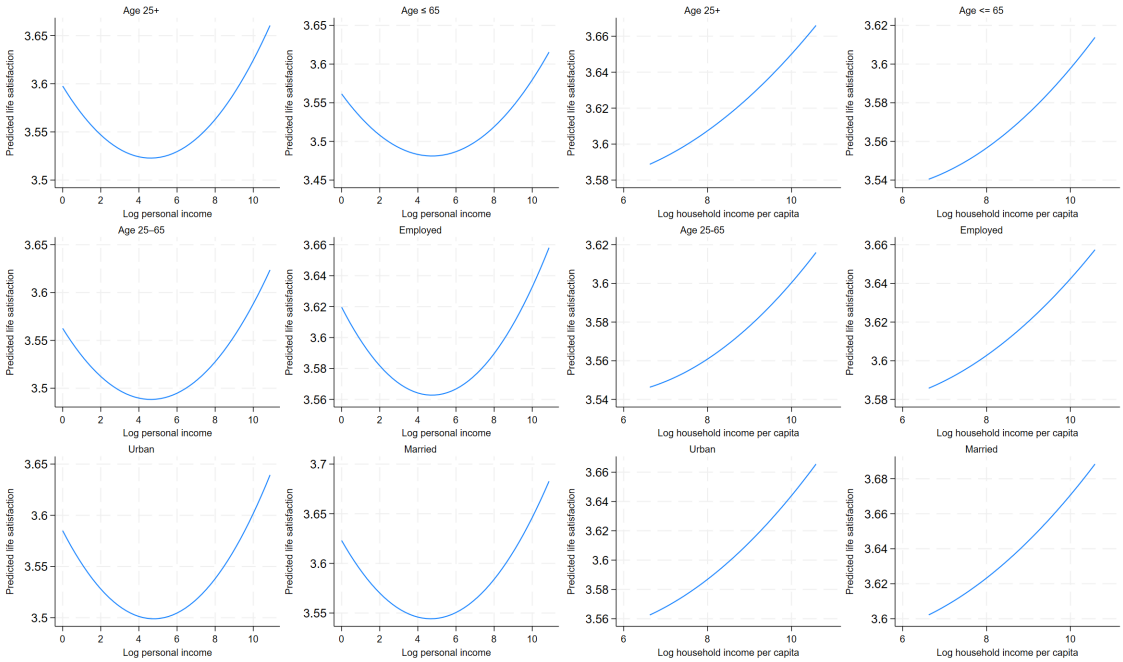
	Panel A: Personal income					
	(1)	(2)	(3)	(4)	(5)	(6)
	Age $\geq$ 25	Age $\leq$ 65	25 $\leq$ Age $\leq$ 65	Employed	Urban	Married
VARIABLES	LS	LS	LS	LS	LS	LS
Log Personal Income	-0.032***	-0.034***	-0.032***	-0.024***	-0.036***	-0.034***
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Log Personal Income Squared	0.004***	0.004***	0.003***	0.003***	0.004***	0.004***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	2.904***	3.007***	2.648***	2.721***	1.960***	3.158***
	(0.51)	(0.40)	(0.51)	(0.48)	(0.74)	(0.51)
Observations	106,108	100,855	91,675	74,590	54,115	95,903
R-squared	0.196	0.190	0.195	0.202	0.185	0.196
	Panel B: Household per capita income					
	(1)	(2)	(3)	(4)	(5)	(6)
	Age $\geq$ 25	Age $\leq$ 65	25 $\leq$ Age $\leq$ 65	Employed	Urban	Married
VARIABLES	LS	LS	LS	LS	LS	LS
Log Household Income	-0.020***	-0.027***	-0.029***	-0.020*	-0.029***	-0.021***
per capita	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Log Household Income Squared	0.002***	0.003***	0.003***	0.002***	0.003***	0.002***
per capita Squared	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	3.159***	3.427***	3.021***	3.333***	2.921***	3.228***
	(0.46)	(0.37)	(0.47)	(0.44)	(0.73)	(0.48)
Observations	124,745	116,147	105,331	84,481	64,531	111,957
R-squared	0.176	0.170	0.176	0.178	0.167	0.176

Note: Table 4-3: Regression results of the fixed-effects model with sub-samples on life satisfaction in China, 2010-2018 presents the empirical results of fixed-effects regressions for subsamples of respondents who were of working age, employed, living in urban areas, and married. Panel A uses the logarithm personal income and its quadratic term as the key explanatory variables, while Panel B uses the logarithm household income per capita and its quadratic term. The dependent variable in all specification is life satisfaction (LS). The independent variables logarithm personal income and logarithm household income per capita were calculated by adding 1 to all observations, as approximately 40% respondents reported zero personal income. Standard errors are presented in parentheses. Descriptions of the explanatory variables are provided in the note to Table 4-1. Full regression results including all covariants are reported in Table S4-2 in the Appendix. Source: Isss.pku.edu.cn. 2023. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 99% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 90% confidence interval.

Table 4-3 presents the regression results for various subsamples. Column 1 and 2 include individuals older than 24 years old or younger than 66 years old, respectively. Analyses with these subgroups help mitigate potential bias from students and retirees, who typically report higher life satisfaction despite having limited personal income but relying on financial support from parents or children. Moreover, Column 3 further narrows the sample to respondents aged 25 years old and 65 years old to reduce the influence of these groups on the lower percentiles of personal income. Column 4-6 report results for respondents who are employed, reside in urban areas, and are married, respectively.

Panel A of Table 4-3 indicate that the U-shaped relationship between life satisfaction and personal income persists across all six subsamples. In Column 1-3, the statistical significance and magnitude of the coefficients for logarithm personal income and its quadratic term remain largely unchanged. When restricting the sample to employed participants, the coefficient on logarithmic personal income fell by approximately 0.008 but remains significant at the 99% confidence interval. Similarly, the coefficients of logarithm personal income and its quadratic term remain stable in magnitude and significant when the regressions are limited to respondents from urban areas or those who are married. Overall, these regression results suggest that the U-shaped relationship between life satisfaction and personal income cannot be attributed to any specific subgroup. Life satisfaction declines as income falls below a certain threshold and rises as income increases beyond that point. However, the underlying mechanisms behind this pattern still need to be further explored.

Figure 4-4: Income and life satisfaction: graphical illustration of the fixed-effects estimates



Note: Figure 4-4: Income and life satisfaction: graphical illustration of the fixed-effects estimates provides a graphical illustration of the fitted relationships between life satisfaction and different income measures implied by the fixed-effects specifications reported in Table 4-3. Predicted life satisfaction is evaluated over the p5-p95 range of the corresponding income measure, holding all the other variables at their sample means. Each panel corresponds to a different subsample definition in Table 4-3. Source: Isss.pku.edu.cn. 2023. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.

To better visualise the results reported in Table 4-3, Figure 4-4 provides a graphical illustration of the fitted relationships between life satisfaction and different income measures implied by the fixed-effects specifications, conditional on average covariates. Across all subsample analyses, the U-shaped relationship between life satisfaction and personal income is preserved. In contrast, household income per capita exhibits a monotonic and positive association with life satisfaction over the observed income range, with increasingly steep slopes at higher income levels.

To further explore whether the relationship between different income measures and life satisfaction varies by gender, a gender heterogeneity analysis is conducted by including the interaction terms between gender and income measures in the fixed-effects regression. Table 4-4 reports the results of the gender heterogeneity analysis.

After introducing the interaction terms between gender and income measures, the coefficients on the interaction terms are not statistically significant in either personal income or household income per capita analyses. This suggests that there is no significant difference between men and women in the relationship between life satisfaction and different income measures. For personal income, both the linear term and quadratic term remain statistically significant after the gender interaction terms are included, suggesting that the U-shaped pattern remains robust. For household income per capita, the quadratic term remains statistically significant while the linear term becomes insignificant. However, since the gender interaction terms are also statistically insignificant, the overall relationship between life satisfaction and household income per capita does not differ significantly across gender.

Table 4-4: Gender heterogeneity in the relationship between different measures of income and life satisfaction

	(1)	(2)
	Personal Income	Household Income per capita
VARIABLES	LS	LS
Log Personal Income	-0.028***	
	(0.01)	
Log Personal Income Squared	0.003***	
	(0.00)	
Male×Log Personal Income	-0.013	
	(0.01)	
Male×Log Personal Income Squared	0.001	
	(0.00)	
Log Household Income		-0.010
per capita		(0.01)
Log Household Income		0.002**
per capita Squared		(0.00)
Male×Log Household Income		-0.016

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VARIABLES	(1) Personal Income LS	(2) Household Income per capita LS
per capita		(0.01)
Male×Log Household Income		0.001
per capita Squared		(0.00)
Constant	3.178***	3.494***
	(0.42)	(0.37)
Observations	115,288	135,561
R-squared	0.191	0.171
Number of pid	42,726	43,568

Note: Table 4-4: Gender heterogeneity in the relationship between different measures of income and life satisfaction presents the results of gender heterogeneity analysis based on the baseline fixed-effects regressions. Columns 1 and 2 use personal income and household income per capita, respectively. Both specifications include interaction terms between gender and the linear and quadratic terms of different income measures. Female is treated as the reference group. The regressions follow the specifications reported in Columns 5 and 6 of Table 4-2. Full regression results including all covariants are reported in Table S4-3 in the Appendix. Source: Isss.pku.edu.cn. 2023. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 99% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 90% confidence interval.

4.4 Discussion

Recently, economists have become increasingly interested in why happiness levels in China have not risen sharply despite rapid economic growth and substantial improvements in living standards. The reasons for this phenomenon still remain unclear. It is generally expected that rising income would enhance individual happiness as higher income is typically associated with better life quality and greater life satisfaction. However, evidence shows that happiness does not rise proportionally with income despite it brings material condition improvements. This inconsistency highlights the importance of further examining the relationship between happiness and absolute income, given the mixed findings in previous studies. Using five waves of panel data from the CFPS survey, this chapter explores the relationship between life satisfaction and personal and household income per capita in China through longitudinal analyses.

This research provides preliminary evidence that personal income and household income per capita associate with life satisfaction differently. Individuals may place different importance on these two income measures when evaluating their overall life satisfaction. The fitted plot shows that the relationship between life satisfaction and household income per capita is monotonic and positive with increasing marginal effects, which is consistent with the common expectations. Surprisingly, personal income exhibits a convex relationship with life

satisfaction. Life satisfaction tends to decline with the rise in personal income for individuals with relatively low income, but personal income is positively associated with life satisfaction beyond a certain threshold. This convex pattern is evident in both Figure 4-2 and the empirical results from the longitudinal analyses. This finding is consistent with Luo (2017) and expands the conclusion proposed in Wu (2021).

While it is reasonable to suspect that the convex relationship between life satisfaction and personal income may result from individuals with limited personal income benefiting from high household income per capita contributed by their families, the fixed-effects regressions on subsamples restricted by the participants' age and employment status help rule out this possibility. The convex pattern between personal income and life satisfaction persists even after excluding individuals outside the working age range and those who are unemployed. These results suggest that even individuals likely to be financially independent experience a decline in life satisfaction as personal income rises, if their personal income does not exceed a specific threshold.

One possible explanation for the convex relationship between life satisfaction and personal income is that individuals with limited personal income may report higher life satisfaction because they benefit from less work-related pressure and fewer working hours. These individuals may be content with their lifestyle and lack strong motivation to pursue a higher income. Under this assumption, life satisfaction declines when they are compelled to seek higher earnings due to increased responsibilities, as this often brings greater job stress and reduced leisure. To test this hypothesis, the regression analyses should be adjusted to control for working hours, job satisfaction, and job classifications. However, due to the high proportion of missing data on working hours and job satisfaction in the CFPS, this chapter is unable to explore their potential role in shaping the observed convex relationship.

Another possible explanation is that individuals with limited personal income benefit from non-monetary welfare provided by their employers, such as stable employment relationships, flexible working hours, and various material subsidies. Although the absolute job security once associated with state-owned enterprises and government employees has largely ended after China's economic reforms and the wave of layoffs in the 1990s, employees in these sectors still enjoy a range of non-monetary benefits today.

Compared with privately owned enterprises, state-owned companies tend to enforce regulations more strictly to protect employees' rights and interests, as the government involvement often influences their decision-making process. Employees in these organisations typically enjoy more flexible working hours and comprehensive social welfare benefits, partly because their employers face less competitive pressure than private enterprise owners. Additionally, working in state-owned enterprises or government departments is usually perceived as a sign of higher social status, reflecting an assumed ability to "pull strings", despite the reality that

may suggest otherwise. These non-monetary benefits are not reflected in personal income but may positively influence life satisfaction. A follow-up study is planned to test this hypothesis and further investigate the mechanisms underlying the U-shaped relationship between life satisfaction and personal income.

An alternative explanation involves the effects of social comparison and hedonic adaptation on perceived life satisfaction. Increases in personal income often result from promotions, job changes, or entry into a more lucrative career, which may lead individuals to perceive their income as relatively low compared to peers. Under this assumption, the perception of low relative income could have contrasting effects on life satisfaction. Individuals in the lower half of the personal income distribution may experience a decline in life satisfaction, while those in the upper half may experience an increase.

All in all, the findings of this chapter provide preliminary evidence for a convex relationship between life satisfaction and personal income. However, reliable and precise conclusions from data analysis still require further rigorous and careful research. Nevertheless, the findings proposed in this chapter with analyses using longitudinal panel data and fixed-effects models contribute to the existing literature by addressing the gaps in research on the determinants of life satisfaction in China. These findings also offer a foundation for future studies and policy evaluation.

Chapter 5: Conclusion

This thesis examines the determinants of well-being and mental health through three independent yet interrelated empirical studies. Chapter 2 investigates the causal impact of relaxing fertility restrictions on mental health outcomes, emphasising the critical role of reproductive autonomy in promoting psychological well-being and the need to consider mental health outcomes in family planning policies. Chapter 3 analyses the adverse effects of the COVID-19 pandemic on mental health, identifying the most vulnerable groups based on lockdown experience and personality traits. Chapter 4 explores how household income per capita and personal income independently correlate with life satisfaction.

Chapter 2 examines the causal effects of fertility restriction relaxation on mental health. Using China's Universal Two-Child Policy as a natural experiment and applying a Difference-in-Differences approach, this study provides the first empirical evidence of a causal link between the relaxation of fertility restrictions and improvements in mental health. Heterogeneity analyses show clear gender differences in the health effects of the UTCP. Compared with affected men, affected women experience weaker mental health improvements, particularly in terms of depression, feeling that everything needs effort, and restlessness. The findings further indicate that the observed improvements in mental health were primarily concentrated among younger individuals, individuals in less developed regions, and married individuals.

Chapter 3 examines the adverse effects of the COVID-19 pandemic on mental health and the mediating role of personality traits. The analysis shows a significant rise in the prevalence of severe depression one year after the pandemic began. These adverse effects are particularly pronounced among individuals who had exhibited symptoms of depression prior to the pandemic. Moreover, those subjected to stricter lockdown measures reported more severe negative mental health outcomes than those who were not. The study also finds that individuals with higher levels of openness reported a greater prevalence of depression, while neuroticism did not appear to predict a greater deterioration in mental health.

Chapter 4 explores how changes in household income per capita and personal income are differentially associated with life satisfaction. Using a nationally representative longitudinal dataset and jointly controlling for both income measures, this study provides further evidence of their independent relationships with life satisfaction. Evidence from the fitted plot and fixed-effects model indicates that the relationship between household income per capita and life satisfaction is monotonic and positive, with increasing marginal effects. In contrast, the

relationship between personal income and life satisfaction follows a U-shaped trajectory. These patterns remain consistent in heterogeneity analyses across different population groups.

The findings of this thesis contribute to research on well-being and mental health by providing rigorous empirical evidence and insightful policy implications. Chapter 2 contributes to a more comprehensive understanding of the family planning policies and their health impacts, offering valuable insights for policymakers on the importance of reproductive autonomy and the delicate design required by fertility restriction-related policies. Findings from Chapter 3 contribute to the understanding of the adverse consequences of public health crises and the identification of the most vulnerable group during an emergencies. Findings in Chapter 4 highlights the importance of considering the independent effects of household income per capita and personal income when examining the relationship between wealth and subjective well-being.

This thesis is subject to several limitations. First, due to dataset constraints, there are potential concerns regarding the robustness of the findings. The dataset is affected by frequent changes in survey questions, high attrition rates across waves, and inconsistent measurement of mental health indicators over time. These issues complicate longitudinal analyses and limit comparability across specific aspects of emotional well-being. Second, the analyses in this thesis are primarily situated within the context of China. While this setting offers valuable insights into the determinants of well-being and mental health, the generalisability of the findings to other countries and cultural contexts remains to be established. Finally, some underlying mechanisms driving the observed relationships warrant further investigation using alternative datasets and more rigorously designed studies.

Future research is planned to further investigate the economic determinants of mental health and well-being. Building on the findings of this thesis, subsequent work will aim to identify the mechanisms behind the observed improvements in mental health following the relaxation of fertility restrictions, with a particular focus on distinguishing the effects of enhanced reproductive autonomy and the experience of actually having an additional child on health outcomes. In addition, upcoming studies will explore how personality traits may mitigate the mental health impacts of other types of life shocks or crises, such as unemployment, compelled residential mobility, and early educational stress. Further research also intends to assess the independent effects of personal income and household income per capita in a wider international context, including countries with different cultural and developmental backgrounds.

Future research will also explore how changes in economic environments influence individuals' attitudes and social preferences, expanding my research interests into broader areas of applied microeconomics and behavioural economics. In particular, I am interested in how public attitudes towards inequality and redistribution may change across different phases

of the macroeconomic cycle. This research will draw on historical data and employ quasi-experimental methods to enhance our understanding of how individuals adjust their economic preferences in response to periods of economic expansion or recession.

Appendix

Supplementary Information for Chapter 2

Table S2-1: Attrition Analysis

	Initial		Final		Difference	
Variable	Mean/SD	Count	Mean/SD	Count	b/se	p-value
UTCP Affected	0.099	49043	0.154	13918	-0.055	0.000
	(0.298)		(0.361)		(0.003)	
Mental Health Symptom	0.039	31717	0.032	13039	0.007	0.000
	(0.194)		(0.176)		(0.002)	
Depression	0.703	31815	0.689	13067	0.015	0.086
	(0.829)		(0.805)		(0.009)	
Needs Effort	0.530	31846	0.483	13081	0.047	0.000
	(0.804)		(0.751)		(0.008)	
Restless	0.490	31845	0.465	13079	0.025	0.002
	(0.755)		(0.727)		(0.008)	
Hopeless	0.302	31807	0.264	13063	0.039	0.000
	(0.658)		(0.604)		(0.007)	
Interviewer-Observed Health	5.548	31890	5.653	13085	-0.105	0.000
	(1.196)		(1.120)		(0.012)	
Residential Area	0.476	34542	0.454	13397	0.022	0.000
	(0.499)		(0.498)		(0.005)	
Age	45.219	37445	45.190	13916	0.029	0.861
	(17.399)		(15.170)		(0.167)	
Education	3.007	37408	2.888	13909	0.119	0.000
	(1.918)		(1.725)		(0.019)	
Single	0.233	37457	0.161	13918	0.073	0.000
	(0.423)		(0.367)		(0.004)	
Employment	0.636	37462	0.725	13918	-0.089	0.000
	(0.481)		(0.447)		(0.005)	
Urban	0.263	36202	0.256	13843	0.007	0.103
	(0.440)		(0.436)		(0.004)	
log Personal Income	4.271	37398	4.114	13903	0.157	0.000
	(4.469)		(4.512)		(0.045)	

Note: The table presents the results of the attrition analysis. The columns labelled *Initial* present the mean, standard deviation, and number of observations for the initial sample. The columns labelled *Final* provide the same statistical information for the final selected sample after excluding respondents who dropped out between the 2014 and 2018 waves and those who reported a change in their ideal number of children after the implementation of the UTCP. The column labelled *Difference* reports the differences between the two samples. This table assesses whether the sample restrictions introduce systematic differences between the initial sample from the raw CFPS dataset and the final sample used in the analyses. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.

Table S2-2: Mental health question wording in the CFPS (CES-D 8 and K6)

Item	Question wording
Panel A: Centre for Epidemiologic Studies Depression Scale (CES-D-8)	
Here are some descriptions of people's mental statuses. Please select according to your statuses in the past week. 1 . Rarely or none of the time (less than 1 day); 2 . Some or a little of the time (1-2 days); 3 . Occasionally or a moderate amount of time (3-4 days); 4 . Most or all of the time (5-7 days).	
CES-D-1	I am in a low spirit.
CES-D-2	I find it difficult to do anything.
CES-D-3	I cannot sleep well.
CES-D-4	I feel happy.
CES-D-5	I feel lonely.
CES-D-6	I have a happy life.
CES-D-7	I feel sad.
CES-D-8	I feel that I cannot continue with my life.
Panel B: Kessler Psychological Distress Scale (K6)	
The following are some descriptions of people's mental conditions. Please answer according to your situation in the past month. 1 . All of the time; 2 . Most of the time; 3 . Some of the time; 4 . A little of the time; 5 . None of the time.	
K6-1	Feel depressed and unable to cheer up.
K6-2	Feel nervous.
K6-3	Feel agitated or upset and unable to remain calm.
K6-4	Feel hopeless about the future.
K6-5	Feel that everything is difficult.
K6-6	Think that life is meaningless.

Note: This table reports the wording of mental health questions used in the China Family Panel Studies (CFPS). Panel A presents the eight-item Centre for Epidemiologic Studies Depression Scale (CES-D-8) used in the 2018 wave, while Panel B presents the six-item Kessler Psychological Distress Scale (K6) used in the 2014 wave. The CFPS interviews were conducted in Chinese. The English wording presented in this table draws on the CFPS English questionnaire and the original English versions of the CES-D and Kessler-6 scales. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.

Table S2-3: Completed Regression Results of Baseline Difference-in-Differences Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
UTCP Affected×	-0.013**	-0.002	-0.032	-0.010	-0.005	0.090***
Post Treatment 1 (Year 2016)	(0.006)	(0.021)	(0.022)	(0.023)	(0.064)	(0.032)
UTCP Affected×	-0.021***	-0.025	-0.071***	0.016		0.021
Post Treatment 2 (Year 2018)	(0.006)	(0.021)	(0.021)	(0.024)		(0.037)
Age	0.003	0.020	0.005	0.006	0.091***	0.001
	(0.005)	(0.013)	(0.015)	(0.013)	(0.006)	(0.024)
Single	0.005	-0.050	0.020	0.016	-0.000	0.031
	(0.013)	(0.039)	(0.036)	(0.044)	(0.406)	(0.080)
Education	-0.008***	-0.001	-0.014**	0.004	-0.051***	0.011

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	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
	(0.002)	(0.006)	(0.006)	(0.006)	(0.016)	(0.008)
Residential Area	-0.000	0.026	0.018	-0.017	0.219	0.114**
	(0.007)	(0.024)	(0.027)	(0.028)	(0.162)	(0.051)
log Personal Income	-0.001**	-0.000	-0.003***	-0.006***	0.000	0.002
	(0.000)	(0.001)	(0.001)	(0.001)	(0.005)	(0.002)
Employment	-0.022***	-0.044***	-0.067***	-0.018	0.063	0.149***
	(0.005)	(0.016)	(0.017)	(0.018)	(0.071)	(0.029)
Constant	-0.052	-0.232	0.492	0.325	-4.043***	5.048***
	(0.224)	(0.622)	(0.711)	(0.598)	(0.367)	(1.157)
Observations	38,798	38,860	38,876	38,887	15,085	35,140
R-squared	0.016	0.006	0.041	0.060	0.382	0.014
Number of pid	13,442	13,442	13,443	13,443	12,914	13,282

Note: The table presents completed empirical results from difference-in-differences regressions that include individual, year, and province fixed-effects. The dependent variables differ across specifications and cover *Menal Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *UTCP Affected*×*Post Treatment (Year)* represents the interaction between the *UTCP Affected* dummy and the *Post Treatment (Year)* indicator within the difference-in-differences framework. Here, *UTCP Affected* denotes whether a respondent was subject to the policy change, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2.1. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 90% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 99% confidence interval.

Table S2-4: Completed Regression Results of Difference-in-Differences Analysis with Interactions of Gender and Treatment Group

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
(Male) UTCP Affected×	-0.020***	-0.007	-0.045	-0.044	0.019	0.071
Post Treatment 1 (Year 2016)	(0.007)	(0.029)	(0.030)	(0.030)	(0.094)	(0.046)
(Male) UTCP Affected×	-0.029***	-0.064**	-0.122***	-0.082***		0.061
Post Treatment 2 (Year 2018)	(0.007)	(0.029)	(0.028)	(0.031)		(0.052)
Female×UTCP Affected×	0.013	0.010	0.024	0.065	-0.043	0.033
Post Treatment 1 (Year 2016)	(0.010)	(0.038)	(0.038)	(0.041)	(0.116)	(0.057)
Female×UTCP Affected×	0.014	0.072*	0.094**	0.182***		-0.071
Post Treatment 2 (Year 2018)	(0.010)	(0.037)	(0.038)	(0.043)		(0.067)
Age	0.003	0.020	0.005	0.007	0.091***	0.001
	(0.005)	(0.013)	(0.015)	(0.013)	(0.006)	(0.024)
Single	0.005	-0.050	0.020	0.015	-0.000	0.031
	(0.013)	(0.039)	(0.036)	(0.044)	(0.406)	(0.080)
Educational Background	-0.008***	-0.001	-0.014**	0.004	-0.051***	0.011
	(0.002)	(0.006)	(0.006)	(0.006)	(0.016)	(0.008)
Residential Area	-0.001	0.026	0.018	-0.018	0.219	0.115**
	(0.007)	(0.024)	(0.027)	(0.028)	(0.162)	(0.051)
log Personal Income	-0.001**	-0.000	-0.003***	-0.006***	0.000	0.002

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VARIABLES	(1) Mental Health Symptom	(2) Depression	(3) Needs Effort	(4) Restless	(5) Hopeless	(6) Observed Health
	(0.000)	(0.001)	(0.001)	(0.001)	(0.005)	(0.002)
Employment	-0.022***	-0.045***	-0.067***	-0.019	0.063	0.150***
	(0.005)	(0.016)	(0.017)	(0.018)	(0.071)	(0.029)
Constant	-0.054	-0.239	0.482	0.305	-4.043***	5.060***
	(0.224)	(0.621)	(0.713)	(0.600)	(0.367)	(1.155)
Observations	38,798	38,860	38,876	38,887	15,085	35,140
R-squared	0.016	0.006	0.041	0.061	0.382	0.014
Number of pid	13,442	13,442	13,443	13,443	12,914	13,282

Note: The table presents completed empirical results from difference-in-differences regressions that include individual, year, and province fixed-effects. The dependent variables differ across specifications and cover *Menal Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *Female×UTCP Affected×Post Treatment (Year)* represents a triple interaction among the *Female* indicator, the *UTCP Affected* dummy, and the *Post Treatment (Year)* indicator in the difference-in-differences framework. Here, *Female* denotes whether a respondent is female, *UTCP Affected* denotes whether a respondent was subject to the policy change, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2.1.
Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 90% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 99% confidence interval.

Table S2-5: Completed Regression Results of Difference-in-Differences Analysis with Interactions of Age Cohorts and Treatment Group

VARIABLES	(1) Mental Health Symptom	(2) Depression	(3) Needs Effort	(4) Restless	(5) Hopeless	(6) Observed Health
(Age 18-30) UTCP Affected×	-0.021**	-0.060	-0.097**	-0.113***	-0.093	0.021
Post Treatment 1 (Year 2016)	(-2.340)	(-1.579)	(-2.504)	(-2.843)	(-0.840)	(0.357)
(Age 18-30) UTCP Affected×	-0.028***	-0.056	-0.195***	-0.187***		0.160**
Post Treatment 2 (Year 2018)	(-2.735)	(-1.345)	(-4.924)	(-3.613)		(2.066)
Age 31-40×UTCP Affected×	-0.011	0.018	0.007	0.027	-0.068	0.084
Post Treatment 1 (Year 2016)	(-0.795)	(0.350)	(0.141)	(0.496)	(-0.424)	(0.997)
Age 31-40×UTCP Affected×	0.017	0.060	0.102**	0.138**		-0.051
Post Treatment 2 (Year 2018)	(1.216)	(1.170)	(2.041)	(2.206)		(-0.513)
Age 41-60×UTCP Affected×	0.021*	0.066	0.118**	0.154***	0.138	0.101
Post Treatment 1 (Year 2016)	(1.796)	(1.417)	(2.463)	(3.101)	(0.984)	(1.422)
Age 41-60×UTCP Affected×	0.004	0.027	0.145***	0.296***		-0.159*
Post Treatment 2 (Year 2018)	(0.340)	(0.542)	(2.974)	(4.916)		(-1.760)
Age Over 60×UTCP Affected×	0.010	0.185***	0.105	0.244***	0.252	0.027
Post Treatment 1 (Year 2016)	(0.612)	(2.904)	(1.635)	(3.522)	(1.324)	(0.286)
Age Over 60×UTCP Affected×	0.006	0.033	0.225***	0.267***		-0.266**
Post Treatment 2 (Year 2018)	(0.337)	(0.565)	(3.683)	(3.656)		(-2.388)
Age	0.003	0.022	0.005	0.006	0.091***	0.001

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	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
	(0.600)	(1.580)	(0.317)	(0.487)	(15.550)	(0.062)
Single	0.005	-0.047	0.011	0.001	0.001	0.049
	(0.419)	(-1.183)	(0.296)	(0.031)	(0.004)	(0.612)
Education	-0.008***	-0.001	-0.014**	0.005	-0.050***	0.011
	(-4.394)	(-0.172)	(-2.342)	(0.805)	(-3.136)	(1.314)
Residential Area	-0.001	0.027	0.020	-0.012	0.216	0.111**
	(-0.076)	(1.100)	(0.758)	(-0.439)	(1.332)	(2.194)
log Personal Income	-0.001**	-0.000	-0.003**	-0.006***	0.001	0.002
	(-2.138)	(-0.335)	(-2.542)	(-4.408)	(0.132)	(0.874)
Employment	-0.022***	-0.044***	-0.066***	-0.015	0.063	0.148***
	(-3.957)	(-2.767)	(-3.861)	(-0.850)	(0.894)	(5.189)
Constant	-0.063	-0.290	0.505	0.345	-4.052***	5.055***
	(-0.280)	(-0.461)	(0.710)	(0.578)	(-11.153)	(4.354)
Observations	38,798	38,860	38,876	38,887	15,085	35,140
R-squared	0.016	0.007	0.041	0.061	0.383	0.014
Number of pid	13,442	13,442	13,443	13,443	12,914	13,282

Note: The table presents completed empirical results from difference-in-differences regressions that include individual, year, and province fixed-effects. The dependent variables differ across specifications and cover*Menal Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *Age Cohort*×*UTCP Affected*×*Post Treatment (Year)* represents a triple interaction among the *Age cohort* indicator, the *UTCP affected* dummy, and the *Post Treatment (Year)* indicator in the difference-in-differences framework. Here, *Age Cohort* denotes whether a respondent falls within a specific age group, *UTCP Affected* denotes whether a respondent was subject to the policy change, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2.1. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 90% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 99% confidence interval.

Table S2-6: Completed Regression Results of Difference-in-Differences Analysis on Areas with Different Development Levels

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
			Panel A: Less Developed Areas			
UTCP Affected×	-0.021***	-0.035	-0.046*	-0.029	0.015	0.077**
Post Treatment 1 (Year 2016)	(0.007)	(0.027)	(0.027)	(0.029)	(0.076)	(0.039)
UTCP Affected×	-0.025***	-0.042	-0.090***	-0.018		0.008
Post Treatment 2 (Year 2018)	(0.007)	(0.027)	(0.027)	(0.030)		(0.046)
Age	0.003	0.018	0.006	0.000	0.273*	-0.011
	(0.006)	(0.015)	(0.018)	(0.014)	(0.161)	(0.025)
Single	0.007	-0.085*	0.027	0.037	-0.248	-0.012
	(0.015)	(0.047)	(0.042)	(0.053)	(0.444)	(0.095)
Education	-0.009***	-0.001	-0.012*	0.013*	-0.037**	0.009
	(0.002)	(0.007)	(0.007)	(0.007)	(0.017)	(0.009)
Residential Area	0.004	0.051	0.051	0.012	0.179	0.186***
	(0.009)	(0.032)	(0.034)	(0.036)	(0.203)	(0.066)
log Personal Income	-0.001*	0.001	-0.003**	-0.005***	-0.004	0.004*

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	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
	(0.000)	(0.001)	(0.001)	(0.002)	(0.006)	(0.002)
Employment	-0.021***	-0.032*	-0.076***	-0.043**	0.046	0.164***
	(0.007)	(0.019)	(0.020)	(0.021)	(0.080)	(0.034)
Constant	-0.106	0.135	0.653	0.162	-11.639	5.696***
	(0.254)	(0.701)	(0.825)	(0.669)	(7.185)	(1.128)
Observations	28,567	28,601	28,611	28,616	11,164	25,959
R-squared	0.018	0.006	0.040	0.055	0.373	0.015
Number of pid	9,996	9,996	9,997	9,997	9,577	9,868
	Panel B: More Developed Areas					
UTCP Affected×	0.007	0.066*	-0.013	0.012	-0.070	0.074
Post Treatment 1 (Year 2016)	(0.009)	(0.036)	(0.035)	(0.040)	(0.114)	(0.057)
UTCP Affected×	-0.012	-0.003	-0.028	0.075*		-0.017
Post Treatment 2 (Year 2018)	(0.009)	(0.036)	(0.036)	(0.042)		(0.064)
Age	-0.000	0.031	-0.014	0.026	0.097***	0.066
	(0.009)	(0.025)	(0.022)	(0.032)	(0.007)	(0.056)
Single	-0.003	0.034	-0.013	-0.099	1.106***	0.157
	(0.025)	(0.071)	(0.075)	(0.087)	(0.164)	(0.150)
Education	-0.005*	-0.003	-0.027**	-0.032**	-0.137***	0.014
	(0.003)	(0.012)	(0.011)	(0.014)	(0.039)	(0.018)
Residential Area	-0.014	-0.067*	-0.085*	-0.095**	0.340	-0.064
	(0.010)	(0.039)	(0.045)	(0.047)	(0.271)	(0.081)
log Personal Income	-0.001**	-0.003	-0.005**	-0.008***	0.013	-0.000
	(0.001)	(0.002)	(0.002)	(0.002)	(0.009)	(0.003)
Employment	-0.022**	-0.073**	-0.042	0.051	0.134	0.113**
	(0.009)	(0.029)	(0.031)	(0.034)	(0.150)	(0.054)
Constant	1.057**	-0.054	2.750**	0.688	-4.479***	3.616
	(0.443)	(1.167)	(1.086)	(1.511)	(0.447)	(2.663)
Observations	10,231	10,259	10,265	10,271	3,921	9,181
R-squared	0.017	0.011	0.044	0.079	0.403	0.016
Number of pid	3,665	3,665	3,665	3,665	3,343	3,462

Note: The table presents empirical results from difference-in-differences regressions that include individual, year, and province fixed-effects. The dependent variables differ across specifications and cover*Menal Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *UTCP Affected×Post Treatment (Year)* represents the interaction between the *UTCP Affected* dummy and the *Post Treatment (Year)* indicator in the difference-in-differences framework. Here, *UTCP Affected* denotes whether a respondent was subject to the policy change, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2.1. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.

* represents significance at 90% confidence interval.

** represents significance at 95% confidence interval.

*** represents significance at 99% confidence interval.

Table S2-7: Completed regression Results of Difference-in-Differences Analysis by Marriage Status

VARIABLES	(1) Mental Health Symptom	(2) Depression	(3) Needs Effort	(4) Restless	(5) Hopeless	(6) Observed Health
			Panel A: Unmarried Sample			
UTCP Affected×	-0.017	0.052	0.019	0.010	-0.062	-0.017
Post Treatment 1 (Year 2016)	(0.014)	(0.061)	(0.062)	(0.071)	(0.175)	(0.107)
UTCP Affected×	-0.014	0.066	-0.058	-0.074		-0.030
Post Treatment 2 (Year 2018)	(0.016)	(0.068)	(0.066)	(0.084)		(0.145)
Age	0.008	0.198***	0.156***	0.088	0.027	0.031
	(0.016)	(0.054)	(0.050)	(0.062)	(0.249)	(0.159)
Education	-0.006	-0.035*	-0.010	-0.008	-0.114	0.032
	(0.004)	(0.020)	(0.020)	(0.028)	(0.127)	(0.048)
Residential Area	0.013	-0.013	-0.057	-0.106	-0.717***	-0.090
	(0.015)	(0.054)	(0.055)	(0.066)	(0.220)	(0.115)
log Personal Income	0.000	0.004	-0.000	-0.004	0.005	-0.000
	(0.001)	(0.003)	(0.003)	(0.004)	(0.013)	(0.006)
Employment	-0.019	0.021	-0.045	0.012	0.095	0.025
	(0.012)	(0.042)	(0.043)	(0.050)	(0.197)	(0.092)
Constant	-0.053	-3.652***	-2.685**	-1.150	0.502	6.913*
	(0.365)	(1.263)	(1.177)	(1.447)	(5.758)	(3.708)
Observations	3,571	3,572	3,572	3,572	1,403	2,738
R-squared	0.020	0.048	0.027	0.043	0.359	0.026
Number of pid	1,406	1,407	1,407	1,407	1,254	1,325
			Panel B: Married Sample			
UTCP Affected×	-0.010	-0.018	-0.039*	-0.011	0.006	0.104***
Post Treatment 1 (Year 2016)	(0.006)	(0.023)	(0.023)	(0.025)	(0.070)	(0.035)
UTCP Affected×	-0.019***	-0.038	-0.071***	0.023		0.038
Post Treatment 2 (Year 2018)	(0.006)	(0.023)	(0.023)	(0.026)		(0.040)
Age	-0.001	0.019	-0.009	-0.005	0.445***	-0.008
	(0.003)	(0.016)	(0.016)	(0.012)	(0.016)	(0.027)
Education	-0.007***	0.005	-0.009	0.010	-0.043**	0.005
	(0.002)	(0.007)	(0.007)	(0.007)	(0.018)	(0.009)
Residential Area	-0.004	0.023	0.030	0.002	0.286*	0.118**
	(0.008)	(0.028)	(0.032)	(0.032)	(0.171)	(0.056)
log Personal Income	-0.001	-0.000	-0.003**	-0.005***	0.003	0.001
	(0.000)	(0.001)	(0.001)	(0.001)	(0.005)	(0.002)
Employment	-0.024***	-0.053***	-0.052***	-0.007	0.069	0.162***
	(0.006)	(0.018)	(0.019)	(0.020)	(0.077)	(0.032)
Constant	0.073	-0.148	1.066	0.770	-20.699***	5.114***
	(0.166)	(0.755)	(0.793)	(0.615)	(0.812)	(1.329)
Observations	33,261	33,309	33,324	33,332	12,967	30,550
R-squared	0.016	0.006	0.047	0.064	0.382	0.014
Number of pid	11,638	11,638	11,638	11,638	11,054	11,474

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	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health

Note: The table presents the completed empirical results from difference-in-differences regressions by marital status. Panel A reports the results for unmarried respondents and Panel B reports the results for married respondents. The dependent variables differ across specifications and cover*Menal Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *UTCP Affected*×*Post Treatment (Year)* represents the interaction between the *UTCP Affected* dummy and the *Post Treatment (Year)* indicator in the difference-in-differences framework. Here, *UTCP Affected* denotes whether a respondent was subject to the policy change, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2-1. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 90% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 99% confidence interval.

Table S2-8: Completed regression Results of Difference-in-Differences Analysis by Regional Fertility Levels

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
	Panel A: Areas with Lower Fertility Rates					
UTCP Affected×	-0.008	0.003	-0.043	0.015	-0.064	0.074*
Post Treatment 1 (Year 2016)	(0.007)	(0.027)	(0.027)	(0.029)	(0.080)	(0.039)
UTCP Affected×	-0.023***	-0.052*	-0.060**	0.040		0.086*
Post Treatment 2 (Year 2018)	(0.008)	(0.027)	(0.028)	(0.030)		(0.045)
Age	-0.004	0.013	-0.014	-0.010	0.089***	-0.024
	(0.004)	(0.018)	(0.019)	(0.014)	(0.004)	(0.026)
Single	-0.016	-0.058	0.014	-0.024	0.448	0.122
	(0.017)	(0.047)	(0.049)	(0.053)	(0.399)	(0.107)
Education	-0.009***	0.007	-0.014*	0.010	-0.042**	0.007
	(0.002)	(0.007)	(0.007)	(0.008)	(0.020)	(0.009)
Residential Area	-0.002	-0.001	0.011	-0.054	0.317*	0.145**
	(0.009)	(0.031)	(0.034)	(0.034)	(0.186)	(0.063)
log Personal Income	-0.001**	-0.001	-0.004***	-0.005***	-0.001	0.000
	(0.000)	(0.001)	(0.002)	(0.002)	(0.006)	(0.002)
Employment	-0.013*	-0.016	-0.043*	0.005	0.113	0.129***
	(0.007)	(0.020)	(0.023)	(0.023)	(0.100)	(0.037)
Constant	0.303	0.097	1.110	1.297*	-3.624***	6.785***
	(0.206)	(0.846)	(0.949)	(0.663)	(0.256)	(1.281)
Observations	23,030	23,068	23,081	23,088	8,961	20,822
R-squared	0.017	0.007	0.042	0.063	0.375	0.026
Number of pid	8,094	8,094	8,095	8,095	7,667	7,886
	Panel B: Areas with Higher Fertility Rates					
UTCP Affected×	-0.020**	-0.017	-0.019	-0.065*	0.102	0.103*
Post Treatment 1 (Year 2016)	(0.009)	(0.037)	(0.036)	(0.039)	(0.105)	(0.057)
UTCP Affected×	-0.019**	0.012	-0.095***	-0.038		-0.053
Post Treatment 2 (Year 2018)	(0.009)	(0.036)	(0.034)	(0.041)		(0.065)

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	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
Age	0.012	0.031*	0.030*	0.030	0.255	0.030
	(0.009)	(0.018)	(0.017)	(0.023)	(0.337)	(0.028)
Single	0.036*	-0.034	0.005	0.038	-0.278	-0.070
	(0.019)	(0.068)	(0.054)	(0.079)	(0.593)	(0.119)
Education	-0.007**	-0.020**	-0.014	-0.008	-0.070***	0.018
	(0.003)	(0.010)	(0.010)	(0.010)	(0.027)	(0.016)
Residential Area	-0.001	0.053	0.003	0.082	-0.022	0.075
	(0.012)	(0.044)	(0.047)	(0.053)	(0.335)	(0.087)
log Personal Income	-0.000	0.000	-0.002	-0.007***	0.002	0.004
	(0.001)	(0.002)	(0.002)	(0.002)	(0.007)	(0.003)
Employment	-0.035***	-0.087***	-0.101***	-0.056**	-0.010	0.185***
	(0.009)	(0.025)	(0.026)	(0.027)	(0.096)	(0.045)
Constant	-0.457	-0.219	-0.505	-0.977	-10.477	4.045***
	(0.406)	(0.801)	(0.754)	(1.035)	(14.839)	(1.250)
Observations	15,768	15,792	15,795	15,799	6,124	14,318
R-squared	0.018	0.006	0.039	0.056	0.392	0.005
Number of pid	5,551	5,551	5,551	5,551	5,251	5,440

Note: The table presents completed empirical results from difference-in-differences regressions by regional ferility levels. Panel A reports the results for respondents from areas with lower fertility levels and Panel B reports the results for respondents from areas with higher fertility levels. The regressions follow the baseline difference-in-differences specifications reported in Table 2-2. The dependent variables differ across specifications and cover*Menal Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *UTCP Affected*×*Post Treatment (Year)* represents the interaction between the *UTCP Affected* dummy and the *Post Treatment (Year)* indicator in the difference-in-differences framework. Here, *UTCP Affected* denotes whether a respondent was subject to the policy change, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2-1. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 90% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 99% confidence interval.

Table S2-9: Completed Regression Results of Difference-in-Differences Analysis by Fertility Preferences and Existing Number of Children

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
	Panel A: Respondents with Ideal Number of Children $\leq$ 1					
Exemption Ineligible×	-0.028**	-0.045	-0.065	-0.108	-0.217	-0.026
Post Treatment 1 (Year 2016)	(0.014)	(0.062)	(0.059)	(0.069)	(0.187)	(0.097)
Exemption Ineligible×	-0.004	0.035	-0.024	-0.171**		0.021
Post Treatment 2 (Year 2018)	(0.017)	(0.068)	(0.061)	(0.068)		(0.116)
Age	0.033*	0.140	0.073	0.116	0.447***	-0.284
	(0.020)	(0.091)	(0.064)	(0.095)	(0.072)	(0.321)
Single	-0.031	-0.258*	-0.149	-0.114		-0.081
	(0.032)	(0.134)	(0.102)	(0.139)		(0.315)
Education	-0.005	0.014	-0.077***	-0.095***	-0.681***	0.034
	(0.006)	(0.037)	(0.030)	(0.031)	(0.227)	(0.048)
Residential Area	-0.012	0.042	-0.043	-0.012	0.536	-0.069
	(0.018)	(0.079)	(0.076)	(0.081)	(0.570)	(0.183)

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	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
log Personal Income	-0.001	-0.007*	-0.002	-0.007	-0.015	-0.006
	(0.001)	(0.004)	(0.004)	(0.005)	(0.015)	(0.007)
Employment	0.013	0.115**	0.062	0.118*	0.442*	0.123
	(0.016)	(0.058)	(0.057)	(0.066)	(0.263)	(0.111)
Constant	-0.982	-3.628	-0.432	-1.506	-12.231***	14.784
	(0.619)	(2.756)	(1.955)	(2.923)	(2.266)	(9.927)
Observations	2,439	2,440	2,440	2,440	1,032	2,079
R-squared	0.038	0.045	0.037	0.079	0.449	0.034
Number of pid	927	928	928	928	909	921
	Panel B: Respondents Already Have More than One Child					
Exemption Ineligible×	-0.017	0.003	-0.029	-0.036	-0.041	-0.167***
Post Treatment 1 (Year 2016)	(0.012)	(0.042)	(0.041)	(0.043)	(0.112)	(0.059)
Exemption Ineligible×	-0.007	0.045	-0.008	0.042		-0.233***
Post Treatment 2 (Year 2018)	(0.013)	(0.045)	(0.043)	(0.047)		(0.071)
Age	-0.011	0.034	0.030	0.021	0.402***	0.152*
	(0.013)	(0.046)	(0.040)	(0.042)	(0.042)	(0.088)
Single	-0.001	-0.096	0.088	0.107	-0.065	0.051
	(0.041)	(0.128)	(0.100)	(0.110)	(0.569)	(0.170)
Education	-0.004	-0.007	0.005	0.013	-0.006	-0.011
	(0.005)	(0.019)	(0.018)	(0.017)	(0.045)	(0.020)
Residential Area	0.017	0.038	0.088	0.028	0.277	0.067
	(0.017)	(0.058)	(0.065)	(0.078)	(0.299)	(0.111)
log Personal Income	-0.001	0.003	-0.000	-0.003	-0.004	-0.003
	(0.001)	(0.003)	(0.003)	(0.003)	(0.011)	(0.004)
Employment	-0.004	-0.051	-0.075*	-0.025	0.215	0.126*
	(0.014)	(0.045)	(0.044)	(0.047)	(0.160)	(0.072)
Constant	0.399	-0.532	-0.589	-0.657	-15.070***	0.005
	(0.467)	(1.653)	(1.470)	(1.562)	(1.593)	(3.182)
Observations	6,766	6,769	6,773	6,773	3,085	6,086
R-squared	0.019	0.012	0.034	0.036	0.357	0.010
Number of pid	2,776	2,777	2,777	2,777	2,698	2,744

Note: The table presents completed empirical results from difference-in-differences regressions for respondents with different fertility preference and existing number of children. Panel A reports the results for respondents who would ideally have no more than one child and Panel B reports the results for respondents who already have more than one child. The analyses use broader treatment definition based only on the policy exemption prior to the UTCP implementation. The sample is restricted to respondents of reproductive age (16~45). The dependent variables differ across specifications and cover*Menal Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *Exemption Ineligible*×*Post Treatment (Year)* represents the interaction between the *Exemption Ineligible* dummy and the *Post Treatment (Year)* indicator in the difference-in-differences framework. Here, *Exemption Ineligible* denotes whether a respondent was ineligible for any exemptions of having a second child prior to the implementation of the UTCP, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2-1. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.

* represents significance at 90% confidence interval.

** represents significance at 95% confidence interval.

*** represents significance at 99% confidence interval.

Table S2-10: Completed Regression Results of Difference-in-Differences Analysis for Older Family Members

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
Older Family Linked×	0.003	-0.099**	-0.003	-0.049	-0.222	-0.034
Post Treatment 1 (Year 2016)	(0.015)	(0.050)	(0.053)	(0.056)	(0.152)	(0.079)
Older Family Linked×	0.026	-0.109**	-0.028	0.058		-0.142
Post Treatment 2 (Year 2018)	(0.017)	(0.052)	(0.056)	(0.058)		(0.090)
Age	-0.020**	-0.043	0.023	-0.044**	0.087***	-0.037
	(0.009)	(0.038)	(0.032)	(0.018)	(0.014)	(0.042)
Single	-0.067	-0.181	-0.128	-0.068		0.042
	(0.060)	(0.111)	(0.153)	(0.148)		(0.267)
Education	-0.001	0.007	0.010	0.018	-0.002	-0.016
	(0.003)	(0.011)	(0.013)	(0.014)	(0.027)	(0.017)
Residential Area	0.034	-0.051	0.058	0.103	-0.157	0.142
	(0.029)	(0.089)	(0.113)	(0.101)	(0.702)	(0.166)
log Personal Income	-0.001	-0.009**	-0.007*	-0.012***	-0.012	0.011*
	(0.001)	(0.004)	(0.004)	(0.004)	(0.019)	(0.006)
Employment	-0.025*	-0.055	-0.072	0.058	-0.063	0.086
	(0.015)	(0.043)	(0.047)	(0.045)	(0.176)	(0.070)
Constant	1.150**	3.163	-0.953	2.958***	-4.650***	7.282***
	(0.534)	(2.175)	(1.827)	(1.021)	(0.969)	(2.383)
Observations	5,730	5,745	5,751	5,755	1,963	5,488
R-squared	0.026	0.016	0.061	0.087	0.416	0.015
Number of pid	2,322	2,322	2,322	2,322	1,665	2,275

Note: The table presents empirical results from difference-in-differences regressions for older family members. The dependent variables differ across specifications and cover *Mental Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *Older Family Linked*×*Post Treatment (Year)* represents the interaction between the *Older Family Affected* dummy and the *Post Treatment (Year)* indicator within the difference-in-differences framework. Here, *Older Family Linked* denotes whether a respondent is considered an older family member linked to a respondent of reproductive age who was affected by the UTCP, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2-1.
Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 90% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 99% confidence interval.

Table S2-11: Regression Results of Difference-in-Differences Analysis (Including Respondents with Changing Ideal Number of Children)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
UTCP Affected×	-0.011**	-0.005	-0.026	-0.015	-0.083	0.097***
Post Treatment 1 (Year 2016)	(0.005)	(0.017)	(0.017)	(0.018)	(0.052)	(0.026)
UTCP Affected×	-0.021***	-0.027	-0.064***	0.007		0.019
Post Treatment 2 (Year 2018)	(0.005)	(0.017)	(0.017)	(0.019)		(0.029)
Age	0.005**	0.027***	0.012	0.024***	0.140**	-0.002
	(0.003)	(0.009)	(0.009)	(0.007)	(0.065)	(0.015)

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	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
Single	0.014	-0.030	0.006	-0.008	-0.009	-0.036
	(0.011)	(0.032)	(0.031)	(0.034)	(0.407)	(0.061)
Education	-0.007***	-0.002	-0.010**	0.001	-0.038***	0.003
	(0.001)	(0.004)	(0.004)	(0.004)	(0.011)	(0.005)
Residential Area	0.006	0.027	0.037*	0.018	0.082	0.120***
	(0.006)	(0.020)	(0.020)	(0.021)	(0.127)	(0.040)
log Personal Income	-0.000	-0.001	-0.004***	-0.005***	-0.001	0.003*
	(0.000)	(0.001)	(0.001)	(0.001)	(0.004)	(0.002)
Employment	-0.020***	-0.040***	-0.068***	-0.025*	-0.026	0.151***
	(0.004)	(0.013)	(0.013)	(0.014)	(0.057)	(0.022)
Constant	-0.150	-0.544	0.202	-0.339	-5.904*	5.672***
	(0.126)	(0.448)	(0.429)	(0.360)	(3.085)	(0.779)
Observations	66,252	66,400	66,427	66,449	25,479	59,377
R-squared	0.016	0.005	0.036	0.058	0.370	0.012
Number of pid	24,061	24,066	24,071	24,069	21,856	23,302

Note: The table presents empirical results from difference-in-differences regressions that include individual, year, and province fixed-effects. The sample includes respondents who reported changes in the ideal number of children after the UTCP implementation. The dependent variables differ across specifications and cover *Menal Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *UTCP Affected*×*Post Treatment (Year)* represents the interaction between the *UTCP Affected* dummy and the *Post Treatment (Year)* indicator within the difference-in-differences framework. Here, *UTCP Affected* denotes whether a respondent was subject to the policy change, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2.1. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 90% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 99% confidence interval.

Table S2-12: Regression Results of Difference-in-Differences Analysis (Excluding Respondents of Ethnic Minority)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health
UTCP Affected×	-0.011*	-0.011	-0.030	-0.020	-0.013	0.115***
Post Treatment 1 (Year 2016)	(0.006)	(0.022)	(0.022)	(0.024)	(0.064)	(0.033)
UTCP Affected×	-0.022***	-0.022	-0.073***	0.001		0.058
Post Treatment 2 (Year 2018)	(0.006)	(0.022)	(0.022)	(0.025)		(0.038)
Age	0.001	0.014	0.001	-0.001	0.089***	0.002
	(0.005)	(0.014)	(0.016)	(0.014)	(0.003)	(0.026)
Single	0.006	-0.043	0.009	0.005	0.414	0.008
	(0.013)	(0.041)	(0.039)	(0.047)	(0.373)	(0.084)
Education	-0.009***	-0.001	-0.014**	0.002	-0.053***	0.013
	(0.002)	(0.006)	(0.007)	(0.007)	(0.018)	(0.009)
Residential Area	-0.000	0.030	0.014	0.004	0.117	0.112**
	(0.007)	(0.026)	(0.029)	(0.029)	(0.175)	(0.054)
log Personal Income	-0.001**	-0.001	-0.004***	-0.006***	-0.001	0.002
	(0.000)	(0.001)	(0.001)	(0.001)	(0.005)	(0.002)
Employment	-0.025***	-0.046***	-0.060***	-0.019	0.046	0.158***
	(0.006)	(0.017)	(0.018)	(0.019)	(0.074)	(0.030)

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VARIABLES	(1) Mental Health Symptom	(2) Depression	(3) Needs Effort	(4) Restless	(5) Hopeless	(6) Observed Health
Constant	0.005	-0.011	0.602	0.611	-4.033***	4.730***
	(0.245)	(0.643)	(0.767)	(0.649)	(0.272)	(1.273)
Observations	34,918	34,976	34,991	35,002	13,569	31,745
R-squared	0.018	0.006	0.045	0.063	0.392	0.016
Number of pid	12,067	12,067	12,068	12,068	11,608	11,929

Note: The table presents empirical results from difference-in-differences regressions that include individual, year, and province fixed-effects. The sample excludes respondents who belong to ethnic minority. The dependent variables differ across specifications and cover *Menal Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *UTCP Affected*×*Post Treatment (Year)* represents the interaction between the *UTCP Affected* dummy and the *Post Treatment (Year)* indicator within the difference-in-differences framework. Here, *UTCP Affected* denotes whether a respondent was subject to the policy change, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2.1. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 90% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 99% confidence interval.

Table S2-13: Regression Results of Difference-in-Differences Analysis (Using 2012 as Reference Year)

VARIABLES	(1) Mental Health Symptom	(2) Depression	(3) Needs Effort	(4) Restless	(5) Hopeless	(6) Observed Health
UTCP Affected×	0.007	0.037*	0.050**	-0.050**	0.115***	-0.010
Pre Treatment (Year 2014)	(0.006)	(0.022)	(0.022)	(0.024)	(0.029)	(0.033)
UTCP Affected×	-0.009	0.018	0.014	-0.060**	0.091	0.083**
Post Treatment 1 (Year 2016)	(0.006)	(0.021)	(0.023)	(0.024)	(0.066)	(0.034)
UTCP Affected×	-0.019***	0.005	-0.038*	-0.037		-0.015
Post Treatment 2 (Year 2018)	(0.007)	(0.021)	(0.023)	(0.025)		(0.041)
Age	-0.001	0.015	0.000	-0.012	0.068**	-0.010
	(0.004)	(0.014)	(0.015)	(0.013)	(0.032)	(0.027)
Single	0.012	-0.036	-0.016	0.009	-0.018	0.030
	(0.010)	(0.028)	(0.029)	(0.033)	(0.065)	(0.054)
Education	-0.007***	-0.006	-0.006	0.003	-0.035***	0.007
	(0.002)	(0.006)	(0.006)	(0.007)	(0.008)	(0.008)
Residential Area	-0.001	-0.008	0.005	-0.000	-0.058	0.117***
	(0.006)	(0.021)	(0.023)	(0.023)	(0.051)	(0.037)
log Personal Income	-0.000	0.000	-0.001	-0.002**	-0.003	0.003*
	(0.000)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Employment	-0.016***	-0.020	-0.037**	-0.025*	0.068**	0.132***
	(0.005)	(0.013)	(0.015)	(0.015)	(0.029)	(0.024)
Constant	0.179	0.181	0.785	1.248**	-1.628	5.032***
	(0.187)	(0.623)	(0.682)	(0.572)	(1.463)	(1.219)
Observations	45,390	45,489	45,505	45,525	24,566	42,544
R-squared	0.011	0.006	0.027	0.043	0.357	0.022
Number of pid	11,902	11,905	11,907	11,907	11,812	11,855

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	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Mental Health Symptom	Depression	Needs Effort	Restless	Hopeless	Observed Health

Note: The table presents empirical results from difference-in-differences regressions that include individual, year, and province fixed-effects. The analyses use 2012 as the reference year. The dependent variables differ across specifications and cover *Menal Health Symptom*, specific negative emotions, and interviewer-observed physical health status. The term *UTCP Affected*×*Post Treatment (Year)* represents the interaction between the *UTCP Affected* dummy and the *Post Treatment (Year)* indicator within the difference-in-differences framework. Here, *UTCP Affected* denotes whether a respondent was subject to the policy change, and *Post Treatment (Year)* indicates the post-implementation period. Personal income is log-transformed after adding 1 to each observation. Standard errors are reported in parentheses. Descriptions of the explanatory variables are provided in the notes to Table 2.1. Source: Isss.pku.edu.cn. 2024. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 90% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 99% confidence interval.

Supplementary Information for Chapter 3

Table S3-1: Cross-sectional and longitudinal sample dimensions in CFPS 2018 and 2020

	Individual is observed twice		
Wave	**No**	**Yes**	**Total**
2018	11,708	18,127	29,835
2020	6,398	18,127	24,525
Total	18,106	36,254	54,360

Source: CFPS (waves 2018 and 2020). The data are from China Family Panel Studies (CFPS), funded by Peking University and the National Natural Science Foundation of China. The CFPS is maintained by the Institute of Social Science Survey of Peking University.

Table S3-2: Descriptive Demographic Statistics, Year 2018 (Prepandemic)

Variable	**Obs.**	**Mean**	**Std. err.**	**[95% Conf. Interval]**	
Mental Health Deterioration	18127	0.0620621	0.0122091	0.0381312	0.0859931
Mental Health Symptoms	18127	1.192365	0.0112286	1.170356	1.214374
Mental Health Caseness	18127	0.0689027	0.0018813	0.0652152	0.0725903
Female	18127	0.4919181	0.0037133	0.4846397	0.4991966
Male	18127	0.5080819	0.0037133	0.5008034	0.5153603
Urban	17965	0.4991372	0.0037305	0.4918251	0.5064494
Income	18127	14096.09	214.4266	13675.79	14516.38
Primary Edu. Group	18127	0.4341038	0.0036814	0.4268879	0.4413197
Secondary Edu. Group	18127	0.4539085	0.003698	0.4466601	0.4611569
Tertiary Edu. Group	18127	0.1119876	0.0023423	0.1073965	0.1165788
Under 18 Years Old	18127	0.109781	0.002322	0.1052297	0.1143323
18–39 Years Old	18127	0.2972362	0.0033947	0.2905822	0.3038901
40–65 Years Old	18127	0.4834225	0.0037118	0.4761471	0.4906979
Over 65 Years Old	18127	0.1095603	0.0023199	0.105013	0.1141076
Agricultural Business	17446	0.2801788	0.0034001	0.2735143	0.2868434
Other Private Business	17446	0.0734266	0.0019748	0.0695557	0.0772974
Agricultural Job	17446	0.0154763	0.0009346	0.0136445	0.0173082
Waged Job	17446	0.2942222	0.0034501	0.2874596	0.3009848
Unemployed	17446	0.0107761	0.0007817	0.0092439	0.0123083
Student	17446	0.1513241	0.0027132	0.1460058	0.1566423

Retired	17446	0.0887883	0.0021535	0.0845671	0.0930094
Housework	17446	0.0513012	0.0016703	0.0480272	0.0545751
Disable	17446	0.0237877	0.0011538	0.0215262	0.0260492
Other Reason	17446	0.0107188	0.0007796	0.0091906	0.012247

Table S3-3: Descriptive Demographic Statistics, Year 2020 (Pandemic)

Variable	Obs.	Mean	Std. err.	[95% Conf. Interval]	
Mental Health Symptoms	18127	1.254427	0.0117985	1.231301	1.277553
Mental Health Caseness	18127	0.0818117	0.0020357	0.0778214	0.0858019
Lockdown	18127	0.0157776	0.0009256	0.0139633	0.0175918
Hubei Lockdown	18127	0.0136261	0.0008611	0.0119382	0.0153139
Xinjiang Lockdown	18127	0.0021515	0.0003442	0.0014769	0.0028261

Table S3-4: Descriptive Demographic Statistics, Year 2016

Variable	Obs.	Mean	Std. err.	[95% Conf. Interval]	
Mental Health Symptoms	14537	1.151544	0.0126048	1.126837	1.176251
Mental Health Caseness	14537	0.0668639	0.0020718	0.0628029	0.0709248

Table S3-5: Descriptive Personality Statistics, Year 2018 (Prepandemic)

Variable	Obs.	Mean	Std. dev.	Min	Max
Openness	16420	3.182562	0.8524371	1	5
Conscientiousness	16544	3.850137	0.6532633	1	5
Extraversion	16495	3.349884	0.7033113	1	5
Agreeableness	16540	3.832648	0.6016804	1	5
Neuroticism	16530	2.968381	0.7356712	1	5
Cognitive	12894	16.5686	5.998624	1	29

Table S3-6: Personality Traits and Cognitive Skill Correlation Matrix, Year 2018 (Prepandemic)

Variable	Openness	Conscientious-ness	Extraversion	Agreeableness	Neuroticism	Cognitive
Openness	1					
Conscientiousness	0.1874	1				
Extraversion	0.2194	0.1726	1			
Agreeableness	0.0956	0.123	0.0634	1		
Neuroticism	0.0034	-0.1058	-0.1487	-0.1053	1	
Cognitive	0.0785	-0.1492	-0.0689	-0.0135	-0.0783	1

Table S3-7: Attrition Analysis

Variable	(1)		(2)		(3)		(4)		(5)		(6)	
							(1) vs. (2)		(1) vs. (3)		(2) vs. (3)	
	Mean/SD	Count	Mean/SD	Count	Mean/SD	Count	b/se	p-value	b/se	p-value	b/se	p-value
Depression Symptoms (in 2020)	1.243	32598	1.243	32598	1.184	19550	0.000	1.000	0.059	0.000	0.059	0.000
	(1.561)		(1.561)		(1.505)		(0.012)		(0.014)		(0.014)	
	(0.125)		(0.124)		(0.125)		(0.001)		(0.001)		(0.001)	
Female	0.500	33097	0.500	32598	0.501	19550	0.000	0.984	-0.001	0.811	-0.001	0.798
	(0.500)		(0.500)		(0.500)		(0.004)		(0.005)		(0.005)	
Age	44.791	37352	44.026	32598	42.531	19550	0.765	0.000	2.260	0.000	1.495	0.000
	(19.366)		(18.588)		(17.745)		(0.144)		(0.166)		(0.165)	
Urban	0.496	35133	0.500	32295	0.504	19366	-0.005	0.242	-0.008	0.063	-0.004	0.401
	(0.500)		(0.500)		(0.500)		(0.004)		(0.004)		(0.005)	
Family Members	4.170	20924	4.179	19895	4.180	19529	-0.009	0.644	-0.011	0.604	-0.001	0.954
	(2.066)		(2.058)		(2.053)		(0.020)		(0.020)		(0.021)	
Education	1.648	37354	1.654	32598	1.704	19550	0.006	0.231	-0.044	0.000	-0.051	0.000
	(0.677)		(0.669)		(0.672)		(0.005)		(0.006)		(0.006)	
Household Income ~	9.634	36683	9.672	32266	9.705	19425	-0.037	0.000	-0.070	0.000	-0.033	0.000
	(0.998)		(0.990)		(0.980)		(0.008)		(0.009)		(0.009)	
Marital Status: Never Married	0.168	19807	0.163	18799	0.164	18435	0.005	0.186	0.004	0.340	-0.001	0.721
	(0.374)		(0.369)		(0.370)		(0.004)		(0.004)		(0.004)	
Marital Status: Married	0.770	19807	0.776	18799	0.776	18435	-0.006	0.182	-0.006	0.141	-0.001	0.887
	(0.421)		(0.417)		(0.417)		(0.004)		(0.004)		(0.004)	
Marital Status: Cohabiting	0.003	19807	0.003	18799	0.003	18435	-0.000	0.921	-0.000	0.988	0.000	0.934
	(0.055)		(0.055)		(0.055)		(0.001)		(0.001)		(0.001)	
Marital Status: Divorced	0.018	19807	0.018	18799	0.018	18435	-0.000	0.987	0.000	0.939	0.000	0.927
	(0.134)		(0.134)		(0.134)		(0.001)		(0.001)		(0.001)	
Marital Status: Widowed	0.041	19807	0.040	18799	0.039	18435	0.001	0.702	0.003	0.199	0.002	0.371
	(0.199)		(0.197)		(0.193)		(0.002)		(0.002)		(0.002)	
Job Status: Agricultural Business	0.228	37354	0.259	32598	0.260	19550	-0.033	0.000	-0.034	0.000	-0.001	0.721
	(0.420)		(0.438)		(0.439)		(0.003)		(0.004)		(0.004)	
Job Status: Private Business	0.061	37354	0.069	32598	0.071	19550	-0.009	0.000	-0.011	0.000	-0.003	0.271

	(0.239)		(0.253)		(0.258)		(0.002)		(0.002)		(0.002)	
Job Status: Agricultural Job	0.013	37354	0.014	32598	0.015	19550	-0.002	0.047	-0.002	0.045	-0.000	0.379
	(0.112)		(0.119)		(0.120)		(0.001)		(0.001)		(0.001)	
Job Status: Wage Job	0.245	37354	0.277	32598	0.295	19550	-0.034	0.000	-0.052	0.000	-0.018	0.000
	(0.430)		(0.447)		(0.456)		(0.003)		(0.004)		(0.004)	
Job Status: Unemployed	0.010	37354	0.011	32598	0.011	19550	-0.001	0.129	-0.001	0.348	0.000	0.722
	(0.099)		(0.104)		(0.102)		(0.001)		(0.001)		(0.001)	
Job Status: Student	0.119	37354	0.126	32598	0.137	19550	-0.008	0.001	-0.019	0.000	-0.011	0.000
	(0.323)		(0.331)		(0.344)		(0.002)		(0.003)		(0.003)	
Job Status: Retiree	0.092	37354	0.103	32598	0.082	19550	-0.012	0.000	-0.009	0.000	0.021	0.000
	(0.289)		(0.304)		(0.274)		(0.002)		(0.002)		(0.003)	
Job Status: Housework	0.050	37354	0.057	32598	0.058	19550	-0.007	0.000	-0.008	0.000	-0.001	0.629
	(0.219)		(0.232)		(0.234)		(0.002)		(0.002)		(0.002)	
Job Status: Disabled	0.025	37354	0.028	32598	0.022	19550	-0.003	0.017	0.003	0.020	0.006	0.000
	(0.157)		(0.165)		(0.146)		(0.001)		(0.001)		(0.001)	
Job Status: Other	0.011	37354	0.013	32598	0.011	19550	-0.001	0.084	0.001	0.491	0.002	0.036
	(0.106)		(0.112)		(0.102)		(0.001)		(0.001)		(0.001)	

Table S3.7: The first column provides basic statistical information about the observations for the whole sample from the raw CFPS dataset. The second column provides basic statistical information about the observations for the sample after dropping the missing values of the depression symptoms. The third column provides basic statistical information about the observations for the sample after dropping the observations that were in the 2018 CFPS survey but not in the 2020 CFPS survey. The fourth, fifth, and sixth columns compare the statistics indexes between the first and the second column, the first and the third column, and the second and the third column, respectively. This table demonstrates whether the attrition caused by missing observations affects the national representation of the sample used for analysis.

Figure S3-1: Mild or Serious Depression in the Prepandemic and Pandemic Waves

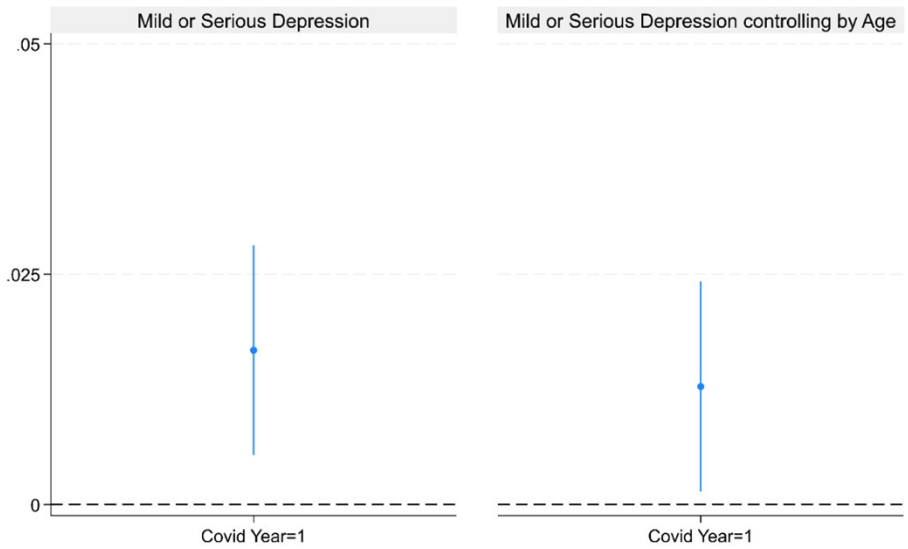

Figure S3-1: Mild or serious depression in the prepandemic and then pandemic waves. Mild and serious depression occur when respondents report eight or more symptoms in the CES-D questionnaire. The two panels report the coefficient of the regression with and without age. The bars represent the 95% confidence intervals. Statistics are weighted using the survey sample weights. Robust standard errors are clustered at the individual levels.

Figure S3-2: Mild or Serious Depression in the Prepandemic and Pandemic Waves (July-December Interviewees only)

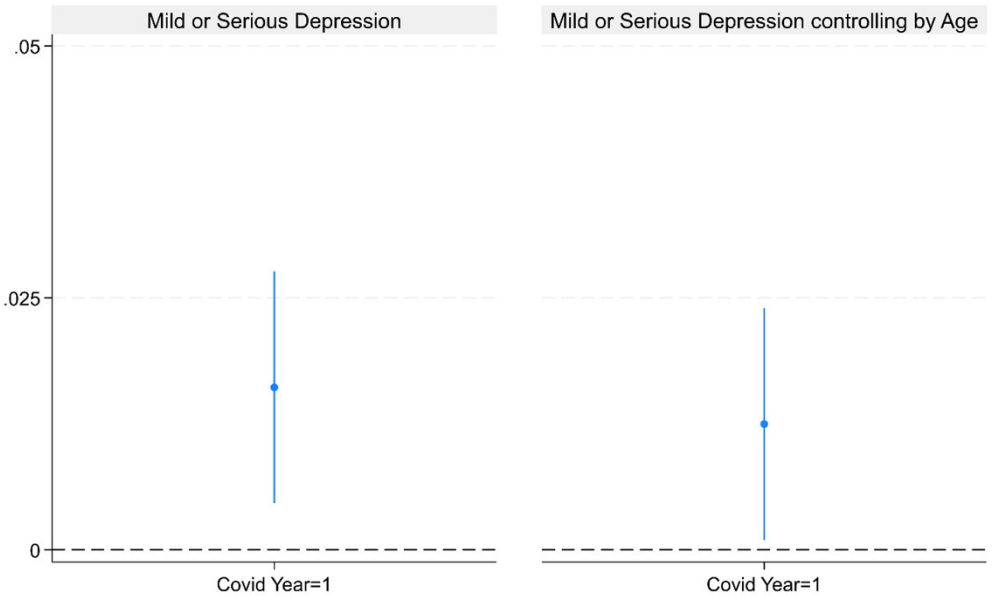

Figure S3-2: Mild or Serious Depression in the Prepandemic and Pandemic Waves (July-December Interviewees only). Figure S2 presents the same information as Figure S1 but restricts the respondents from the 2018 wave and the 2020 wave to the same set of months (July to December). Mild and serious depression occur when respondents report eight or more symptoms in the CES-D questionnaire. The two panels report the coefficient of the regression with and without age. The bars represent the 95% confidence intervals. Statistics are weighted using the survey sample weights. Robust standard errors are clustered at the individual levels.

Table S3-8: Mental Health in the Pandemic Year with and without Age Effects

	(1)	(2)	(3)	(4)
VARIABLES	Caseness	Caseness	Symptoms	Symptoms
Age		0.002***		0.027***

		(0.001)		(0.004)
Age Squared		-0.000		-0.000***
		(0.000)		(0.000)
Year 2020	0.012***	0.009**	0.061***	0.038*
	(0.004)	(0.004)	(0.020)	(0.020)
Constant	0.067***	-0.004	1.161***	0.361***
	(0.003)	(0.011)	(0.019)	(0.073)
Observations	30,772	30,772	30,772	30,772

Robust standard errors in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

Table S3-9: Mild and Serious Depression Prevalence in the Pandemic Year with and without Age Effect

VARIABLES	(1) Caseness	(2) Caseness
Age		0.008***
		(0.001)
Age Squared		-0.000***
		(0.000)
Year 2020	0.017***	0.013**
	(0.006)	(0.006)
Constant	0.252***	0.044**
	(0.005)	(0.020)
Observations	30,772	30,772

Robust standard errors in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

Table S3-10: Mental Health and Personality Traits

VARIABLES	(1) Personality	(2) + Basic Demographics	(3) + Income and Education
Female		0.047	0.056
		(0.037)	(0.037)
18-39 Years Old		0.260***	0.223***
		(0.072)	(0.072)
40-65 Years Old		0.443***	0.419***
		(0.076)	(0.078)
Over 65 Years Old		0.520***	0.447***
		(0.091)	(0.094)
Urban			-0.049
			(0.038)
Family Size			-0.047***
			(0.010)
Secondary Education Group			-0.033
			(0.049)
Tertiary Education Group			0.222***
			(0.079)
log Household Income			-0.129***

			(0.023)
Openness	-0.073***	-0.062***	-0.067***
	(0.022)	(0.022)	(0.022)
Agreeableness	-0.032	-0.043**	-0.044**
	(0.021)	(0.021)	(0.021)
Conscientiousness	-0.085***	-0.106***	-0.100***
	(0.021)	(0.022)	(0.022)
Neuroticism	0.371***	0.371***	0.367***
	(0.020)	(0.020)	(0.020)
Extraversion	-0.113***	-0.114***	-0.111***
	(0.020)	(0.020)	(0.020)
Cognitive	-0.254***	-0.202***	-0.191***
	(0.019)	(0.022)	(0.027)
Constant	1.076***	0.714***	2.154***
	(0.217)	(0.230)	(0.322)
Observations	11,469	11,469	11,374

Robust standard errors in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

Table S3-11: Mental Health Deterioration and Personality Traits, with Reported Coefficients on Control Variables

VARIABLES	(1) Personality	(2) + Basic Demographics	(3) + Income and Education
Female		-0.058	-0.070
		(0.043)	(0.044)
18-39 Years Old		-0.042	-0.022
		(0.105)	(0.109)
40-65 Years Old		-0.087	-0.071
		(0.110)	(0.113)
Over 65 Years Old		-0.116	-0.120
		(0.123)	(0.127)
Urban			0.053
			(0.046)
Family Size			-0.001
			(0.011)
Secondary Education Group			-0.113**
			(0.056)
Tertiary Education Group			-0.181**
			(0.092)
log Household Income			-0.016
			(0.025)
Openness	0.084***	0.079***	0.082***
	(0.025)	(0.025)	(0.025)
Agreeableness	-0.012	-0.007	-0.006
	(0.023)	(0.023)	(0.023)
Conscientiousness	0.012	0.017	0.016
	(0.024)	(0.025)	(0.025)
Neuroticism	-0.087***	-0.083***	-0.083***
	(0.023)	(0.023)	(0.023)
Extraversion	0.020	0.021	0.021

	(0.023)	(0.023)	(0.023)
Cognitive	-0.006	-0.018	0.018
	(0.023)	(0.027)	(0.031)
Constant	-0.056	0.050	0.262
	(0.220)	(0.248)	(0.336)
Observations	10,047	10,047	10,001

Robust standard errors in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

Table S3-12: Mental Health and Some Demographic Characteristics, with Reported Coefficients on Control Variables

	(1)	(2) 2018	(3) 2018	(4) Overall with	(5) Plus Aggregate
VARIABLES	Overall	Symptoms=0	Symptoms>0	Job Class	Variables
Lockdown	0.437***	0.142	0.748***	0.426***	0.393***
	(0.147)	(0.135)	(0.246)	(0.147)	(0.149)
Female	-0.091**	-0.017	-0.089	-0.120***	-0.122***
	(0.042)	(0.036)	(0.066)	(0.044)	(0.044)
18-39 Years Old	0.159*	0.250***	0.164	0.218**	0.226**
	(0.083)	(0.073)	(0.150)	(0.091)	(0.092)
40-65 Years Old	0.082	0.209**	0.101	0.137	0.144
	(0.098)	(0.101)	(0.157)	(0.112)	(0.113)
Over 65 Years Old	0.131	0.238**	0.060	0.190	0.187
	(0.112)	(0.112)	(0.177)	(0.130)	(0.131)
Urban	0.026	-0.084*	0.032	0.036	0.033
	(0.041)	(0.043)	(0.060)	(0.043)	(0.043)
Family Size	0.003	-0.012	-0.003	0.001	-0.001
	(0.010)	(0.011)	(0.014)	(0.010)	(0.010)
Secondary Education Group	-0.081*	-0.272***	-0.150**	-0.081*	-0.084*
	(0.045)	(0.043)	(0.067)	(0.047)	(0.047)
Tertiary Education Group	-0.240**	-0.307***	-0.342*	-0.237**	-0.240**
	(0.102)	(0.062)	(0.175)	(0.103)	(0.100)
log Household Income	-0.008	-0.099***	-0.046	0.005	0.006
	(0.023)	(0.024)	(0.033)	(0.024)	(0.025)
Married	-0.103	0.038	-0.036	-0.036	-0.039
	(0.072)	(0.078)	(0.114)	(0.090)	(0.090)
Cohabitation	0.213	0.643	0.428	0.408	0.422
	(0.475)	(0.600)	(0.605)	(0.532)	(0.540)
Divorced	0.053	0.696	0.070	0.056	0.052
	(0.251)	(0.454)	(0.277)	(0.253)	(0.253)
Widowed	-0.111	0.277*	-0.001	-0.027	-0.030
	(0.140)	(0.166)	(0.189)	(0.152)	(0.152)
Agricultural Business				0.074	0.076
				(0.064)	(0.065)
Other Private Business				-0.083	-0.082
				(0.088)	(0.089)
Agricultural Job				-0.307**	-0.310**
				(0.134)	(0.134)
Unemployed				-0.468***	-0.458***
				(0.173)	(0.174)

Student				0.147	0.150
				(0.099)	(0.099)
Retired or Old				0.024	0.034
				(0.086)	(0.087)
Housework				0.109	0.109
				(0.099)	(0.099)
Disable				-0.178	-0.176
				(0.137)	(0.138)
Other Reason Out				-0.031	-0.024
				(0.188)	(0.189)
Log GDP per Capita					0.095
					(0.086)
Density					0.017
					(0.022)
log Fiscal Expenditure per Capita					-0.172*
					(0.095)
Constant	0.268	1.767***	-0.044	0.004	-1.055
	(0.257)	(0.269)	(0.378)	(0.290)	(0.909)
Observations	14,204	6,371	7,833	13,683	13,645

Robust standard errors in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

Supplementary Information for Chapter 4

Table S4-1: Completed regression results with the OLS estimator and the fixed-effects model of life satisfaction in China, 2010-2018

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	FE	FE	OLS	OLS	FE	FE	FE
VARIABLES	LS	LS	LS	LS	LS	LS	LS
Log Personal Income	-0.044***		-0.016***		-0.033***		-0.031***
	(0.00)		(0.00)		(0.00)		(0.00)
Log Personal Income Squared	0.004***		0.001***		0.004***		0.003***
	(0.00)		(0.00)		(0.00)		(0.00)
Log Household Income		-0.206***		-0.136***		-0.017**	-0.014
per capita		(0.01)		(0.01)		(0.01)	(0.01)
Log Household Income		0.016***		0.011***		0.002***	0.001**
per capita Squared		(0.00)		(0.00)		(0.00)	(0.00)
Urban			0.044***	0.032***	-0.012	-0.011	-0.011
			(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Migrant			-0.012	-0.024**	0.045*	0.056***	0.058**
			(0.01)	(0.01)	(0.02)	(0.02)	(0.02)

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	FE	FE	OLS	OLS	FE	FE	FE
VARIABLES	LS	LS	LS	LS	LS	LS	LS
Male			-0.052***	-0.057***			
			(0.01)	(0.01)			
Age			-0.027***	-0.029***	-0.031***	-0.038***	-0.027***
			(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Age Squared			0.000***	0.000***	0.000***	0.000***	0.000***
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Have Medical Insurance			0.065***	0.045***	0.033***	0.009	0.025**
			(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Have Endowment Insurance			0.145***	0.123***	0.028***	0.031***	0.025***
			(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Education			0.004	-0.008***	-0.010	-0.040***	-0.012
			(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Married			0.167***	0.149***	0.089***	0.079***	0.094***
			(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Employed			0.072***	0.030***	0.008	-0.005	0.008
			(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Family Member			0.002	0.006***	0.005	0.004	0.006*
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Social Position			0.426***	0.406***	0.311***	0.292***	0.310***
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GDP pc (10k CNY)			0.021***	0.011***	0.009	0.009*	0.008
			(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Constant	3.645***	4.147***	2.464***	3.007***	3.179***	3.504***	3.028***
	(0.00)	(0.02)	(0.03)	(0.04)	(0.42)	(0.37)	(0.40)
Observations	122,886	146,630	115,288	135,561	115,288	135,561	111,212
R-squared	0.002	0.008	0.192	0.186	0.191	0.171	0.192
Year Fixed Effects	No	No	No	No	Yes	Yes	Yes

Note: Table S4-1: Completed regression results with the OLS estimator and the fixed-effects model of life satisfaction in China, 2010-2018 presents the empirical results of linear regressions estimated using the OLS and fixed-effects models. The dependent variable in all specifications is life satisfaction (LS). The independent variables logarithm personal income and logarithm household income per capita were calculated by adding 1 to all observations, as approximately 40% of respondents reported zero personal income. Standard errors are presented in parentheses. Descriptions of the explanatory variables are provided in the note to Table 4-1. Source: Isss.pku.edu.cn. 2023. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.
* represents significance at 99% confidence interval.
** represents significance at 95% confidence interval.
*** represents significance at 90% confidence interval.

Table S4-2: Completed regression results of the fixed-effects model with sub-samples on life satisfaction in China, 2010–2018

	Panel A: Personal income					
	(1)	(2)	(3)	(4)	(5)	(6)
	Age $\geq$ 25	Age $\leq$ 65	25 $\leq$ Age $\leq$ 65	Employed	Urban	Married
VARIABLES	LS	LS	LS	LS	LS	LS
Log Personal Income	-0.032***	-0.034***	-0.032***	-0.024***	-0.036***	-0.034***
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)

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	(1)	(2)	(3)	(4)	(5)	(6)
	Age $\geq$ 25	Age $\leq$ 65	25 $\leq$ Age $\leq$ 65	Employed	Urban	Married
VARIABLES	LS	LS	LS	LS	LS	LS
Log Personal Income Squared	0.004***	0.004***	0.003***	0.003***	0.004***	0.004***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Urban	-0.011	-0.008	-0.007	0.003		0.001
	(0.02)	(0.02)	(0.02)	(0.02)		(0.02)
Migrant	0.041*	0.056**	0.052*	0.054*	0.051*	0.044*
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Age	-0.022**	-0.035***	-0.024**	-0.021*	0.001	-0.030***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Age Squared	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Have Medical Insurance	0.036***	0.031**	0.034**	0.015	0.041**	0.034**
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
Have Endowment Insurance	0.024***	0.020**	0.017*	0.012	0.024**	0.026***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Education	0.024	-0.007	0.028*	-0.006	0.005	0.024
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Married	0.110***	0.120***	0.152***	0.104***	0.116***	
	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	
Employed	0.012	0.008	0.012		0.002	0.006
	(0.01)	(0.01)	(0.01)		(0.01)	(0.01)
Family Member	0.004	0.004	0.003	0.006	-0.004	0.003
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
Social Position	0.312***	0.313***	0.315***	0.310***	0.313***	0.311***
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)
GDP pc (10k CNY)	0.006	0.010	0.006	0.013*	-0.002	0.011*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	2.904***	3.007***	2.648***	2.721***	1.960***	3.158***
	(0.51)	(0.40)	(0.51)	(0.48)	(0.74)	(0.51)
Observations	106,108	100,855	91,675	74,590	54,115	95,903
R-squared	0.196	0.190	0.195	0.202	0.185	0.196

Panel B: Household per capita income

	(1)	(2)	(3)	(4)	(5)	(6)
	Age $\geq$ 25	Age $\leq$ 65	25 $\leq$ Age $\leq$ 65	Employed	Urban	Married
VARIABLES	LS	LS	LS	LS	LS	LS
Log Household Income	-0.020***	-0.027***	-0.029***	-0.020*	-0.029***	-0.021***
per capita	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Log Household Income Squared	0.002***	0.003***	0.003***	0.002***	0.003***	0.002***
per capita Squared	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Urban	-0.005	-0.001	0.006	0.018		0.004
	(0.02)	(0.02)	(0.02)	(0.02)		(0.02)
Migrant	0.050**	0.066***	0.061**	0.042	0.067***	0.057**
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
Age	-0.029***	-0.045***	-0.034***	-0.038***	-0.019	-0.034***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Age Squared	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***

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	(1)	(2)	(3)	(4)	(5)	(6)
	Age $\geq$ 25	Age $\leq$ 65	25 $\leq$ Age $\leq$ 65	Employed	Urban	Married
VARIABLES	LS	LS	LS	LS	LS	LS
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Have Medical Insurance	0.025**	0.007	0.024*	0.006	0.014	0.023*
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
Have Endowment Insurance	0.025***	0.026***	0.022***	0.011	0.026***	0.028***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Education	0.027**	-0.040***	0.027*	-0.003	-0.019	0.029*
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
Married	0.086***	0.116***	0.135***	0.090***	0.081***	
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	
Employed	0.005	-0.004	0.006		-0.011	0.005
	(0.01)	(0.01)	(0.01)		(0.01)	(0.01)
Family Member	0.002	0.005*	0.004	0.007*	-0.002	0.002
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Social Position	0.294***	0.299***	0.301***	0.298***	0.290***	0.293***
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)
GDP pc (10k CNY)	0.007	0.013**	0.010	0.021***	-0.003	0.010*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	3.159***	3.427***	3.021***	3.333***	2.921***	3.228***
	(0.46)	(0.37)	(0.47)	(0.44)	(0.73)	(0.48)
Observations	124,745	116,147	105,331	84,481	64,531	111,957
R-squared	0.176	0.170	0.176	0.178	0.167	0.176

Note: Table S4-2: Completed regression results of the fixed-effects model with sub-samples on life satisfaction in China, 2010-2018 presents the empirical results of fixed-effects regressions for subsamples of respondents who were of working age, employed, living in urban areas, and married. Panel A uses the logarithm personal income and its quadratic term as the key explanatory variables, while Panel B uses the logarithm household income per capita and its quadratic term. The dependent variable in all specification is life satisfaction (LS). The independent variables logarithm personal income and logarithm household income per capita were calculated by adding 1 to all observations, as approximately 40% respondents reported zero personal income. Standard errors are presented in parentheses. Descriptions of the explanatory variables are provided in the note to Table 4-1. Source: Isss.pku.edu.cn. 2023. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.

* represents significance at 99% confidence interval.

** represents significance at 95% confidence interval.

*** represents significance at 90% confidence interval.

Table S4-3: Completed regression results of the gender heterogeneity in the relationship between different measures of income and life satisfaction

	(1)	(2)
	Personal Income	Household Income per capita
VARIABLES	LS	LS
Log Personal Income	-0.028***	
	(0.01)	
Log Personal Income Squared	0.003***	
	(0.00)	
Male×Log Personal Income	-0.013	
	(0.01)	
Male×Log Personal Income Squared	0.001	
	(0.00)	

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	(1)	(2)
	Personal Income	Household Income per capita
VARIABLES	LS	LS
Log Household Income per capita		-0.010
		(0.01)
Log Household Income per capita Squared		0.002**
		(0.00)
Male×Log Household Income per capita		-0.016
		(0.01)
Male×Log Household Income per capita Squared		0.001
		(0.00)
Urban	-0.012	-0.011
	(0.02)	(0.02)
Migrant	0.045*	0.056***
	(0.02)	(0.02)
Age	-0.031***	-0.038***
	(0.01)	(0.01)
Age Squared	0.000***	0.000***
	(0.00)	(0.00)
Have Medical Insurance	0.033***	0.009
	(0.01)	(0.01)
Have Endowment Insurance	0.027***	0.031***
	(0.01)	(0.01)
Education	-0.010	-0.040***
	(0.01)	(0.01)
Married	0.089***	0.079***
	(0.02)	(0.02)
Employed	0.007	-0.005
	(0.01)	(0.01)
Family Member	0.005	0.004
	(0.00)	(0.00)
Social Position	0.311***	0.292***
	(0.00)	(0.00)
GDP pc (10k CNY)	0.009	0.009*
	(0.01)	(0.01)
Constant	3.178***	3.494***
	(0.42)	(0.37)
Observations	115,288	135,561
R-squared	0.191	0.171
Number of pid	42,726	43,568

Note: Table S4-3: Completed regression results of the gender heterogeneity in the relationship between different measures of income and life satisfaction presents the results of gender heterogeneity analysis based on the baseline fixed-effects regressions. Column (1) and column (2) use personal income and household income per capita, respectively. Both specifications include interaction terms between gender and linear and quadratic term of different income measures. Female is treated as the reference group. Regressions are based on the specifications reported in Columns 5 and 6 of Table 4-2. Source: Isss.pku.edu.cn. 2023. [online] Available at: <https://www.isss.pku.edu.cn/cfps/en/index.htm>.

* represents significance at 99% confidence interval.

** represents significance at 95% confidence interval.

*** represents significance at 90% confidence interval.

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