Inflation and Subjective Well-being

by

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Abstract

How does inflation relate to people's subjective well-being (SWB)? The answer to this question is important to inform policies aimed at enhancing citizens' well-being. A number of studies found that aggregate inflation rates have a consistent negative impact on SWB. However, people's perceptions of inflation, which ultimately affect SWB, do not always match aggregate inflation statistics. This thesis contains three studies in the context of China that advance previous understanding of the inflation-SWB association.

Firstly, I propose a new concept of reference-dependent inflation evaluation within a changing economic growth context. My findings suggest that an unstable inflation environment harms people's SWB. Additionally, a high GDP growth rate mitigates the negative impact of inflation on SWB.

Secondly, I investigate the impact of commodity-specific inflation rates on individual SWB. To this end, I create a unique dataset by matching household expenditure data with consumer price indices. I find that the inflation of different commodities impacts SWB differently. Specifically, the inflation of advanced-need commodities leads to better SWB, as it reflects quality improvements.

Finally, to explore the impact of people's inflation concerns on SWB, I develop a novel measure of inflation based on the Baidu Search Volume Index. I find that people's unexpected concerns about inflation are significantly and negatively associated with SWB. Moreover, my results suggest that the non-working older population with low income is the most vulnerable when facing high inflation, and that middle-aged and elderly people are more concerned about medicine prices than food prices.

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Declaration

I declare that the work in this PhD thesis was carried out in accordance with the requirements of the University of Birmingham. The thesis has not been submitted for any other academic award. The work presented in this thesis is the my own work except where indicated by specific reference in the text.

SIGNED: .....Fangzhou Xu..... DATE: .....29th September 2022.....

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Chapter 1. Introduction

1.1. Economic background and motivation

Subjective well-being (SWB) is defined to be a 'good mental status, including all of the various evaluations, positive and negative, that people make of their lives and the affective reactions of people to their experiences' (OECD, 2013). Literature investigating the determinants of SWB is interdisciplinary, spanning psychology, economics, sociology, philosophy, health research and political science.

The Stiglitz Commission (2009) argues that national statistical systems should use SWB as a measure of economic performance. Following advice provided by the Stiglitz Commission (2009), the UK Coalition Government's Budget 2010 Report also declared that "the government is committed to developing broader indicators of well-being and sustainability…" (HM Treasury, 2010, p.10), and called for help from the Office for National Statistics (ONS) and the Cabinet Office to deliver SWB data on a national scale. As a result, starting from 2012, the ONS started to release personal well-being estimates by local authority, including four measures of well-being: anxiety, happiness, life satisfaction and worthwhile.[1] Given the renewed importance attributed to SWB, understanding its determinants can be particularly useful in devising wellbeing-enhancing policies (Layard, 2005; Stiglitz Commission, 2009; Dolan *et al*., 2011).

Making use of panel analyses, a number of studies found that national aggregate

[1] Details about the four SWB questions can be accessed at this site: https://www.ons.gov.uk/peoplepopulationandcommunity/wellbeing/methodologies/surveysusingthe4officefornationalstatisticspersonalwellbeingquestions

inflation rates (e.g., the growth rate of consumer price index) have a consistent negative effect on individual SWB measures (e.g., self-reported life satisfaction and happiness ladders) in Europe (Di Tella *et al*., 2001, 2003; Wolfers, 2003; Blanchflower *et al*., 2014; Welsch and Kühling, 2016) and the United States (Di Tella *et al*., 2003; Alesina *et al*., 2004; Ruprah and Luengas, 2011; Welsch and Kühling, 2016). High inflation is also characterised by SWB studies as one of the major measures of economic crisis (Arampatzi, Burger and Veenhoven, 2015; Welsch and Kühling, 2016; Gonza and Burger, 2017; Arampatzi *et al*., 2019).[2] Compared to non-crisis periods, the negative impact of inflation on individual SWB significantly amplifies during the 2008-09 economic crisis (Welsch and Kühling, 2016; Gonza and Burger, 2017). Therefore, linking inflation rates to SWB enables the evaluation of inflation performance and policy appraisal during both ordinary and extreme economic situations.

In accordance with Shiller (1996), the above-mentioned studies argue that people dislike high inflation mainly because it means reduced purchasing power, increased costs of living and lower living standards. However, relying on such a simple understanding of the negative association between official aggregate inflation rates and SWB is not sufficient to provide practical policy implications. A vast literature in behavioural economics and economic psychology argues in fact that people's perceptions and evaluations of inflation are complex and cannot be simply explained by a high or low national aggregate inflation rate (e.g., Ranyard *et al*., 2008; Malmendier and Nagel, 2016; Cavallo *et al*., 2017). For example, the adverse impact

[2] Other major measures of economic crisis include high unemployment rates and negative GDP growth.

of inflation can be negligible if a consumer experienced a significant rise in income (Souleles, 2004; Ranyard *et al*., 2008; Del Giovane *et al*., 2009). Moreover, a consumer may be indifferent to the price change of commodities that he/she seldom purchases (Brachinger, 2008). Therefore, to improve the understandings of the association between inflation and SWB and deliver nuanced and insightful policy suggestions, this thesis provides three empirical studies that focus on the effects of inflation on SWB in China over the period 2010-2018. This thesis is the first study to investigate the association between inflation and SWB accounting for people's perceptions and evaluations of inflation.

This thesis makes use of individual SWB data for the following two main reasons. First, as I mentioned above, people's perceptions and evaluations of inflation are heterogeneous. Using national or regional-level average SWB data neglects the possible heterogeneity in the inflation-SWB association across cohorts and household-level factors (e.g., relative income ranks and household consumption patterns). Second, using average SWB data may mask substantial amounts of heterogeneity in SWB which mainly results from individual and household-level factors, such as age, marital status, income and household assets (Dolan *et al*., 2008; Boyce, Delaney and Wood, 2018).

China represents an ideal setting to test the association between inflation and SWB for the following reasons. First, an implicit inflation targeting has been applied by the government aiming at a low and stable annual inflation rate around 3% since 2012. The annual Reports of the Work of the Government of China stated that the implicit inflation targeting operated as an important government policy which was expected to improve

people's livelihood.[3] The implicit inflation targeting helped China achieve stable aggregate annual inflation rates of around 2% from 2012 to 2018 after a period of highly volatile inflation from 2009 to 2011. Therefore, the unique trajectory of China's inflation rates with periods of volatility and stability in inflation methodologically enables my study to assess whether the 2012-2018 low and stable inflation rates truly performed well in enhancing Chinese people's well-being. Second, considering that China has over 30 very diverse provinces and 300 prefecture-level cities, a nation-wide inflation policy may not fit all regions. Therefore, China is the perfect setting to study whether tailored inflation policies which take into account the heterogeneous economic situations across regions are appropriate. Third, China has become an aging society since 2000. Considering that its old-age dependency ratio is expected to soar to more than 50% in 2050, up-to-date empirical evidence using Chinese data is needed to provide insightful suggestions for future inflation policies aiming at an age-friendly economic environment.[4] Fourth, previous studies focused on the inflation-SWB association in China are all cross-sectional. As such, they do not account for unobservable heterogeneity or the impact of inflation on SWB over time (Zhang and Ou, 2013; Chen *et al*., 2014; Yan and Wen, 2020). As a result, these studies are not able to evaluate the performance of inflation in China over the past decade. This calls for

[3] The annual Reports of the Work of the Government can be accessed at the site http://www.gov.cn/guowuyuan/zfgzbg.htm

[4] The old-age dependency ratio is the ratio of the number of people aged 65 and above to the population aged 15 to 64. The prediction of Chinese old-age dependency ratio is provided by the World Population Prospects (2022). The full statistics can be accessed at the site: https://population.un.org/wpp/

new studies based on panel data.

1.2. Structure and contents of thesis

Three empirical studies focusing on the effects of inflation on SWB in China are presented in Chapters 2, 3 and 4 respectively. Each chapter tackles a unique issue. Chapter 2 focuses on developing the concept of a reference-dependent inflation evaluation with a changing economic growth context to explain the nonlinear association between inflation and SWB. Chapter 3 focuses on inflation rates for different commodities and how their impact on SWB varies across consumption patterns. Chapter 4 develops a novel measure of inflation based on internet user-generated content to explore the impact of people's inflation concerns on SWB. The reminder of this section describes the studies and contributions in more detail. To better interpret policy implications, Chapter 5 briefly concludes the thesis and provides a structured policy discussion.

1.2.1. Chapter 2

Following Brachinger (2008), Del Giovane *et al*. (2009) and Dräger *et al*. (2014), Chapter 2 proposes a new conceptual framework that describes the effects of inflation on people's SWB under different macroeconomic contexts. The conceptual framework posits that people's SWB adapts to a reference inflation level which is determined by their past inflation experiences. The degree of inflation instability is defined as the gap between the current inflation and the reference inflation. Furthermore, a high regional economic growth rate is expected to counteract the negative impact of high inflation on

SWB. Using inflation statistics taken from the National Bureau of Statistics of China (NBSC) and SWB data taken from the China Family Panel Studies (CFPS) over the period 2010-2018, I find, firstly, that the reference inflation level does not affect SWB. Secondly, inflation instability is negatively associated with SWB. Thirdly, economic growth mitigates the negative impact of inflation on SWB. These findings suggest that, with an annual GDP growth rate below 7% observed in China after 2016, the stable inflation environment could potentially benefit Chinese citizens' SWB. I conclude that, in general, to be more effective, inflation policies should be tailored to the regional growth and inflation environment rather than being nation-wide.

1.2.2. Chapter 3

The policy implications provided by Chapter 2 focus on the aggregate inflation rates. However, aggregate inflation rates rely on an unrealistic assumption that all consumers experience same inflation rates according to the consumption pattern of a representative household. Considering the growing concerns about high inflation and cost of living since the outbreak of COVID-19 in early 2020, policy suggestions targeting on different constitutes of inflation have become more pronounced.[5] Therefore, Chapter 3 considers the distributional factors of inflation perceptions. Firstly, different commodities play heterogeneous roles in a household's consumption basket in terms of the extent to which their consumptions improve household members' well-being (Van Boven and Gilovich,

[5] For example, to better monitor the rise of living costs, the Office for National Statistics of (ONS) UK has been developing the Household Costs Indices (HCIs) since 2017 which highlights households' direct experience of prices across different consumption patterns.

2003; Howell and Hill, 2009; Heffetz, 2011; Zimmermann, 2014; Wang *et al*., 2019). Secondly, the aggregate price level experienced at the household level will be a function of the household's expenditure shares on various categories of commodities (Brachinger, 2008; D'Acunto, Malmendier and Weber, 2021). Taking the two above-mentioned arguments into consideration, a unique dataset is created by matching data from the 2010-2018 waves of the CFPS with consumer price indices of different categories of commodities taken from the NBSC. I find that the inflation rates of basic-need commodities such as utilities, rent and communication are negatively associated with SWB, reflecting rising living costs. Contrary to the traditional conclusion that inflation is detrimental to people's well-being, the inflation rates of advanced-need commodities such as food and entertainment are positively associated with SWB, reflecting the beneficial effects of upgrades in quality. Furthermore, the inflation rates of utilities and rent (clothing and entertainment) hurt (benefit) those individuals who spend greater shares on these commodities. Finally, I suggest that the quality improvements of food drive the positive impact of household-level expenditure-share-weighted-average aggregate inflation rates on SWB. Therefore, inflation policies aiming at improving people's living standards and well-being using the official aggregate inflation rate as a tool may be misleading because the aggregate inflation rate ignores the heterogeneity of commodities and households' expenditure patterns.

1.2.3. Chapter 4

Chapter 2 and 3 follow the methodology applied by traditional literature focusing on the association between inflation and SWB where inflation is measured by the official

inflation statistics (e.g., Di Tella *et al*., 2003 and Welsch and Kühling, 2016). Yet, the connection between inflation and individual SWB would be better established by focusing on people' direct experiences and insights on price changes rather than on official inflation statistics. With the development of internet technology and the emerging population of internet users, the official inflation statistics is no longer the only data that can reflect the inflation environment. Therefore, chapter 4 uses the Baidu Search Volume Index (BSVI) to measure people's concerns about inflation in each Chinese city.[6] The BSVI was never used by previous studies focusing on the inflation-SWB association, which contributes to the novelty of my approach. Additionally, considering that China has become an aging society with a rapid growing old population, Chapter 4 focuses on the well-being of middle-aged and elderly Chinese population. Using SWB data taken from the 2011 to 2018 waves of the China Health and Retirement Longitudinal Study (CHARLS) which covers respondents residing in all Chinese provinces aged 45 and above and their spouses, I find that the unexpected concerns about inflation measured by the gap between the current and the previous year's adjusted BSVI is significantly and negatively associated with SWB. I also find that the elderly, retired, and the poorest respondents are more averse to inflation than their younger counterparts, the employed, and the richest respondents. Finally, Chinese respondents aged 45 and above are found to be significantly more concerned about the prices of medicines than food. From a policy perspective, this chapter argues that, firstly,

[6] The BSVI provides city-level data indicating the frequency of keyword-based search queries on the most popular Chinese search engine website, Baidu. The Baidu search engine website can be accessed at the site: http://www.baidu.com/.

the decreasing people's inflation concern over the period 2011-2018 suggests that the low and stable inflation environment did improve Chinese residents' well-being, which support my findings in Chapter 2. Secondly, maintaining low and stable aggregate inflation and especially low and stable medicine prices is of great importance to benefit the well-being of the growing non-working elderly population with low family income.

Chapter 2. Inflation and Subjective Well-being

2.1. Introduction

Rising inflation is believed to worsen peoples' well-being as it implies lower wages, higher costs of living and worse living standards (Di Tella *et al*., 2001, 2003; Frey and Stutzer, 2002; Welsch, 2007; Dolan *et al*., 2008; Blanchflower *et al*., 2014). However, several questions still remain unanswered. First, is rising inflation always associated with worsening well-being under all inflation contexts? Second, how does the instability of inflation relate to SWB? Third, can higher economic growth mitigate the negative impact of inflation on SWB?

To thoroughly investigate the association between inflation and SWB, and also answer the above-mentioned questions, one needs to focus on an economy with some degree of inflation instability coupled with a high economic growth. China is the ideal case as it experienced volatile inflation and remarkable high economic growth during the last two decades (see Figure 2.1). China's annual Gross Domestic Production (GDP) growth rate almost doubled from 7.7% in 1999 to 14.2% in 2007. After the global financial crisis, China's GDP growth slowed from a 10.6% in 2010 to 6.1% in 2019. As for the annual inflation rate, it was unstable and trended upwards from -1.4% in 1999 to 6% in 2008. Price instability was more pronounced during the financial crisis and soon after the stimulus package was implemented in 2009 (Li *et al*., 2012). The annual inflation rate decreased to -0.7% in 2009 and quickly shifted back to 5.6% in 2011. Afterwards, annual inflation moved mildly around 2% from 2012 to 2018 and was much

more stable than in previous periods.

During the same period in the last two decades, Subjective Well-being (SWB) in China is often found to trend opposite the economic growth trajectory. Based on multiple SWB surveys in China, Easterlin *et al*. (2012, 2021) conclude that SWB trends are U-shaped from 1995 to 2015, with SWB falling and reaching the lowest level between 2000 and 2005.[1] Li and Raine (2014) find that SWB trended downwards from 1990 to 2010 with a clear negative association with the GDP per capita growth rate. Such "progress paradox" in China can be explained by the rising aspirations, increasing inflation and income inequality, transforming labor markets[2], social safety net and lifestyle, and the risk and insecurity brough by high economic growth (Knight and Gunatilaka 2009; Graham *et al*., 2017; Asadullah *et al*., 2018; Wang and Tapia Granados, 2019). In the second decade of 21st century, when economic growth rate slowed down, SWB was generally increasing (Clark *et al*., 2019).[3]

Over the period 2010 to 2019, the annual contribution ratio of consumption to GDP growth was generally over 50%, which was the highest among the main economic growth contributors except in 2010 and 2013 (see Figure 2.2).[4] Therefore, inflation

[1] Easterlin *et al*. (2012, 2021) use China's SWB data from World Values Survey (WVS), the Gallup Poll, the Asia-barometer (AB), the China Horizon survey, and the Pew Global Attitudes surveys (Pew). Using World Values Survey (WVS) data, Brockmann *et al*. (2009) reached similar results, but they argue that the decline in SWB level lasted longer.

[2] The registered unemployment rate in China increased rapidly from 3.3% in 2000 to 4.6% in 2003 and fluctuated around 4.5% from 2004 to 2019.

[3] Clark *et al*. (2019) finds an increasing happiness level using data from CHFS (China Household Finance Survey) over the period 2013-2017. The average life satisfaction score registered in the China Family Panel Studies (CFPS) generally increased by 15% from 2010 to 2018.

[4] The National Bureau of Statistics of China reports the ratios of the three main contributors of GDP

stability, which is closely related to Chinese citizens' consumption, has been a very important concern by the China's government especially since the stimulus policy against the financial crisis was implemented in 2009. According to the annual Report on the work of the PRC (People's Republic of China) Government, policies aiming at controlling local consumer price stability were especially highlighted from 2009 to 2011.[5] However, it is noteworthy that, after the low and stable inflation period from 2012 to 2016, inflation was trending upwards in the recent years from 2017 to 2019. In 2019, inflation rate reached the highest since 2012.

Little attention is paid to the impact of inflation on SWB in China. Using a random sample survey in Beijing in 2000 which records 732 inhabitants' perceptions of modern economic conditions and SWB, Cheung and Leung (2004) argue that a low inflation environment contributes significantly to the reporting of favourable perceived economic conditions which benefits SWB. Using national representative survey data in China, recent studies based on cross-sectional analyses consistently find negative associations between inflation and SWB (Zhang and Ou, 2013; Chen *et al*., 2014; Yan and Wen, 2020).[6] However, panel analysis does not show any significant association between inflation and SWB (Gao *et al*., 2014).[7]

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including consumption, investment, and net export.

[5] The annual Report on the Work of the PRC (People's Republic of China) Government from 2009 to 2019 is available on http://www.gov.cn/guowuyuan/zfgzbg.htm

[6] Zhang and Ou (2013) use SWB data from the Chinese Household Income Project Survey (CHIPS) in 2002. Chen *et al*. (2014) use SWB data from the General Social Survey (CGSS) in 2010. Yan and Wen (2020) use SWB data from the CGSS in 2013.

[7] Using SWB data from the CGSS in 2003, 2005 and 2006, Gao *et al*. (2014) argue that inflation-SWB association is not significant due to the small variation and the low value of the inflation during this

Could the rise in SWB in China in the last decade be explained in light of the more stable inflation rate in recent years? Could the high economic growth in China mitigate the negative impact of inflation on SWB? I use microeconomic survey data from the China Family Panel Studies (CFPS) over the period 2010 to 2018 to investigate the association between inflation stability and SWB. I contribute to the literature along the following dimensions. Firstly, I argue that people adjust and adapt to a psychologically defined reference inflation determined by past inflation experiences (henceforth, adaptive inflation). I then investigate, for the first time in SWB studies, the association between unanticipated inflation (the difference between current inflation and the adaptive inflation) and SWB in two episodes, namely when current inflation is above and below the adaptive inflation. I find that the higher the deviations of inflation relative to the adaptive inflation, the lower the SWB. Second, I study, for the first time, the extent to which the association between unexpected inflation and SWB depends on different GDP growth contexts. I find that a high GDP growth rate mitigates the negative association between unanticipated inflation and SWB. To fully absorb the above-mentioned association, a much greater GDP growth rate is required in above-adaptive inflation episodes than in below-adaptive inflation episodes.

From a policy viewpoint, my findings provide a generalized framework to analyse the social well-being cost of inflation. According to the recent macroeconomic context, I suggest that inflation stabilising and smoothing policies would benefit Chinese residences' well-being. I also generalized my findings beyond China by introducing a

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period.

policy framework. It suggests that, to be more effective, economic policies should be tailored to the regional growth and inflation environment rather than being nation-wide.

The remainder of the paper is structured as follows. Section 2.2 provides some economic background of SWB studies and inflation perception studies. The contributions of this study are included in Section 2.3. Section 2.4 illustrates my conceptual framework. Section 2.5 introduces my empirical strategies. The data and descriptive statistics are included in Section 2.6. Section 2.7 presents my main results and a number of additional and robustness checks. Section 2.8 discusses the policy implications, and Section 2.9 concludes.

2.2. Economic background

2.2.1. Inflation and SWB

Since Di Tella *et al*., (2001)'s pioneering work which comprehensively studies the macroeconomics of happiness, the role of macroeconomic factors, such as GDP, the unemployment rate and the inflation rate, which reflect the *wider economic, social, and political environment* has often been investigated in SWB studies (Clark and Oswald, 1994; Di Tella *et al*., 2003; Welsch and Kühling, 2011, 2016; Deaton, 2012; Blanchflower *et al*., 2014; Helliwell and Huang, 2014; Mertens and Beblo, 2016). A rising inflation implies lower wages, worse living standards, and increased economic and political instability, as well as a riskier investment environment (Shiller, 1996; Frey and Stutzer, 2002). Based on individual-level or national-level average SWB data, the regional inflation rate has often been found to be negatively associated with SWB (Di

Tella *et al*., 2001, 2003; Wolfers, 2003; Malesevic Perovic, 2008; Ruprah and Luengas, 2011; Blanchflower *et al*., 2014; Welsch and Kühling, 2011, 2016; El ouardighi and Munier, 2019). However, the impact of inflation on SWB is often found to be minor compared to that of the GDP growth rate and unemployment rate. For example, using individual-level SWB data from Euro-barometers over the period 1975-2012, Blanchflower *et al*. (2014) find that the well-being loss from a 1 percentage point increase in the unemployment rate is over five times larger than that from a 1 percentage point increase in inflation.

Only a small strand of literature further investigates the association between inflation and SWB by focusing on inflation instability, anticipated and unanticipated inflation, and the interactions between inflation and economic growth. High inflation variability or volatility generates greater economic instability and relative-price distortions, as well as declines in public faith in political institutions (Frey and Stutzer, 2002; Wolfers, 2003). As a result, people need to frequently adjust to the newly changed prices and the associated sense of uncertainty may be detrimental to their SWB. Using individual-level life satisfaction data from the Eurobarometer Survey 1973-1998, and controlling for moving averages of the inflation rate and unemployment rate, Wolfers (2003) finds that the long-term volatility of inflation undermines SWB.

Individuals can adjust to an anticipated price increase with little cost, while they cannot easily adjust to an unexpected inflation shock (Frey and Stutzer, 2002). Using individual-level SWB data from the 2010 wave of the Chinese General Social Survey (CGSS) and based on a cross-sectional analysis, Chen *et al*., (2014) find a significant

and negative association between unexpected inflation and SWB, but an insignificant association between expected inflation and SWB. The authors argue that people may follow an adaptive expectation. As a result, only unexpected inflation brings well-being losses.

The association between inflation and SWB also varies depending on the wider economic contexts. Using Eurobarometer country-level SWB data over the period 1995-2005, El Ouardighi and Munier (2019) find that there is no association between the inflation rate and SWB. After considering the contribution of economic growth, the authors find that the GDP growth mitigates the negative impact of inflation on average SWB.

Very few studies investigate the association between inflation and SWB using Chinese data, and most of them are cross-sectional. Using provincial inflation data and individual-level SWB data from the Chinese Household Income Project (CHIP) in 2002 (Zhang and Ou, 2013), the CGSS in 2010 (Chen *et al*., 2014) and 2013 (Yan and Wen, 2020), SWB is found to be low among provinces with relatively high inflation after controlling for socio-demographic variables. However, panel analysis fails to find a negative inflation-SWB association. Using SWB data from the CGSS in 2003, 2005 and 2006, Gao *et al*. (2014) argue that the insignificant association between inflation and SWB may result from the low variation of the provincial inflation rates during the research period.

2.2.2. How do people perceive and evaluate inflation?

Behavioural economics studies at the individual level argue that people's inflation evaluations are not rational, and that a significant discrepancy exists between people's inflation evaluations and official statistics (Driver and Windram, 2007; Blanchflower and Kelly, 2008; Pfajfar and Santoro, 2008; Cavallo *et al*., 2017).[8] For example, inflation estimates are considerably higher than the inflation statistics in the EU and the US (Arioli *et al*., 2017; Axelrod *et al*., 2018). Also, Mankiw, Reis and Wolfers (2003) find that, compared to professional economic definitions, laypersons tend to hold heterogenous beliefs in terms of inflation. In the remaining part of this section, I survey studies that look at how people evaluate whether inflation is stable or volatile, first. Next, I look at studies which focused on whether inflation perceptions vary according to the economic context.

How do people evaluate whether inflation is stable or volatile?

According to the Adaptation-Level Theory (AL Theory. Helson, 1964), people evaluate a stimulus relative to the level they expect from prior experience. Consistent with the rationale of AL Theory, the reference price is defined as the adaptation level, and other price stimuli are evaluated relative to this adaptation level (Monroe, 1973). The reference price is shaped mainly by people's prior experiences i.e., daily purchase experience (Briesch *et al*., 1997). The AL theory is also widely adopted by empirical

[8] Under the assumption that aggregate information dissipates slowly in the economy, households' inflation perceptions can be seen as forecasts or expectations made today (so-called 'nowcast'). 'Inflation estimates' refer to both inflation perception and expectation henceforth. Definitions of inflation-related terms are included in Table 2.12.

studies to investigate inflation perception mechanisms. For example, Brachinger (2008) measures the reference prices based on the prices of the preceding year and construct an Index of Perceived Inflation. Using monthly perceived inflation and actual inflation statistics in 10 EU countries over the period 1996-2010, Dräger *et al*. (2014) find that people perceive the increases and decreases in inflation relative to a reference level measured by the average inflation rates in the past 13 months. The authors also find that the reference inflation is time-varying, as it is updated and adjusted in each period according to prior inflation rates.

Do inflation evaluations vary according to the economic context?

Easterly and Fischer (2001), Gamble (2006), Pfajfar and Santoro (2008), Howard *et al*. (2009), Stigliz *et al*. (2009) and Bruine de Bruin *et al*. (2010) find that personal income significantly influences people's inflation evaluations. Experiencing the same level of inflation, people are less aversive against the inflation if they have a rise in income (Souleles, 2004; Ranyard *et al*., 2008; Del Giovane *et al*., 2009). Therefore, from the macroeconomic viewpoint, greater aggregate income increases (i.e., GDP growth rate) may result in lower inflation aversion.

2.2.3. Limitations of current SWB studies about inflation

SWB studies focusing on the impact of inflation often ignore the difference between inflation statistics and people's evaluations of inflation. For instance, Wolfers (2003) focuses on the association between the volatility of inflation and SWB, as well as on the shape of the SWB function as a function of the inflation rate. Yet, he does not

consider the reference inflation, which, to a significant extent, is crucial to inflation evaluations and perceptions. Moving one step further, Chen *et al*. (2014) include both expected inflation (reference inflation) and unexpected inflation in the SWB function. However, they simply assume that the association between unexpected inflation and SWB is the same if the current inflation is above or below the reference level. Also, their study is s cross-sectional analysis, which prevents the authors from considering the impact of inflation on SWB over time. Yet, none of these authors consider the inflation-SWB association under different economic growth contexts. El Ouardighi and Munier (2019) fill this gap in the literature. However, they do not consider the reference inflation. Also, their study is based on country-level inflation and SWB data, which prevents them from considering people's inflation perceptions.

2.3. Contribution

This paper contributes to the literature in three ways. First, using individual-level panel data, I am able to account for the reference inflation (also known as the adaptative level of inflation), which is assumed to be perceived as the psychologically stable inflation. I will refer to it as "adaptive inflation" henceforth. Specifically, following the Adaptation-Level Theory and the reference price research mentioned in the previous section, backward-looking moving averages of inflation rates are used to measure the reference inflation.

Second, different from previous studies that focus on the level of inflation, I shift the attention to unexpected inflation (the difference between the current inflation and

adaptive inflation) and the instability of inflation. In other words, for the first time, using individual-level SWB data, I investigate the association between inflation deviations relative to the adaptive level (higher inflation instability) and SWB. I build on Wolfers (2003) and Chen *et al*. (2014) by considering the adaptive inflation and by distinguishing two inflation episodes. Also, it is the first panel study using China's data to investigate such topic.

Lastly, I investigate how the association between unexpected inflation and SWB varies under different GDP growth contexts. Following El Ouardighi and Munier (2019), I generally investigate whether the above-mentioned association can be fully absorbed by the high economic growth. I extend the authors' approach by using individual-level SWB data and considering the above-adaptation inflation and below-adaptation inflation episodes.

2.4. Conceptual framework

In light of the inflation perception studies mentioned in Section 2.2.2, I propose the following conceptual framework to explain the association between unexpected inflation and SWB.

2.4.1. The Adaptive Inflation: the stable inflation from individual perspectives

In Figure 2.3, $(Inflation)_{t-k\ldots t-1}$ refers to the past inflation experience indexed by the historical inflation rates. From the inflation perception viewpoint, $(Adaptive\ Inflation)_t$ is the reference inflation determined by $(Inflation)_{t-k\ldots t-1}$. Following Dräger *et al*. (2014), the adaptive inflation is assumed to be fully adjusted

and updated by individuals in each term according to their prior inflation experience. From the well-being viewpoint, the adaptive inflation also indicates the SWB-neutral inflation level, because it refers to the stable inflation that is perceived by people, and to which they have adapted. Therefore, the adaptive inflation is not expected to be associated with SWB.

2.4.2. Inflation instability: inflation deviations relative to the adaptive inflation

I then look at two inflation episodes relative to $(Adaptive\ Inflation)_t$: the current inflation $(Inflation)_t$ is above or below the adaptive level (henceforth 'above-adaptation episodes' and 'below-adaptation episodes'). The $(Unexpected\ Inflation)_t$ is the gap between the current inflation $(Inflation)_t$ and adaptive inflation $(Adaptive\ Inflation)_t$. The greater the absolute values of $(Unexpected\ Inflation)_t$, the larger the inflation deviations relative to the adaptive inflation, and the higher the degree of inflation instability. As a result, $(Unexpected\ Inflation)_t$ is expected to be negatively associated with SWB.

2.4.3. The role of the economic growth: variations of the association between unexpected inflation and SWB

Lastly, according to Easterly and Fischer (2001). Ranyard *et al*. (2008), Del Giovane *et al*. (2009), and El Ouardighi and Munier, 2019), I expect that, in both inflation episodes, the association between unexpected inflation and SWB varies across different economic growth contexts. In concert with El Ouardighi and Munier (2019), high economic growth is also expected to absorb the negative association between unexpected inflation

and SWB.

2.5. Empirical strategy

Following the conceptual framework explained in section 2.4, I apply a step-by-step procedure to introduce the adaptive inflation, the unexpected inflation (i.e., below- and above-adaptation episodes), and the interaction terms between the unexpected inflation and the GDP growth rate to the basic SWB equation. The basic SWB equation takes the form from previous SWB studies (Di Tella *et al*., 2001, 2003; Di Tella and MacCulloch, 2006; Welsch and Bonn, 2008; Welsch and Kühling, 2011; Powdthavee and van den Berg, 2011; Blanchflower *et al*, 2014; Huang *et al*., 2018).

2.5.1. Baseline SWB equation with the adaptive inflation

Firstly, the baseline SWB equation as a function of the adaptive inflation and unexpected inflation that I estimate takes the following form:

$$W_{ijt} = \alpha + [\,\beta_1 \pi_{jt}^{A} + \beta_2 (\pi_{jt}^{U})] + \gamma_1' M_{jt} + \gamma_2' Z_{it} + \varepsilon_{ijt} \quad (2\text{-}1)$$

$$\pi_{jt}^{U} = (\pi_{jt} - \pi_{jt}^{A}) \quad (2\text{-}2)$$

where π_{jt} is the actual inflation rate of urban or rural area in province j where individual i lives. π_{jt}^{A} is the time-varying adaptive inflation (reference inflation rate), which is measured by the backward-looking moving averages of annual inflation rate. π_{jt}^{U} refers to the unexpected inflation which equals to the difference between current inflation and adaptive inflation. GDP per capita, the GDP growth rate and the unemployment rate in province j are included as macroeconomic control variables (M_{jt}). Z_{it} is a set of demographic characteristics. According to Di Tella *et al*. (2003),

Dolan *et al*. (2008) and Knight *et al*. (2009), I include age, age squared, gender, residency, educational degrees, marital status, employment status, health status, personal relative income, family relative income, and family size as control variables. The SWB function is expected to be U-shaped in age. SWB is expected to be higher among people who are married, employed, healthier, and richer. To control for household assets and debt, I include home ownership, the price of the house where the household lives, and mortgage debts. SWB is expected to be higher, the higher the assets held by the household, and the lower the debt (Clark *et al*., 2019, and Zhang and Zhang 2019). The error term ε_{ijt} includes four components, that is, $\varepsilon_{ijt} = \mu_j + \eta_t + \xi_i + \upsilon_{ijt}$ where μ_j encompasses unobservable region-specific effects, η_t denotes time-specific effects. ξ_i is an individual-specific effect. υ_{ijt} includes the remaining components of the error term and is assumed to be i.i.d. β_1 is expected to be insignificant as the adaptive inflation is assumed to be unrelated to SWB. β_2 is also expected to be insignificant as the unexpected inflation is not divided into above and below-adaptation episodes. Therefore, equation (2-1) does not reflect inflation instability.

2.5.2. Deviations of inflation from the adaptive inflation

To directly investigate the effects of inflation movements relative to the adaptive level on SWB, I estimate the following piecewise equation with unexpected inflation in above- and below-adaptation episodes. Together, the unexpected inflation terms in both inflation episodes are regarded as the deviations of current inflation relative to the adaptive inflation.

$$W_{ijt} = \alpha_0 + [\,\beta_1\pi_{jt}^{A} + \beta_2\pi_{jt}^{+} + \beta_3\pi_{jt}^{-}\,] + \gamma_1' M_{jt} + \gamma_2' Z_{it} + \varepsilon_{ijt} \quad (2\text{-}3.1)$$

$$\pi_{ujt}^{+} = \begin{cases} \pi_{jt}^{U}, & if\ \pi_{jt} > \pi_{jt}^{A} \\ 0, & otherwise \end{cases}$$

$$\pi_{ujt}^{-} = \begin{cases} \pi_{jt}^{U}, & if\ \pi_{jt} < \pi_{jt}^{A} \\ 0, & otherwise \end{cases} \quad (2\text{-}3.2)$$

In equation (2-3), π_{jt}^{A} and π_{jt}^{U} follow the same definitions as equation (2-1) and (2-2). π_{jt}^{+} (π_{jt}^{-}) is the unexpected inflation π_{jt}^{U} when the current inflation π_{jt} is above (below) the adaptive inflation π_{jt}^{A}, and zero otherwise. β_1 is expected to be insignificant. β_2 is expected to be significantly negative and β_3 is expected to be significantly positive. I also expect that people are equally averse against inflation deviations in both above-adaptation and below-adaptation scenarios. GDP per capita, the GDP growth rate and the unemployment rate in province *j* are included as regional macroeconomic control variables (M_{jt}). The rest components of equation (2-3.1) are identical to equation (2-1).

2.5.3. The contribution of economic growth to the association between unexpected inflation and SWB

In this section, I explore how the association between unexpected inflation and SWB varies under different economic growth contexts. I extend El ouardighi and Munier's (2019) approach by introducing adaptive inflation and the two inflation episodes. Therefore, the following SWB function includes interaction terms between unexpected inflation and economic growth in above and below-adaptation episodes.

$$W_{ijt} = \alpha + [\,\beta_{j\pi}^{A} * \pi_{jt}^{A} + \beta_{j\pi}^{+} * \pi_{jt}^{+} + \beta_{j\pi}^{-} * \pi_{jt}^{-}\,] + \gamma_1' M_{jt} + \gamma_2' Z_{it} + \varepsilon_{ijt} \quad (2\text{-}4.1)$$

$$\pi_{ujt}^{+} = \begin{cases} \pi_{jt}^{U}, & if\ \pi_{jt} > \pi_{jt}^{A} \\ 0, & otherwise \end{cases}$$

$$\pi_{ujt}^{-} = \begin{cases} \pi_{jt}^{U}, & if\ \pi_{jt} < \pi_{jt}^{A} \\ 0, & otherwise \end{cases} \quad (2\text{-}4.2)$$

$$\beta_{j\pi}^{A} = \phi_{0\pi}^{A} + \phi_{1\pi}^{A} * GDPg_{jt} + \phi_{2\pi}^{A} * GDPg_{jt}^{2} \quad (2\text{-}4.3)$$

$$\beta_{j\pi}^{+} = \sum_{\tau=0}^{l=2} \phi_{\tau\pi}^{+} GDPg_{jt}^{\tau} \quad (2\text{-}4.4)$$

$$\beta_{j\pi}^{-} = \sum_{\tau=0}^{l=2} \phi_{\tau\pi}^{-} GDPg_{jt}^{\tau} \quad (2\text{-}4.5)$$

In the equations above, $GDPg_{jt}^{\tau}$ refers to regional GDP growth rates. Therefore, M_{jt} contains the rest regional macroeconomic control variables including GDP per capita, and the unemployment rate. The definitions of π_{jt}^{+} and π_{jt}^{-} in equation (2-4.2) are identical to those in equation (2-3.2). I include the adaptive inflation and its interaction terms with GDP growth rate and GDP growth rate squared. $\beta_{j\pi}^{+}$ and $\beta_{j\pi}^{-}$, refer to the parameters associated with unexpected inflation in above and below-adaptation episodes, and they are polynomial functions of the GDP growth rate (equation (2-4.4) and (2-4.5)). The values of l is determined by the statistical significance of parameters $\phi_{\tau\pi}$. The following three cases are applicable to both above and below adaptation scenarios.

Case 1: When $l = 0$, $\beta_{j\pi} = \phi_{0\pi}$. (2-5.1)

Case 2: When $l = 1$, $\beta_{j\pi} = \phi_{0\pi} + \phi_{1\pi} * GDPg_{jt}$. (2-5.2)

Case 3: When $l = 2$, $\beta_{j\pi} = \phi_{0\pi} + \phi_{1\pi} * GDPg_{jt} + \phi_{2\pi} * GDPg_{jt}^{2}$. (2-5.3)

In case 1, the interaction terms between unexpected inflation and GDP growth rate are not associated with SWB. In this case, the parameters $\phi_{0\pi}$ are homogeneous across different GDP growth rates. In case 2 and 3, $\beta_{j\pi}^{+}$ and $\beta_{j\pi}^{-}$ are functions of the GDP

growth rate which means the association between unexpected inflation and SWB varies across different GDP growth rates.

I directly estimate equation (2-5.3) based on Case 3, which includes interaction terms between unexpected inflation, GDP growth rate and GDP growth rate squared. In accordance with El ouardighi and Munier's (2019), Case 2 and Case 3 support the heterogeneity in $\beta_{j\pi}^{+}$ and $\beta_{j\pi}^{-}$. Both $\beta_{j\pi}^{+}$ and $\beta_{j\pi}^{-}$ are expected to follow the analysis below.

When $l = 1$ (Case 2), a positive (negative) $\phi_{1\pi}$ means that $\beta_{j\pi}$ decreases (increases) as the GDP growth rate rises. The direction of $\beta_{j\pi}$ reverses when the GDP growth rate equals to $\frac{-\phi_{0\pi}}{\phi_{1\pi}}$.

When $l = 2$ (Case 3), I define that the two roots of the quadratic function (equation (2-5.3)) are g_1 and g_2.[9] There are two possible quadratic formulations of $\beta_{j\pi}$. First, when $\phi_{2\pi} > 0$, equation (2-5.3) is U-shaped. $\beta_{j\pi}$ is negative when the GDP growth rate is between g_1 and g_2. $\beta_{j\pi}$ reaches the minimum when the GDP growth rate equals to $\frac{-\phi_{1\pi}}{2\phi_{2\pi}}$. Second, when $\phi_{2\pi} < 0$, equation (2-5.3) follows an inverse U-shape. $\beta_{j\pi}$ is positive when the GDP growth rate is between g_1 and g_2.

In light of the formulations explained above, I also consider the domain of definitions according to the revealed GDP growth rates.[10] Therefore, the contribution of the GDP growth rate to the association between unexpected inflation and SWB

[9] The two roots g_1 and g_2 are the solutions of the quadratic function when $\beta_{j\pi} = 0$. Also, I define that $g_1 < g_1$.

[10] The revealed GDP growth rate means the GDP growth rate data given by the sample data in this study.

depends on the estimated parameters $\phi_{\tau\pi}$ and the true GDP growth rates experienced by individuals.

2.5.4. Estimation methodology

Subjective well-being data is widely accepted as a good approximation of *experienced utility* in the emerging literature dealing with economics of well-being (Frey and Stutzer, 2002; Dolan and Kahneman, 2008).[11] *Experienced utility* is defined as the hedonic (subjective) experience produced by an outcome when it is eventually gained (Kahneman *et al*., 1997). Responses to SWB questions can be treated as cardinal or ordinal, and SWB equations are usually estimated using ordinary least squares (OLS) or ordinal regression models such as ordered logit or probit.[12] Focusing on the determinants of well-being, there is no virtual difference between the regression results from microeconomic equations under cardinal and ordinal assumptions (Frey and Stutzer, 2000; Ferrer-i-Carbonell and Fritjers, 2004; Layard *et al*., 2007; Dolan *et al.,* 2008).[13]

In this study, main results are based on OLS regressions with fixed effects. To assess the robustness of my findings, I also provide results based on fixed-effects ordered logit and fixed-effects Poisson regressions.

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[11] A series of studies explain in depth that experienced utility fits the traits of the information contained in SWB data (i.e., Frey and Stutzer, 2002; Kahneman and Krueger, 2006; Dolan and Kahneman, 2008).

[12] The cardinal assumption of SWB data assumes that SWB scores reflect the absolute magnitude of well-being judgement and SWB scores are interpersonally comparable. The Ordinal assumption of SWB data posits that SWB scores show the rank order of different states (OECD, 2013).

[13] According to Layard *et al*. (2008), the cardinality assumption is both justified and reasonable. Marginal utilities can be estimated by SWB data as the information about the utility function's curvature is necessary for correct policy design.

2.6. Data

2.6.1. Individual level survey data and macroeconomic data

I use five waves of the China Family Panel Studies (CFPS) data over the period 2010 to 2018. The CFPS is a nationally representative longitudinal survey conducted every two years by Peking University.[14] The baseline survey in 2010 includes over 13,000 families and 33,000 adults in 25 out of 31 provinces (including 4 municipalities: Beijing, Tianjin, Shanghai and Chongqing) in China. I focus on adults aged between 18 to 60, which cover 78% of the total sample in the 2010 baseline.[15]

The main dependent variable in this paper is "Life Satisfaction" which is used as a measure of SWB Each wave of the CFPS includes the question: "Are you satisfied with your life?" Respondents rank their life satisfaction on a five-point scale (1 to 5 points), ranging from "very unsatisfied" (1) to "very satisfied" (5). Therefore, a higher value means better life satisfaction. I also include "happiness" as an alternative measure of SWB as a robustness check. In the 2012, 2016 and 2018 waves of the CFPS, people are asked: "How often did you feel happy in the past week?" Respondents can select their happiness status from "never" (1), "sometimes" (2), "often" (3), and "most of the time" (4).[16] The happiness s questions in 2010 and 2014 are not consistent with the above-

[14] See www.isss.edu.cn/cfps/EN for a more detailed introduction of CFPS.

[15] Chapter 2 was finished in 2019 and the 2018 CFPS preliminary version I applied contains too many missing values among old respondents (e.g., self-reported income, employment status, and self-reported health status). The final version of the 2018 CFPS was published in January 2021. Therefore, Chapter 3 uses the newest CFPS version and includes all adults aged 18 and older. Details about the update of the 2018 CFPS data can be accessed at the site: https://www.isss.pku.edu.cn/cfps/xgxw/cfpsdt/1336727.htm

[16] The happiness question is included as one of the 20-question used to construct the Center for Epidemiological Studies Depression Scale (CESD) in the 2012, 2016, and 2018 waves of the CFPS.

mentioned one and, as a result, cannot be used.

The CFPS collects information about respondents' personal characteristics, family socio-economic status and subjective views about various personal and social problems. I include various individual and family level control variables according to previous studies (see Section 2.5.1). The definitions of all control variables are included in Table 2.1.

The macroeconomic variables are collected from the National Bureau of Statistics of China (NBSC). I use the RPI (Retail Price Index) growth rate to measure the inflation. GDP per capita, GDP growth rates and the unemployment rate are included as macroeconomic control variables. I collect the annual RPI growth rate data of both urban and rural area of each province. The provincial GDP per capita is measured in Purchasing Power Parities at 2010 constant CNY (Chinese Yuan) according to the corresponding urban/rural-provincial inflation rate. The annual GDP growth rate and unemployment rate are also at the provincial level. According to the NBSC, the unemployment rate only records the proportion of people who have reported and registered their unemployment status to the local government. Therefore, the official unemployment rate is not representative of the true regional labor market situation.[17] For each observation in the 5 waves of the CFPS, the RPI growth rate and GDP per capita is matched according to the area (urban or rural) and province each respondent

[17] The problem about unemployment rate in China is also reported by Chen *et al*. (2014). The surveyed unemployment rate published by the National Bureau of Statistics of China starting from 2018 would be a better index to use in future studies.

lives in. The GDP growth rate and unemployment rate are matched according to the province of residence. The adaptive inflation rates are measured by 3-year backward-looking moving averages of inflation in my main results. I also provide a short-run measure (previous year's inflation) and a long-run measure (7-year backward-looking moving averages of inflation) of the adaptive inflation as robustness checks.

2.6.2. Descriptive Statistics

Table 2.2 reports the descriptive statistics of the dependent variables and macroeconomic variables in each wave. From 2010 to 2018, the average life satisfaction scores reported in the CFPS were generally upward trending. At the same time, the average current inflation, adaptive inflation, inflation standard deviations, and GDP growth rates were generally decreasing. It is noteworthy that, compared to 2010, the standard deviation of inflation in 2018 was about 6 times smaller. The proportional decrease in the standard deviation of inflation was the most significant compared to other macroeconomic variables. Table 2.2 also reports the frequencies of the above and below-adaptation episodes in each year. From 2010 to 2016, the below-adaptation episodes were much more prevalent than the above-adaptation episodes. Therefore, the majority of the respondents experienced an inflation rate lower than the average level in previous years. Especially in 2014, all of the respondents experienced inflation below the adaptive level. The Inflation rate increased in 2018 and about 90% of the respondents experienced above-adaptation inflation. For the first time in the past decade, the above-adaptation episodes became more prevalent than the below-adaptation episodes The descriptive statistics for the control variables are included in Table 2.3.

Table 2.4 contains the correlation coefficients of the Life Satisfaction score and some macroeconomic variables.

2.7. Results

2.7.1. Adaptive Inflation and the Unexpected Inflation baseline

Table 2.5 column (1) and (2) report the regression results based on the traditional SWB equation where inflation is included as the main independent variable (i.e., Di Tella *et al*., 2003; Welsch and Kühling, 2011). Column (1) includes the inflation variable only, and column (2) also controls for other macroeconomic variables. Consistent with Gao *et al*. (2014) who also use SWB data in China, I find that inflation is not associated with SWB in both column (1) and (2). Column (3) reports the regression result when adaptive inflation measured by the 3-year backward-looking moving averages of inflation is included. I find that the adaptive inflation is not associated with SWB. When other macroeconomic variables are included (column (4)), the adaptive inflation is still not associated with SWB. Column (5) shows the regression result based on equation (2-1), and both the adaptive inflation and the unexpected inflation are not associated with SWB. This result contradicts Chen *et al*.'s (2014) cross-sectional study based on the 2010 wave of the China General Social Survey. This might imply that the negative association between the unexpected inflation and SWB does not necessarily hold when the within-subject association between the unexpected inflation and SWB is included. Also, the association between the unexpected inflation and SWB may vary depending on the inflation episodes relative to the adaptive inflation, because people tend to

evaluate inflation differently when the current inflation is higher or lower than their psychologically adapted level. Therefore, I discuss the regression results based on equation (2-3) in the next subsection (section 2.7.2).

As to the other macroeconomic control variables, I do not find any significant association between aggregate income-related variables (Log of GDP per capita and GDP growth rate) and SWB. As for the micro-level income-related variables, I find that SWB is better among respondents with higher relative personal and family income. In line with Easterlin (1995), Di Tella *et al*. (2003) Ferrer-i-Carbonell (2005) and Knight *et al.* (2009), my study supports the income relativities argument. The coefficients associated with other control variables are discussed in Appendix Section A2.1.

2.7.2. Deviations of inflation and Subjective Well-being

Main results

To investigate how SWB relates to the deviations of inflation from the adaptive level, I estimate a piecewise SWB equation (equation (2-3)) which includes the associations between unexpected inflation and SWB in two episodes. Table 2.6 shows that, in above-adaptation episode, the unexpected inflation is significantly and negatively associated with SWB, while in below-adaptation episode, the above-mentioned association is significant and positive. The WALD tests suggest that I cannot reject the null: $\beta_2 + \beta_3 = 0$. Accepting the null means that people are equally aversive against inflation deviations in both above-adaptation and below-adaptation scenarios. To explain these findings, I plot the linear SWB function relative to the adaptive inflation in Figure 2.4.

The slopes in above- and below-adaptation episodes are the estimated parameters β_2 and β_3 from Table 2.6. The graph shows that SWB decreases when the current inflation shifts away from the adaptive level. Therefore, the larger the deviations of current inflation from the adaptive level (higher degrees of inflation instability), the lower the SWB. Also, the response of SWB to inflation deviations is symmetric relative to the adaptive inflation, because β_2 and β_3 are statistically the same in absolute value.

Robustness Checks

Firstly, in Section 2.7.2, I verify whether my findings are robust to using different measures of adaptive inflation. In addition to the 3-year backward-looking average inflation used to measure the adaptive inflation so far, I also consider a short-run and a long-run measure. Table 2.7 column (1) and (2) report the estimates of equation (2-3) when the adaptive inflation is measured by the previous year's inflation and the 7-year backward-looking moving averages of inflation.

First, consistent with my main result in Table 2.6, Table 2.7 column (1) and (2) show that the adaptive inflation is not associated with SWB. Second, I find that Column (1) repots insignificant β_2 and β_3, but Column (2) is consistent with my main result in Table 2.6 regarding the significance and the signs of β_2 and β_3. Consistent with Chen *et al*. (2014), the findings above implies that people evaluate the inflation changes by referring to their experience of the long-run inflation trend. Third, the WALD test in Table 2.7 column (2) suggests that β_2 and β_3 are statistically the same in absolute value. Therefore, my main result in Table 2.6 is robust to the use of a long-run backward-looking measure of adaptive inflation.

Secondly, I check the robustness to using different regression methods. Following Dickerson *et al*. (2012), Wang and Cheng (2017), Table 2.7 Column (3) shows that my main results in Table 2.6 are robust to the use of fixed effects Poisson specifications. I also estimate equation (2-3) using the fixed effects ordered logit regression. The five columns in Table 2.8 report the marginal effects at means. Consistent with my main results, the larger the deviations of current inflation from the adaptive level, the lower the probability for a respondent to report "Satisfied" or "Very Satisfied". Additionally, the WALD Test results in both Table 2.7 Column (3) and Table 2.8 suggest that β_2 and β_3 is statistically the same in absolute value. Therefore, my main results in Table 2.6 are robust to using both fixed effects Poisson and ordered logit specifications.

Lastly, I use happiness as an alternative measure of SWB and estimate equation (2-3) based on fixed effects OLS and fixed effects ordered logit regressions. Consistent with my main results in Table 2.6, Table 2.9 shows that he higher the unexpected inflation in above-adaptation episodes, the lower the probability to report greater happiness. However, as for the below-adaptation episodes, I do not find any significant association between unexpected inflation and SWB. This might be explained by the loss of observations. As I mentioned in Section 2.6.1, my happiness data does not cover the years 2010 and 2014 due to the inconsistency of happiness questions. This results in a great loss of below-adaptation episodes because all respondents experienced below-adaptation inflation in 2014 (see Table 2.2).

Further tests

Before running further tests to support my proposed conceptual framework, it is

worth mentioning that my results differ from traditional views on the inflation-SWB association. Specifically, previous studies mainly rely on an intuitive argument that inflation is bad for SWB (i.e., Di Tella *et al*., 2001, 2003; Wolfers, 2003; Welsch and Kühling, 2011, 2016). However, the simple negative inflation-SWB association may result in flaws when I use the individual-level SWB data to understand how people evaluate inflation movements. Firstly, the simple negative inflation-SWB association ignores people's adaptative behaviour which is considered as a very important mechanism in both well-being and inflation perception studies (i.e., Ranyard *et al*., 2008). Therefore, the adaptive inflation is crucial as it indicates the reference inflation and the neutral SWB level which drives people's evaluations of inflation. Secondly, the simple negative inflation-SWB association may not be applicable if inflation is very low. For example, when inflation is positive but very close to zero, any further decrease in inflation might largely increase the public concerns of deflation which would not bring well-being gains.

To further investigate other forms of the association between inflation instability and SWB, I also provide two extensions based on my main result in section 2.7.2. Extension 1 focuses on an alternative measure of the inflation instability—the standard deviations of inflation. Extension 2 further investigates the nonlinear SWB function subject to the deviations of inflation. The results and the robustness checks regarding the two extensions are included in Appendix A2.2.

2.7.3. The contribution of the economic growth to the association between unexpected inflation and SWB

Main results

I now move to the last part of the conceptual framework and discuss the role of the economic growth. Table 2.10 shows the estimates of equation (2-4). The adaptive inflation is not associated with SWB, as $\phi_{0\pi}^{A}$, $\phi_{1\pi}^{A}$ and $\phi_{2\pi}^{A}$ are all insignificant. According to the significance and the values of the estimated parameters in Table 2.10, equation (2-4.4) and (2-4.5) can be expressed as follows:

Above-adaptation episodes:

$$\beta_{j\pi}^{+} = 0.2764 - 0.0695 * GDPg_j + 0.0037 * GDPg_j^2 \quad (2\text{-}6)$$

Below-adaptation episodes:

$$\beta_{j\pi}^{-} = -0.1829 + 0.0365 * GDPg_j - 0.0015 * GDPg_j^2 \quad (2\text{-}7)$$

In terms of the above-adaptation episodes, Figure 2.5 plots equation (2-6) and the corresponding distributions of the revealed GDP growth rates experienced by the sample population. Figure 2.5 shows how $\beta_{j\pi}^{+}$ varies across different GDP growth rates. The revealed GDP growth rates range from a lower bound $g^L = 3.6\%$ to $g^U = 17.4\%$.[18] Equation (2-6) has two roots ($g_1 = 5.7\%$ and $g_2 = 13.1\%$) that lie between the g^L and g^U. $\beta_{j\pi}^{+}$ reaches the minimum when the GDP growth rate equals to $g_0 = 9.4\%$. g_0, g_1 and g_2 divide the distribution into four intervals. Intervals *I, II*, *III and IV* cover 3.9%, 69.7%, 16.6% and 9.7% of the population in above-adaptation episodes. The majority (96.1%) of the observations experience GDP growth rates between g_1 and

[18] In the above-adaptation episodes, the lower bound and upper bound of the regional GDP growth rates experienced by the respondents in the CFPS over the period 2010-2018 are $g^L = 3.6\%$ and $g^U = 17.4\%$.

g^U. Accordingly, the two areas shaded in grey in Graph (a) are the possible ranges of $\beta_{j\pi}^{+}$ suggested by the GDP growth context experienced by the respondents. Firstly, I find that the negative association between unexpected inflation and SWB is amplified by the GDP growth rate in interval *II* (covering 69.7% of the population in above-adaptation episodes). The negative association between unexpected inflation and SWB is mitigated by the GDP growth rate when it is higher than g_0 (interval III and IV covers 26.4% of the population in the above-adaptation episodes). With the GDP growth rate rising further above $g_2 = 13.1\%$, the negative association between SWB and the unexpected inflation is fully absorbed. Therefore, g_2 indicates the full-absorption GDP growth rate. Secondly, I also find that most of the population experienced a negative association between unexpected inflation and SWB (interval *II* and *III* covers 86.4% of the population in the above-adaptation episodes). About 9.7% of the population (interval *IV*) experienced a positive association between unexpected inflation and SWB.

In terms of the below-adaptation episodes, Figure 2.6 plots equation (2-7) with the revealed GDP growth rates ranging between $g^L = -2.5\%$ and $g^U = 17.1\%$. One root of equation (2-7) ($g_1 = 7.1\%$) lies between g^L and g^U. The other root ($g_2 = 17.3\%$) is higher than g^U. Therefore, the distribution of the revealed GDP growth rates is divided into three intervals *I*, *II* and *III*. When the GDP growth rate is below $g_0 = 12.2\%$, it mitigates the negative association between the unexpected inflation and SWB (interval I and II covers 79.1% of the population in the below-adaptation episodes). The full-absorption GDP growth rate is $g_1 = 7.6\%$. The area shade in solid grey (interval *I*) indicates a negative $\beta_{j\pi}^{-}$ (covering 19.1% of the population in below-adaptation

episodes), while the shaded area with vertical strips (interval *II*) indicates a positive $\beta_{j\pi}^{-}$ (covering 80.9 % of the population in the below-adaptation episodes).

The role of the high but unbalanced regional economic growth

Compared to traditional well-being studies which argue that inflation is always bad for SWB, my results argue that the unexpected inflation-SWB association varies depending on the GDP growth rates. I find that almost half of the observations in my sample experienced a positive association between unexpected inflation and SWB.[19] My findings do not mean that inflation is good for well-being. They can be explained by the overall high economic growth in China over the period 2010-2018, and especially by the extremely high economic growth observed from 2010 to 2012 (see Table 2.2). The average GDP growth rate of 30 OECD countries over the period 1990-2008 was about 3.1% (Welsch and Kühling, 2011), while the average GDP growth rate in my sample is about 9.0%. Therefore, unexpected inflation no longer brings well-being loss to people as the economic growth is high enough to counteract the loss. Also, this is consistent with the argument mentioned in Section 2.2.2 that people become less aversive against inflation when they experience income rises (Souleles, 2004; Ranyard *et al*., 2008; Del Giovane *et al*., 2009).

Based on country-level SWB data, El ouardighi and Munier (2019) find that the negative association between inflation and SWB is always fully absorbed by the

[19] The association between unexpected inflation and SWB is positive within Intervals I and IV of Figure 2.5 and Intervals II and III of Figure 2.6. They cover $\frac{3.91\%+9.71\%+80.9\%}{2} = 47.26\%$ of the total observations.

economic growth. However, I find that the association between unexpected inflation and SWB varies a lot under different GDP growth contexts. For about half of the total observations in my sample, the rising GDP growth rate does not mitigate the negative association between unexpected inflation and SWB.[20] This could be explained by the unbalanced regional economic development in China. Compared to developed provinces that experienced rather high and stable economic growth, some provinces experienced very low economic growth in some years.[21] For example, Liaoning province suffered from a recession in 2014 and the negative economic growth in Liaoning could not fully absorb the well-being losses from inflation.

The Asymmetric Costs of Well-being from Inflation

The findings in Section 2.7.3 also provide an indirect perspective to look at the asymmetric association between unexpected inflation and SWB. Comparing the results in Figure 2.5 and Figure 2.6, the full-absorption GDP growth rate in the above-adaptation episode ($g_2 = 13.1\%$) is almost twice that in the below-adaption episode ($g_1 = 7.6\%$). This refers to an implicit asymmetric perception that people may perceive stronger negative impact from inflation when it is above the adaptive level than below. As a result, compared to the below-adaptation episodes, a much higher GDP growth rate is needed to fully counteract the well-being loss from unexpected inflation when

[20] GDP growth mitigates the negative association between unexpected inflation and SWB: Figure 2.5. Interval III and IV. Figure 2.6. Interval I and II. In total, it covers $(26.4\% + 79.1\%)/2 = 52.75\%$ of the total observations.

[21] For example, Zhejiang province is one of the most developed province in the east coast of China. It experienced rather high and stable economic growth in the past decade with the GDP growth rate ranging from 7.1% to 11.9%.

inflation is above the psychological adaptive level. In other words, relative to the reference inflation, the rising inflation in the above-adaptation episodes might be more strongly perceived as a loss than in the below-adaptation episodes.

2.8. Policy Implications

In this section, I will first analyse the policy implications of my findings in the context of China. Next, I will discuss more general policy implications applicable to any country.

Table 2.11 Panel A reports the annual inflation rate observed in China, as well as the general monetary policies adopted over the last decade. According to the annual Report on the Work of the PRC (People's Republic of China) Government, inflation policies aiming at achieving price stability were highlighted from 2009 to 2012 when inflation was highly volatile (Zheng *et al.*, 2012; Girardin *et al*., 2017). Table 2.11 Panel B reports the inflation and GDP growth experienced between 2010 and 2018. The standard deviation of inflation decreased over the period 2010-2018. My results, according to which the lower the inflation instability, the lower the SWB loss (see Section 2.7.2), suggest that these inflation stabilizing policies benefited people's well-being.

According to the inflation episodes and the economic growth environment, I provide a general policy framework regarding the well-being costs under different macroeconomic contexts (see Figure 2.7). The four contexts shown in Figure 2.7 are combinations of high/low GDP growth and above/below-adaptation inflation episodes.

Using China's data as a case study, I can simply plot the data summarized in Panel B of Table 2.11 and my main findings in Section 2.7 in Figure 2.7.

In 2010, China experienced below-adaptation inflation with high GDP growth (see context ii in Figure 2.7). The GDP growth continuously decreased over the period 2010-2016 which indicates a shift from context ii to iii (see Period A in Figure 2.7). After 2018, the GDP growth rate remained stable around 6.9%, but the inflation rose above the adaptive level. As a result, the economy shifted from context iii to iv. Based on my findings from Section 2.7.3, the GDP growth rate in 2018 was far below the full-absorption threshold (13.1%). Therefore, boosting economic growth (Route 1. Figure 2.7) to fully counteract the well-being loss from the rising inflation was not feasible as it would have meant doubling the GDP growth rate. Alternatively, it could have been feasible to maintain a stable inflation environment to minimize the well-being loss from inflation (Route 2. Figure 2.7). As a matter of fact, inflation has been low and stable in China and policies did therefore not need to target inflation stability since 2013.[22] Therefore, I suggest that, regarding the maintaining of a good social well-being level, policies aiming at achieving inflation stability need to be concerned according to the recent macroeconomic trend in China. Furthermore, the one-for-all inflation target suggested by the central government may not fit all regions in China, as my findings suggest that the well-being cost of inflation varies in different economic growth

[22] Chinese monetary policy is not officially characterised by inflation targeting but can be characterised as "implicit inflation targeting" (He and Pauwels, 2008). Focusing on the Asia-Pacific region, Filardo and Genberg (2009) argue that formal inflation targeting is not the only monetary policy framework capable of delivering price stability.

contexts. Thus, to be more effective, economic policies should be tailored to the regional growth and inflation environment rather than being nation-wide.

2.9. Conclusion

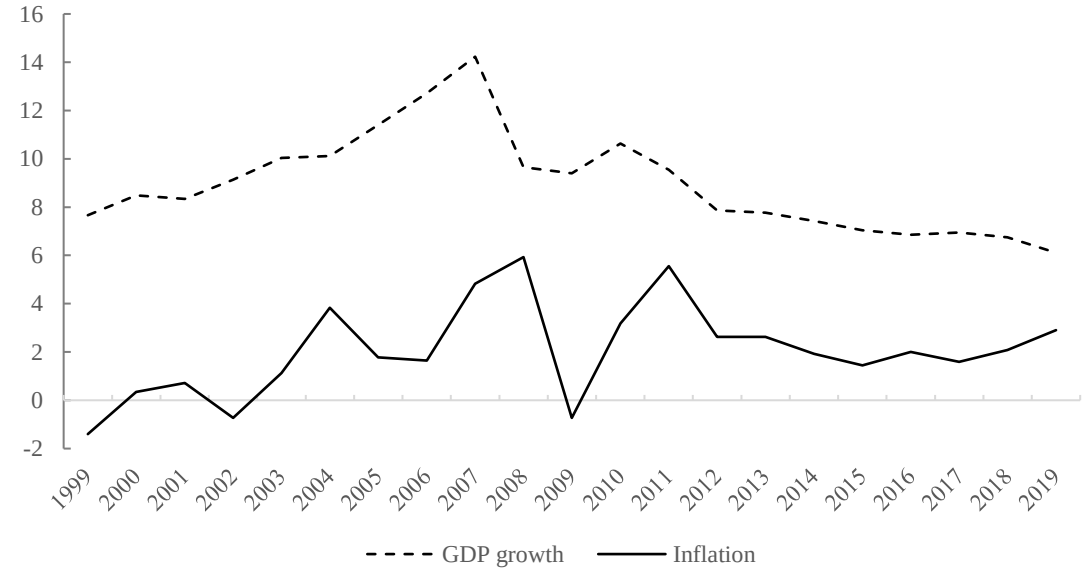
Previous studies about inflation and SWB generally conclude that 'inflation is bad for well-being'. For the first time, in light of concepts from the Adaptation-Level Theory and reference inflation, I introduce the adaptive inflation measured by prior inflation rates to the SWB equation. The adaptive inflation serves as the reference inflation, and it also indicates the SWB-neutral inflation level. Using data from the China Family Panel Study (CFPS) over the period 2010-2018, I find that the higher the inflation instability, the lower the SWB. My results are robust to using different measures of adaptive inflation and different estimation methods. I also find that the association between unexpected inflation and SWB varies across economic growth contexts. Specifically, high economic growth can fully absorb the negative impact of unexpected inflation on SWB. To fully absorb the negative impact of unexpected inflation on SWB, a much higher economic growth rate is needed for inflation above than below the adaptive level.

My work could be extended in several ways. First, due to the data limitation, I only focus on the role of the economic growth in moderating the association between unexpected inflation and SWB. It would be interesting to look at the role of other variables such as labour markets, public welfare. To provide more detailed macroeconomic policy implications, further studies are needed to investigate how the

changes in various macroeconomic indicators interactively influence people's well-being. Second, this chapter only uses provincial inflation data because the CFPS does not provide information about cities where respondents live. To better capture the inflation environment that people experience, future studies are encouraged to develop city-level and community-level inflation measures. Third, SWB reflects the overall evaluations of people's life. Better data is needed which directly collects people's changes in the 'experienced' wellbeing of inflation. Fourth, China is a perfect case to investigate the framework as it showed considerable degrees of inflation instability and high economic growth in the past decade. However, the conceptual framework and the policy framework I provide are not restricted to the country because the inflation evaluation mechanism behind it is universal. Future studies could extend the above-mentioned frameworks to other countries.

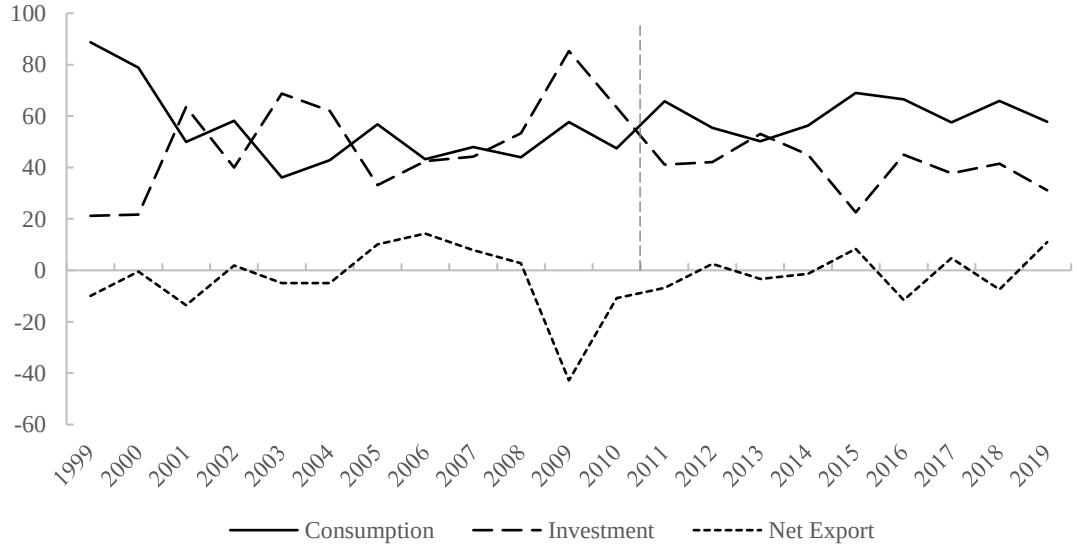
Figures and Tables in Chapter 2

Figure 2.1 GDP growth and Inflation trends, China, 1999-2019



Notes: GDP growth and inflation annual rates are in percent and at national level.
Source: National Bureau of Statistics of China

Figure 2.2 Main contributors of China's GDP growth from 1999 to 2019



Notes: The contribution ratios of consumption, investment and net export to GDP growth are in percent.
Starting from 2011, consumption is generally the highest contributor to China's GDP growth.

Figure 2.3 Inflation instability and SWB

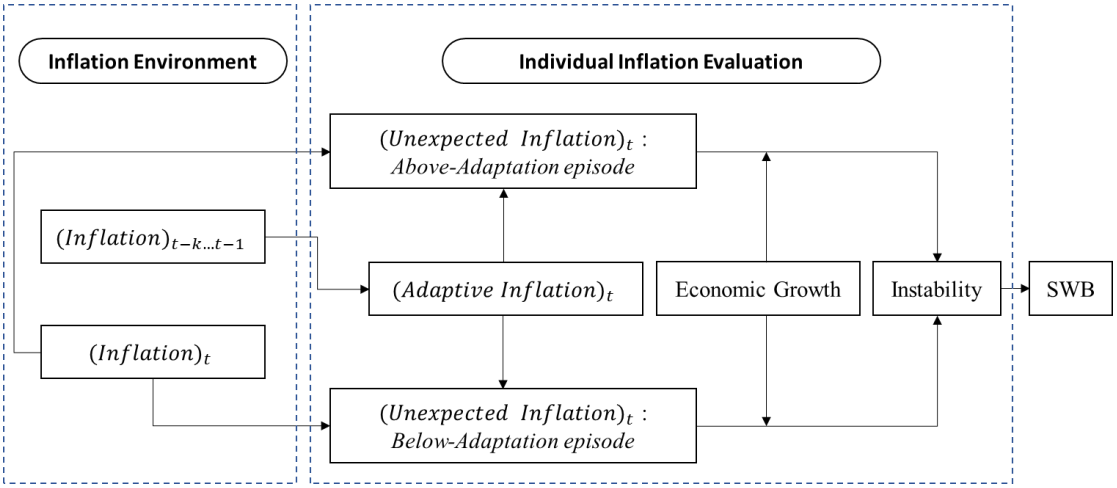
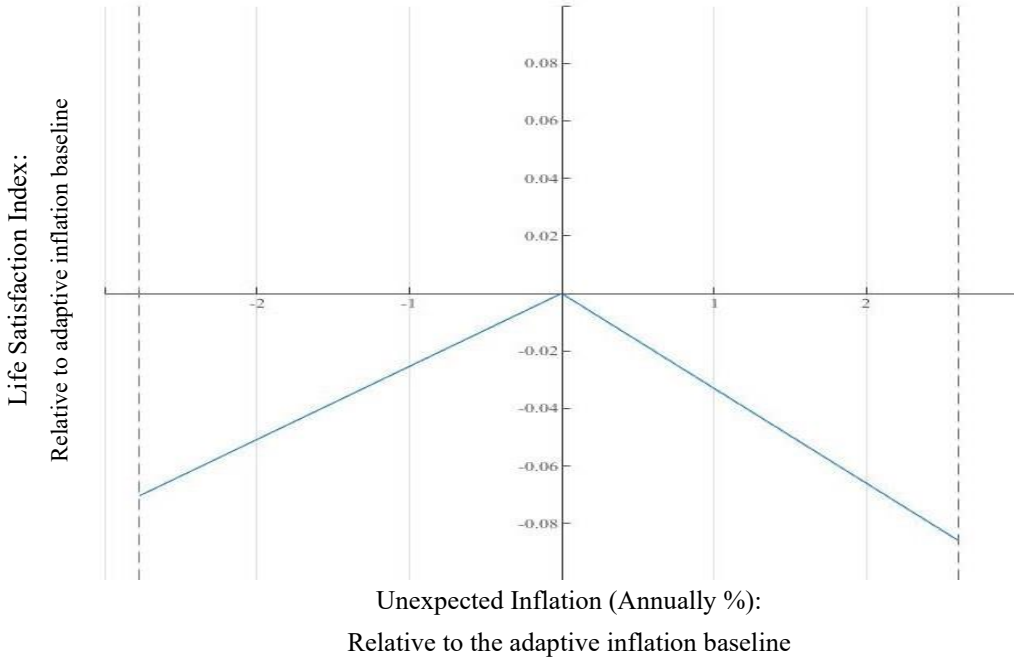
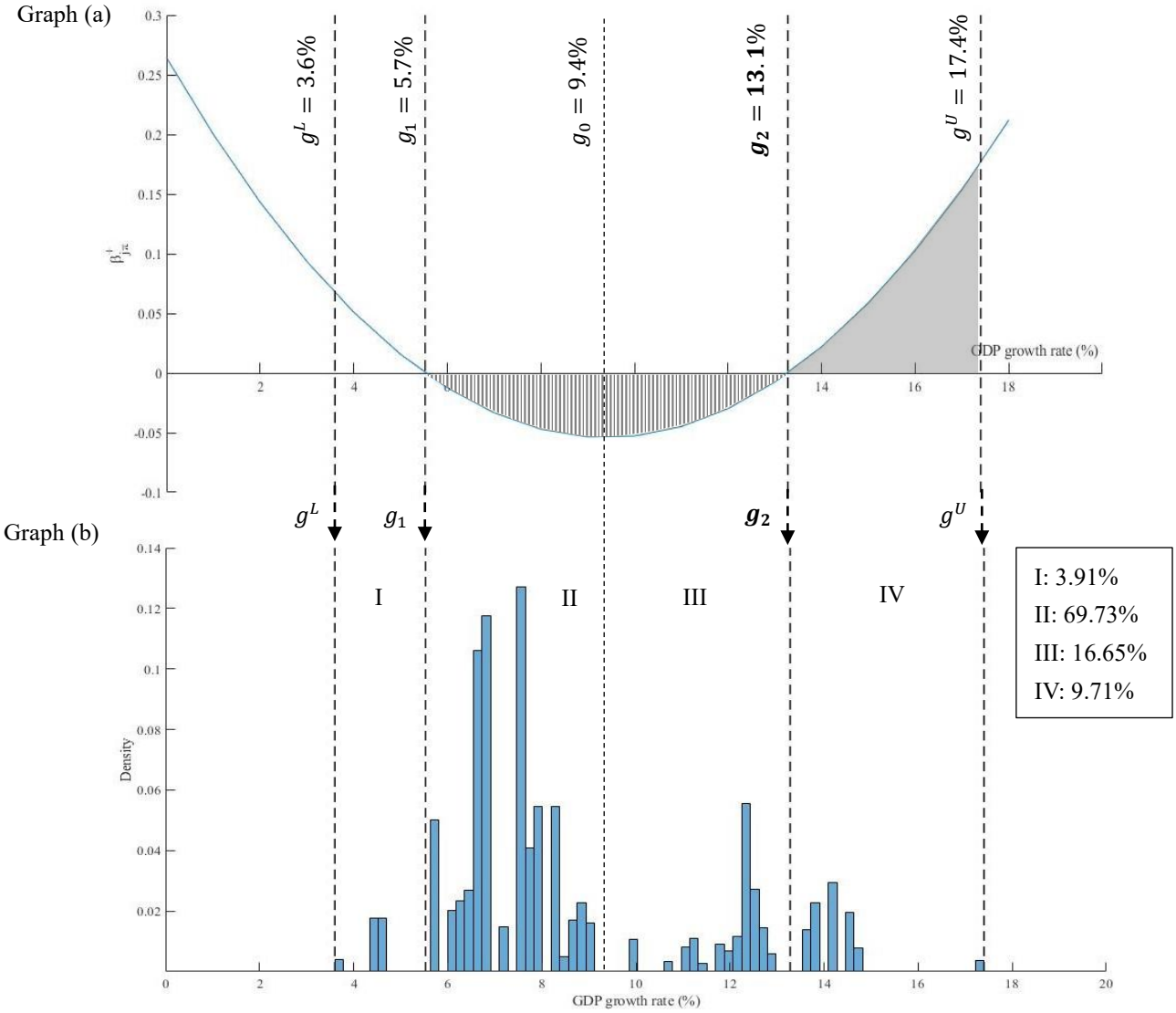


Figure 2.4 Linear SWB function relative to the adaptive inflation baseline



Notes: The graph plots the linear SWB function subject to inflation deviations relative to the adaptive inflation baseline according to the estimated parameters reported in Table 2.6. The graph corresponds to the estimated equation (2-3) with adaptive inflation measured by 3-year backward-looking moving averages. The vertical dashed lines are the lower-bound (-2.77%) and upper-bound (2.6%) of the unexpected inflation experienced by the respondents.

Figure 2.5 The contributions of economic growth: Above-adaptation episodes



Graph (a) Plot of equation (2-6)

Graph (b) Distribution of revealed GDP growth rate (%) in above-adaptation episodes.

Notes: Graph (a) is plotted according to equation (2-6). Graph (b) corresponds to the distribution of revealed GDP growth data when inflation is above the adaptive level. GDP growth rate is in percent. The 5 vertical dashed lines are consistent in both graphs and indicate:

g^L: The lower bound of the revealed GDP growth rate equal to 3.6%.

g_0: The GDP growth rate when $\beta_{j\pi}^{+}$ reaches the minimum.

g_1 and g_2: GDP growth rate equals to 5.7% and 13.1%. The two roots of equation (2-7) when $\beta_{j\pi}^{+} = 0$.

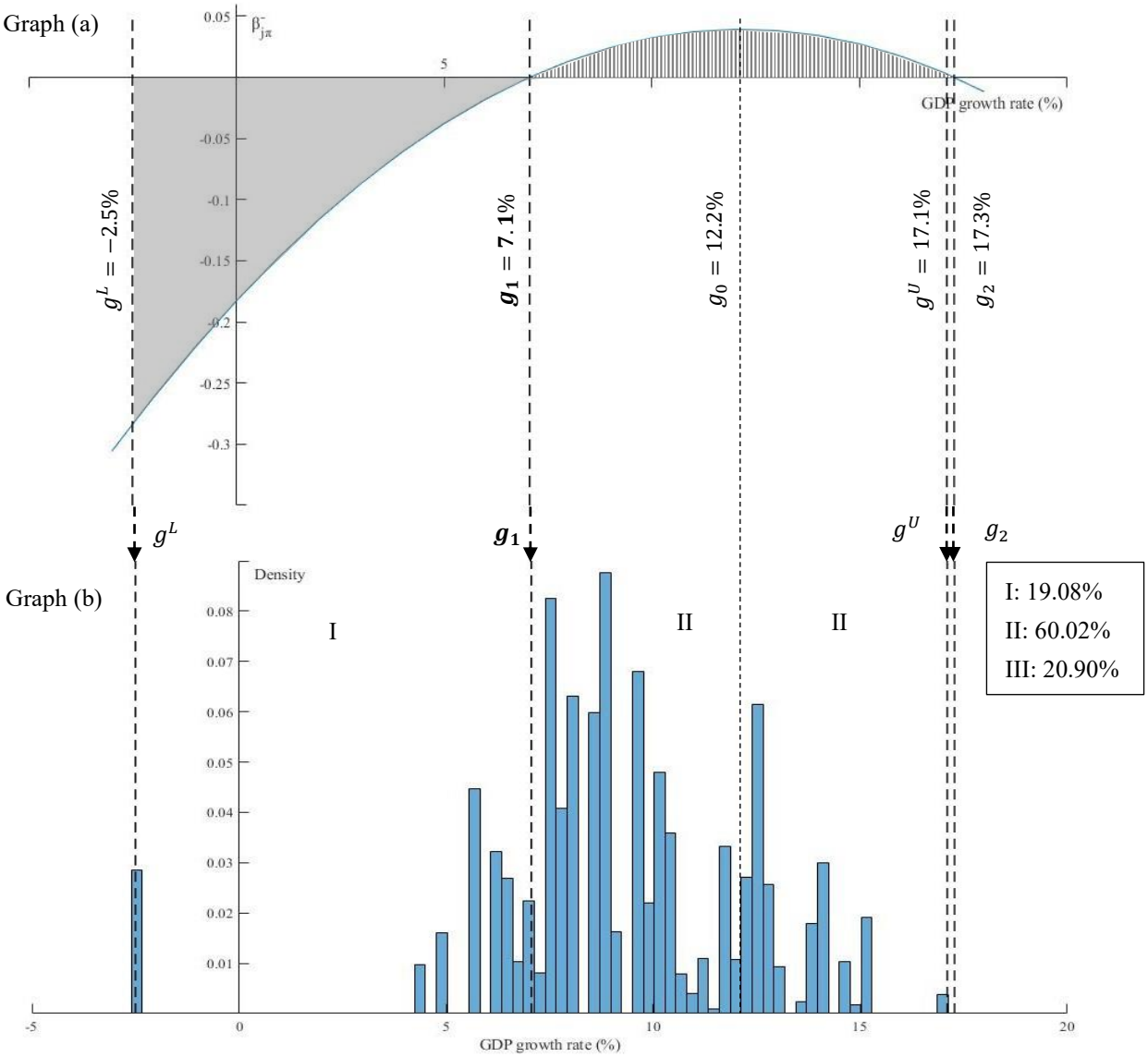
g^U: The upper bound of the revealed GDP growth data equal to 17.4%.

The legend of Graph (b) shows the population percentage of the GDP growth rate intervals I, II, III and IV:

Full-absorption GDP growth rate: $GDPg = g_2$ indicates that the negative impact of unexpected inflation on SWB is fully absorbed.

The two areas shaded in grey in Graph (a) refer to the possible ranges of $\beta_{j\pi}^{+}$ suggested by 96.09% of the population (interval II and III: GDP growth rate lies between g_1 and g^U).

Figure 2.6 The contributions of economic growth: Below-adaptation episode



Graph (a) Plot of equation (2-7)

Graph (b) Distribution of revealed GDP growth rate (%) in above-adaptation scenario.

Notes: Graph (a) is plotted according to equation (2-7). Graph (b) corresponds to the distribution of revealed GDP growth data when inflation is above the adaptive level. GDP growth rate is in percent. The 5 vertical dashed lines are consistent in both graphs and indicate:

g^L: The minimum of the revealed GDP growth rate equal to -2.5%.

g^U: The maximum of the revealed GDP growth rate equal to 17.1%.

g_0: The GDP growth rate when $\beta^{-}_{j\pi}$ reaches the maximum.

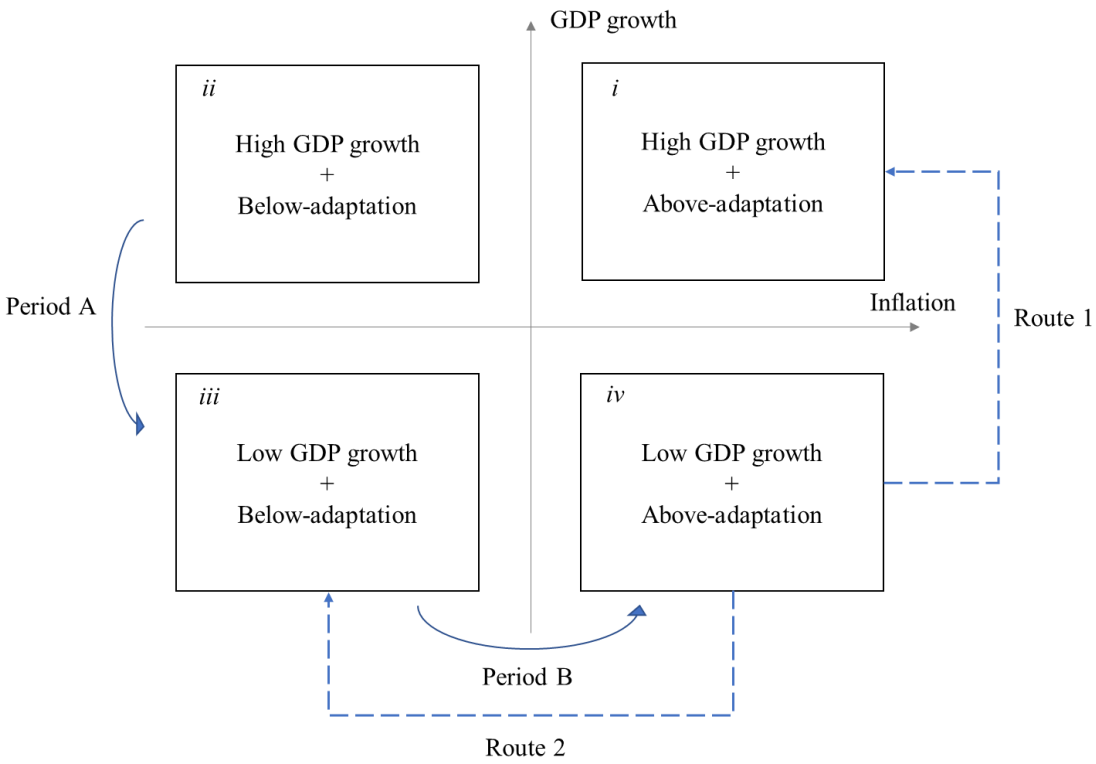
g_1 and g_2: GDP growth rate equals to 7.1% and 17.3%. The two roots of equation (2-7) when $\beta^{-}_{j\pi} = 0$.

The legend of Graph (b) shows the population percentage of the GDP growth rate intervals I, II and III:

Full-absorption GDP growth rate: $GDPg = g_1$ indicates that the negative impact of unexpected inflation on SWB is fully absorbed.

The two areas shaded in grey in Graph (a) refer to the possible ranges of $\beta^{-}_{j\pi}$ suggested by all sample population. (interval I and II: GDP growth rate lies between g^L and g^U).

Figure 2.7 Breakdown of the general economic growth and inflation



Notes:

Period A refers to the period from 2010 to 2016 when the GDP growth rate was decreasing, and inflation was generally below the adaptive level.

Period B refers to the period after 2016 when the GDP growth rate remained stable, but inflation rose above the adaptive level.

Two routes to counteract the potential well-being loss from unstable inflation:

Route 1. Boosting economic growth.

Route 2. Maintaining a stable inflation environment.

Table 2.1 Definitions of variables

Variable	Abbreviation	Description
Dependent variables		
Life satisfaction	LS	Rank 1-5 points from "very unsatisfied" to "very satisfied"
Happiness	happiness	Answers to "I was happy in the past week". Never (less than 1 day) Sometimes (1-2 days) Often (3-4 days) Most of the time (5-7 days)
Macroeconomic variables		
Current Inflation	π	rural/urban-provincial RPI annual growth rate
Adaptive Inflation	π^A	moving averages of rural/urban-provincial RPI annual growth rate
Unexpected Inflation	π^U	Difference between Current Inflation and Adaptive Inflation
Log GDP per capita	LGDP_pc	Log of provincial GDP per capita (*in Purchasing Power Parity at 2010 constant ¥*)
GDP growth rate	GDPg	Provincial and annual GDP growth rate
Unemployment rate	UR	Provincial and annual registered unemployment rate
Micro Control variable		
Personal level		
Age	age	Adults aged 18-60
gender	gender	1 = male; 0 = female
Current residence place	residence	1 = urban area. 0 = rural area.
Registered residence type	hukou	1 = non-agricultural hukou; 0 = agricultural hukou.
Highest educational degree	degree	5 categories of highest attained educational degree: Illiterate/Semi-literate Primary school Junior high school Senior high school At least college
Marital status	married	1 = Married (having a spouse) 0 = Never married, cohabitation, divorced or widowed
Retired	retired	1 = retired, 0 otherwise.
Employment status	employed	3 categories of employment statuses: Employed Unemployed Out of labor market
Self-rated relative income	pr-income	A 5-point scale of self-rated income rank from low to high
Self-rated health status	sr-health	A 5-point scale of self-rated health status: 1 = Excellent; 2 = Very good; 3 = Good; 4 = Fair; 5 = unhealthy
Self-rated health status compared to a year ago	sr-health-cp	A 3-point scale of self-rated health status compared to a year ago: 1 = Better; 2=No change; 3=Worse.
Exercise	exercise	1 = respondent did exercises last week. 0 = respondent did not do exercise last week.
Family level		
Family agriculture work	agricultural_f	1 = family engaged in agricultural production last year, 0 otherwise

Family size	familysize	Number of family members
Relative family income per capita	relative_Fincome	Fourths family income per capita quantile within the same rural or urban area in a province.
House ownership	ownership	1 = current-living property right solely owned by the family member, 0 otherwise.
Ownership of other houses	extra_house	1 = Own other houses elsewhere, 0 otherwise.
Log house price	lhousepricie	Log of current-living house price in the survey year
Housing debts	housedebts	Outstanding housing loans: 1 = yes, 0 = no
Bank debts	bankdebts	Other bank loans except for housing loans: 1 = yes, 0 = no
Other controls		
Geographical divisions	Geo-regions	25 provinces are divided to 6 geographical regions: North, Northeast, East, South-Central, Southwest, Northwast.
Survey waves	wave	5 waves from year 2010 to 2018

Table 2.2 Descriptive statistics of macroeconomic variables and SWB data by year

Variables	2010	2012	2014	2016	2018
Life satisfaction	3.4323	3.25704	3.7832	3.5379	3.9447
	(1.0425)	(1.0574)	(1.0047)	(1.0790)	(0.9694)
Happiness	N/A	2.7900	N/A	2.9172	2.8665
		(0.9989)		(0.9386)	(0.9164)
Current Inflation	3.1779	2.1792	1.1169	0.7978	1.8421
	(0.8590)	(0.5399)	(0.4415)	(0.3852)	(0.6186)
Adaptive Inflation	3.4504	2.6240	3.0423	1.0740	0.7208
	(1.0443)	(0.6459)	(0.4904)	(0.4939)	(0.3296)
Inflation Standard Deviation	3.6800	2.9544	1.8753	0.8354	0.5720
	(0.7265)	(0.8362)	(0.4042)	(0.2448)	(0.2931)
Above-adaptation episodes	6,431	2,630	0	5,951	17,030
Below-adaptation episodes	10,625	10,971	17,389	11,850	2,034
Log GDP per capita	10.2590	10.5024	10.6749	10.7414	10.9013
	(0.4658)	(0.4034)	(0.3880)	(0.3877)	(0.3967)
GDP growth rate	12.9993	10.6326	7.9416	6.7022	6.9201
	(1.4118)	(1.7205)	(1.4785)	(3.0628)	(1.0625)
Unemployment rate	3.6151	3.3009	3.2374	3.2444	3.1498
	(0.5302)	(0.4937)	(0.6347)	(0.6580)	(0.4812)
N	17,056	13,601	17,389	17,801	19,064

Note: Standard deviations are reported in parentheses. Adaptive inflation is measured by the 3-year backward-looking averages of RPI growth rates. Inflation Standard Deviation is measured by the inflation rates among the 3 years prior to the survey year.

Table 2.3 Descriptive statistics

Variables	Mean	Std. Dev.	Min	Max
Dependent variable				
Life Satisfaction	3.6115	(1.0565)	1	5
Happiness	2.8638	(0.9483)	1	4
Macroeconomic variables				
Current Inflation	1.8125	(1.0354)	-1.9	5.5
Log GDP per capita	10.6223	(0.4666)	9.4513	11.8262
GDP growth rate	8.9668	(3.0772)	-2.5	17.4
Unemployment rate	3.3087	(0.5892)	1.3	4.5
Personal level controls				
Age	42.8274	(10.9062)	18	60
Gender	0.4984	(0.5000)	0	1
Current residence place	0.4657	(0.4988)	0	1
Registered residence type	0.2664	(0.4421)	0	1
#Highest educational degree				
Illiterate/Semi-literate	21.43%		0	1
Primary school	21.25%		0	1
Junior high school	31.43%		0	1
Senior high school	15.29%		0	1
At least college	10.60%		0	1
Marital status	0.8765	(0.3290)	0	1
Retired	0.0238	(0.1524)	0	1
#Employment status				
Employed	80.88%		0	1
Unemployed	2.66%		0	1
Out of labor market	16.45%		0	1
Self-rated income				
#Self-rated health status				
Excellent	21.28%		0	1
Very good	22.33%		0	1
Good	31.18%		0	1
Fair	13.92%		0	1
Unhealthy	11.28%		0	1
#Self-rated health status compared to a year ago				
Better	10.94%		0	1
No change	60.82%		0	1
Worse	28.24%		0	1
Exercise	0.3643	(0.4812)	0	1
Family level controls				
Family agriculture work	0.5904	(0.4918)	0	1
Family size	4.3856	(1.8778)	1	26
#Relative family income per capita				
1	21.93%		0	1
2	25.05%		0	1
3	26.08%		0	1
4	26.94%		0	1
House ownership	0.9246	(0.2640)	0	1
Ownership of other houses	0.1819	(0.3857)	0	1
Log house price	2.7246	(1.2060)	0.1823	5.7071
Housing debts	0.1890	(0.3915)	0	1
Bank debts	0.0890	(0.2847)	0	1

Note: For categorical variables, I report the percentage of the population in each category.

Table 2.4 Correlation coefficients

	LS	π	π^A	π^U	LGDP_pc	GDPg	UR
LS	1						
π	-0.0659	1					
π^A	-0.0867	0.4664	1				
π^U	0.0356	0.3561	-0.6605	1			
LGDP_pc	0.0839	-0.3805	-0.5869	0.2970	1		
GDPg	-0.1223	0.6208	0.5773	-0.0829	-0.4925	1	
UR	-0.0136	0.0893	0.1051	-0.0352	-0.0490	0.1207	1

Note: Inflation is measured by RPI growth rates. Adaptive inflation π^A is measured by 3-year backword-looking moving averages of RPI growth rates. π^U refers to the unexpected inflation which is the difference between current inflation and adaptive inflation.

Table 2.5 Baseline Regressions: CFPS 2010-2018. Dependent variable: Life Satisfaction

Variables	Traditional SWB equation		Adaptive inflation baseline		
Backward-looking adaptive inflation			3-year MA	3-year MA	3-year MA
	(1)	(2)	(3)	(4)	(5)
Inflation	-0.0014	-0.0020			
	(0.0069)	(0.0071)			
Adaptive Inflation			0.0066	0.0058	0.0036
			(0.0091)	(0.0091)	(0.0109)
Unexpected inflation					-0.0026
					(0.0071)
Inflation STD					
Log GDP per capita		0.0559		0.0582	0.0570
		(0.0469)		(0.0468)	(0.0469)
GDP growth rate		0.0041		0.0039	0.00405
		(0.0026)		(0.0026)	(0.00261)
Unemployment rate		0.0243		0.0282*	0.0278*
		(0.0160)		(0.0160)	(0.0160)
Age	-0.1819***	-0.1829***	-0.1820***	-0.1830***	-0.1829***
	(0.0265)	(0.0266)	(0.0265)	(0.0266)	(0.0266)
Age^2	0.0038***	0.0038***	0.0038***	0.0038***	0.0038***
	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Gender	0.0135	0.0142	0.0135	0.0142	0.0142
	(0.1284)	(0.1284)	(0.1284)	(0.1284)	(0.1284)
Residence (urban=1)	0.0294	0.0274	0.0316	0.0298	0.0297
	(0.0224)	(0.0220)	(0.0222)	(0.0222)	(0.0222)
Hukou	0.0242	0.0240	0.0239	0.0237	0.0237
	(0.0279)	(0.0279)	(0.0280)	(0.0279)	(0.0280)
Highest educational degree (reference group: Illiterate/Semi-literate)					
#Primary school	0.0508	0.0499	0.0511	0.0502	0.0502
	(0.0336)	(0.0336)	(0.0336)	(0.0336)	(0.0336)
#Junior high school	0.0687	0.0671	0.0691	0.0675	0.0676
	(0.0440)	(0.0440)	(0.0440)	(0.0440)	(0.0440)
#Senior high school	0.0819	0.0804	0.0821	0.0805	0.0809
	(0.0615)	(0.0615)	(0.0615)	(0.0615)	(0.0615)
#At least college	0.0273	0.0272	0.0267	0.0265	0.0271
	(0.0769)	(0.0769)	(0.0768)	(0.0768)	(0.0769)
Married	0.1310***	0.1308***	0.1307***	0.1308***	0.1308***
	(0.0254)	(0.0254)	(0.0254)	(0.0254)	(0.0254)
Retired	0.0122	0.0139	0.0117	0.0134	0.0136
	(0.0257)	(0.0257)	(0.0257)	(0.0257)	(0.0257)
Employment status (reference group: employed)					
#Unemployed	-0.0441*	-0.0443*	-0.0442*	-0.0444*	-0.0442*
	(0.0268)	(0.0268)	(0.0268)	(0.0268)	(0.0268)
#Out of labor market	0.0252*	0.0257*	0.0246*	0.0251*	0.0252*
	-0.0441*	(0.0135)	(0.0135)	(0.0135)	(0.0135)
Self-rated income rank (reference group: lowest self-rated income rank=1)					
#2	0.1680***	0.1690***	0.1681***	0.1687***	0.1687***
	(0.0123)	(0.0123)	(0.0123)	(0.0123)	(0.0123)
#3	0.3930***	0.3934***	0.3931***	0.3935***	0.3935***
	(0.0122)	(0.0122)	(0.0122)	(0.0122)	(0.0122)
#4	0.5794***	0.5798***	0.5795***	0.5799***	0.5799***
	(0.0185)	(0.0185)	(0.0185)	(0.0185)	(0.0185)
#5	0.8246***	0.8244***	0.8252***	0.8250***	0.8249***
	(0.0235)	(0.0235)	(0.0235)	(0.0235)	(0.0235)
Self-rated health (reference group: Excellent)					

#Very good	-0.1050***	-0.1055***	-0.1050***	-0.1055***	-0.1055***
	(0.0126)	(0.0126)	(0.0126)	(0.0126)	(0.0126)
#Good	-0.2049***	-0.2049***	-0.2051***	-0.2051***	-0.2050***
	(0.0137)	(0.0137)	(0.0137)	(0.0137)	(0.0137)
#Fair	-0.2464***	-0.2467***	-0.2468***	-0.2471***	-0.2470***
	(0.0165)	(0.0165)	(0.0165)	(0.0165)	(0.0165)
#Unhealthy	-0.3299***	-0.3305***	-0.3298***	-0.3304***	-0.3304***
	(0.0198)	(0.0198)	(0.0198)	(0.0198)	(0.0198)
Self-rated health compared to a year ago (reference group: Better)					
#No change	-0.0565***	-0.0561***	-0.0564***	-0.0560***	-0.0560***
	(0.0136)	(0.0136)	(0.0136)	(0.0136)	(0.0136)
#Worse	-0.1017***	-0.1015***	-0.1016***	-0.1014***	-0.101***
	(0.0154)	(0.0154)	(0.0154)	(0.0154)	(0.0154)
Exercise	0.0439***	0.0437***	0.0440***	0.0438***	0.0438***
	(0.0095)	(0.0095)	(0.0095)	(0.0095)	(0.0095)
Family agricultural work	0.0297**	0.0293**	0.0296**	0.0293**	0.0292*
	(0.0149)	(0.0149)	(0.0149)	(0.0149)	(0.0149)
Family size	0.0026	0.0026	0.0026	0.0026	0.0026
	(0.0040)	(0.0040)	(0.0040)	(0.0040)	(0.0040)
Regional family income per capita quartile (reference group: first quartile)					
#2nd	0.0242**	0.0243**	0.0241**	0.0242**	0.0242**
	(0.0116)	(0.0116)	(0.0116)	(0.0116)	(0.0116)
#3rd	0.0289**	0.0292**	0.0287**	0.0291**	0.0291**
	(0.0123)	(0.0123)	(0.0123)	(0.0123)	(0.0123)
#4th	0.0402***	0.0405***	0.0399***	0.0403***	0.0403***
	(0.0137)	(0.0137)	(0.0137)	(0.0137)	(0.0137)
House ownership	0.0155	0.0158	0.0155	0.0157	0.0158
	(0.0184)	(0.0184)	(0.0184)	(0.0184)	(0.0184)
Own another house	0.0251**	0.0251**	0.0250**	0.0250**	0.0250**
	(0.0122)	(0.0122)	(0.0122)	(0.0122)	(0.0122)
Log house price	0.0394***	0.0383***	0.0393***	0.0382***	0.0382***
	(0.0063)	(0.0063)	(0.0063)	(0.0063)	(0.0063)
Whether have housing debts	-0.0360***	-0.0358***	-0.0361***	-0.0359***	-0.0360***
	(0.0114)	(0.0114)	(0.0114)	(0.0114)	(0.0114)
Bank debts	-0.0201	-0.0202	-0.0204	-0.0204	-0.0205
	(0.0152)	(0.0152)	(0.0152)	(0.0152)	(0.0152)
Regional and Wave FEs	Yes	Yes	Yes	Yes	Yes
Observations	84,911	84,911	84,911	84,911	84,911
R-squared	0.1436	0.1437	0.1436	0.1437	0.1437

*Note: * p<0.1, ** p<0.05, *** p<0.01. Individual clustered standard error in parentheses. Inflation, GDP growth and unemployment rates are in percent. GDP per capita is in Purchasing Power Parities at 2010 constant ¥. Adaptive inflation is measured by the 3-year backward-looking moving averages of annual RPI growth rates. Column (1) and (2) are estimates of traditional SWB equations which only include inflation as the main dependent variable. Column (3), (4) and (5) include adaptive inflation. Column (5) is the estimate of equation (2-1) which includes adaptive inflation, unexpected inflation, and macroeconomic control variables.*

Table 2.6 Inflation deviations and SWB: Fixed Effects OLS, CFPS 2010-2018, Dependent Variable: Life Satisfaction

Variables	Life Satisfaction
Adaptive Inflation	0.0189
	(0.0117)
Above-adaptation unexpected inflation (π_{jt}^{+})	-0.0310***
β_2	(0.0106)
Below-adaptation unexpected inflation (π_{jt}^{-})	0.0232**
β_3	(0.0101)
WALD test statistics	0.31
Prob.>WALD test statistics	0.5797
Fixed effects and controls	Yes
Observations	84,911
R-squared	0.1439

*Note: * p<0.1, ** p<0.05, *** p<0.01. Individual clustered standard error in parentheses. Inflation rates are in percentages. Adaptive inflation is measured by 3-year moving averages of annual inflation. The table shows the estimate of equation (2-4). The F_{WALD} statistic designates the null hypothesis that $\beta_2 + \beta_3 = 0$. Accepting this null hypothesis implies that SWB responds equally to inflation shifting away from the adaptive level, no matter above or below the adaptive level.*

Table 2.7 Inflation deviations and SWB: Robustness Checks, CFPS 2010-2018. Dependent variable: Life Satisfaction

Estimation Methods	OLS	OLS	Poisson
Measures of Adaptive Inflation	Previous year	7-year MA	3-year MA
	(1)	(2)	(3)
Adaptive Inflation	0.0013	-0.0041	0.0023
	(0.0079)	(0.0147)	(0.0057)
Above-adaptation unexpected inflation (π_{jt}^{+})	-0.0030	-0.0299**	-0.0112*
β_2	(0.0081)	(0.0118)	(0.0067)
Below-adaptation unexpected inflation (π_{jt}^{-})	-0.0048	0.0184*	0.0098*
β_3	(0.0113)	(0.0010)	(0.0063)
WALD test statistics	0.26	0.61	0.09
Prob.>WALD test statistics	0.6110	0.4339	0.7606
Fixed effects and controls	Yes	Yes	Yes
Observations	84,911	84,911	73,509
R-squared	0.1437	0.1438	

*Note: * p<0.1, ** p<0.05, *** p<0.01. Individual clustered standard error in parentheses. Inflation rates are in percent. All columns report estimates of equation (2-3). The adaptive inflation is measured by the previous year's inflation in column (1) and 7-year backward-looking moving averages of annual inflation in column (2). Both columns are estimates of fixed effects OLS regressions. Column (3) reports the estimate of fixed effects Poisson regression. The adaptive inflation in Column (3) is measured by a 3-year backward-looking moving averages of annual inflation rates. The WALD test statistics designate the same null hypothesis that $\beta_2 + \beta_3 = 0$. The test statistics in all columns suggest rejecting the null hypothesis.*

Table 2.8 Inflation deviations and SWB: Robustness Checks, Fixed effects Ordered Logit, Marginal effects CFPS 2010-2018. Dependent variable: Life satisfaction

Estimation Methods	Ordered Logit				
Life Satisfaction score from 1 to 5	1-Very Unsatisfied	2-Unsatisfied	3-Fair	4-Satisfied	5-Very Satisfied
	(1)	(2)	(3)	(4)	(5)
Adaptive Inflation	-0.0023	-0.0043	-0.0073	0.0038	0.0102
	0.0015	0.0028	0.0048	0.0025	0.0066
Above-adaptation unexpected inflation (π_{jt}^{+})	0.0021*	0.0039*	0.0066*	-0.0034*	-0.0092*
β_2	(0.0011)	(0.0021)	(0.0036)	(0.0019)	(0.0050)
Below-adaptation unexpected inflation (π_{jt}^{-})	-0.0027**	-0.0049**	-0.0083**	0.0043**	0.0116**
β_3	(0.0011)	(0.0020)	(0.0035)	(0.0018)	(0.0048)
Control variables			Yes		
WALD test statistics			0.15		
Prob.>WALD test statistics			0.7015		
Observations			62,172		
R-squared			0.1584		

*Note: * p<0.1, ** p<0.05, *** p<0.01. Individual clustered standard error in parentheses. Inflation rates are in percent. All columns report estimates of equation (2-3). All columns report marginal effects of fixed effects ordered logit estimates. All columns report marginal effects evaluated at sample means. The WALD test statistics designate the same null hypothesis that $\beta_2 + \beta_3 = 0$. The test statistics in all columns suggest rejecting the null hypothesis.*

Table 2.9 Inflation deviations and Happiness: Robustness Checks, CFPS 2012, 2016 and 2018. Dependent variable: Happiness

Estimation Methods	OLS	Ordered Logit			
Dependent Variables	Happiness scores	Less than 1 day	1-2 days	3-4 days	5-7 days
Measures of Adaptive Inflation	3-year MA	3-year MA	3-year MA	3-year MA	3-year MA
	(1)	(2)	(3)	(4)	(5)
Adaptive Inflation	0.0253	-0.0068	-0.0106	0.0016	0.0159
	(0.0228)	(0.0048)	(0.0075)	(0.0011)	(0.0112)
Above-adaptation unexpected inflation (π_{jt}^{+})	-0.0274**	0.0056**	0.0088**	-0.0013**	-0.0131**
β_2	(0.0136)	(0.0028)	(0.0044)	(0.0006)	(0.0066)
Below-adaptation unexpected inflation (π_{jt}^{-})	0.0183	-0.0044	-0.0070	0.0010	0.0104
β_3	(0.0215)	(0.0044)	(0.0070)	(0.0010)	(0.0104)
WALD test statistics	0.15		0.06		
Prob.>WALD test statistics	0.6977		0.8097		
Fixed effects and controls	Yes		Yes		
Observations	50,461		27,530		
R-squared	0.0340		0.0260		

*Note: * p<0.1, ** p<0.05, *** p<0.01. Individual clustered standard error in parentheses. Inflation rates are in percent. All columns report estimates of equation (2-3). The adaptive inflation in all columns is measured by 3-year backward-looking moving averages of annual inflation. Data only includes CFPS 2012, 2016 and 2018 due to the availability and consistency of happiness questions across waves. Column (1) reports the estimate of fixed effects OLS regressions. Column (2) to (5) report marginal effects of fixed effects ordered logit estimates. All marginal effects are evaluated at sample means. The WALD test statistics designate the same null hypothesis that $\beta_2 + \beta_3 = 0$. The test statistics in all columns suggest rejecting the null hypothesis.*

Table 2.10 The contribution of GDP growth rate to the association between unexpected inflation and SWB: Fixed Effects, CFPS 2010-2018.

Variables	Life Satisfaction
	(1)
Adaptive Inflation ($\phi_{0\pi}^{A}$)	0.0066
	(0.0904)
Adaptive Inflation * GDP growth rate ($\phi_{1\pi}^{A}$)	-0.0057
	(0.0165)
Adaptive Inflation * GDP growth rate^2 ($\phi_{2\pi}^{A}$)	0.0006
	(0.0008)
Above-adaptation episodes	
Unexpected inflation ($\phi_{0\pi}^{+}$)	0.2764***
	(0.0919)
Unexpected inflation * GDP growth rate ($\phi_{1\pi}^{+}$)	-0.0695***
	(0.0200)
Unexpected inflation * GDP growth rate^2 ($\phi_{2\pi}^{+}$)	0.0037***
	(0.0010)
Below-adaptation episodes	
Unexpected inflation ($\phi_{0\pi}^{-}$)	-0.1829***
	(0.0561)
Unexpected inflation * GDP growth rate ($\phi_{1\pi}^{-}$)	0.0365***
	(0.0129)
Unexpected inflation * GDP growth rate^2 ($\phi_{2\pi}^{-}$)	-0.0015**
	(0.0008)
GDP growth rate	0.0096*
	(0.0055)
GDP growth rate^2	-0.0014***
Fixed effects and controls	Yes
Observations	84,911
R-squared	0.1446

*Note: * p<0.1, ** p<0.05, *** p<0.01. Individual clustered standard error in parentheses. GDP growth rate^2 refers to the squared term of GDP growth rate. Unexpected inflation is the difference between the current inflation and the adaptive inflation. Inflation and GDP growth rates are in percent. This table reports estimates of equation (2-4). The adaptive inflation is measured by 3-year backward-looking moving averages of annual RPI growth rates.*

Table 2.11 Implications for China's inflation policies

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Panel A: Inflation statistics and policies according to the Annual Report on the work of the PRC Government											
Annual inflation rate	-0.73	3.18	5.55	2.62	2.60	1.92	1.44	2.00	1.59	2.07	2.90
Monetary policies	Relatively loose		Prudent monetary policy								
Wordings for Inflation policies	Prevent	Stabilize	Control	Maintain low and stable inflation							
Panel B: Inflation and GDP growth experienced by CFPS observations											
Inflation STD		3.5		2.9		1.6		0.7		0.4	
Adaptive inflation		3.8		2.9		3.6		2.0		1.5	
Unexpected inflation		-0.62		-0.28		-1.68		0		**+0.57**	
inflation episodes: Above/Below-adaptation		below		below		below		stable		**above**	
Average GDP growth rate		13.0		10.6		7.9		6.7		6.9	
Max provincial GDP growth		17.4		13.8		10.9		10.7		9.1	
Min provincial GDP growth		10.3		7.5		4.9		-2.5		3.6	

Note: All inflation and GDP growth rates are in percent and at national level. PRC refers to the People's Republic of China. The wordings for inflation policies are taken directly from the Annual Report on the work of the PRC Government. Adaptive inflation is the sample mean of the 3-year backward-looking moving averages of inflation in each wave of CFPS. Unexpected inflation refers to the difference between current annual inflation rate and adaptive inflation. Inflation STD is the 3-year backward-looking standard deviation of inflation. Max and Min provincial GDP growth rate are the highest and the lowest GDP growth rate experienced by CFPS observations in each wave. In 2018, inflation rose above the adaptive level for the first time since 2009.

Table 2.12 Definitions of inflation-related terms

This Table presents the definitions of inflation-related terms and synonyms.
Actual inflation: inflation rates given by national statistical office or departments. For instance, the growth rate of EU Harmonised Index of Consumer Prices (HICP) published by statistical office of the European Union. The growth rate of Consumer price index (CPI) and Retail price index (RPI) at national, provincial, and major city-level published by National Bureau of Statistics of China. Synonyms: CPI inflation, RPI inflation, HICP inflation, Official inflation data
Perceived inflation (Fluch and Stix, 2005; Ranyard et al., 2008): the subjective perception of the current and past price changes by the general public. This perception is influenced by several factors (general psychological phenomena and/or special circumstances, as in the case of the euro cash changeover), which makes it difficult to quantify it. Synonyms: inflation perception
Expected inflation (Fluch and Stix, 2005; Ranyard et al., 2008): estimates of price developments in a certain future period of time (e.g., the 12 upcoming months). Similar to perceived inflation, expected inflation cannot be measured directly; it has to be derived from various sources. Synonyms: inflation expectation
Inflation estimates (Arioli et al., 2017): inflation estimates refer to both inflation perception and inflation expectation as defined above. Synonyms: inflation evaluations

Appendix A2

A2.1 Results and Discussions of other control variables

Table 2.5 also reports the parameters associated with control variables from estimates of the baseline regression (equation (2-1)). Consistent with Blanchflower and Oswald (2004) and Chen *et al*. (2019), I find that SWB is U-shaped in age with lowest life satisfaction occurring in middle age. Consistent with Dolan *et al*. (2008), SWB is higher among respondents who are married, employed, healthier, and exercise frequently. Consistent with Clark *et al*. (2019), I find that the ownership of the house where respondents are currently living is not associated with SWB. This can be explained bearing in mind that over 90% of the families owns their house (see Table 2.3 Descriptive Statistics). Consistent with Zhang and Zhang (2019), people are found to report higher SWB when they own more than one house and when the price of their house of residence increases. Consistent with Turunen and Hiilamo (2014), SWB is found to be lower if the family holds housing debts. I do not find significant associations between education and SWB. According to (Dolan *et al*., 2008), the association between education and SWB is often found to be insignificant in fixed effects models, because most adult respondents are unlikely to improve their education level over the survey years.

A2.2 Further Evidence on Inflation Instability and SWB

A2.2.1 Extension 1: Inflation Standard Deviations and SWB

Extension 1 provides an alternative measure of inflation instability. In accordance with Wolfers (2003), the following equation includes the standard deviation of inflation as an indirect measure of inflation instability.

$$W_{ijt} = \alpha + [\beta_1 \pi^{A}_{j,t-k\ldots t} + \beta_2 \pi^{SD}_{j,t-k\ldots t}] + \gamma_1' M_{jt} + \gamma_2' Z_{it} + \varepsilon_{ijt} \quad \text{(A2-1)}$$

In equation (A2-1), $\pi^{A}_{jt,t-k}$ is the adaptive inflation measured by the average (urban or rural area) annual inflation from time $t-k$ to t, and $\pi^{SD}_{j,t-k\ldots t}$ refers to the inflation volatility measured by the standard deviation of the annual inflation rate from time $t-k$ to t. The rest components of equation (A2-1) are identical to equation (2-1). Following my main results in Section 2.7, I choose $k = 3$ to construct the main backward-looking measure. In robustness checks, I also look at the long-run inflation adaptation and at the corresponding impact of inflation volatility on SWB.

Extension 1: Main Results

In column (1) of Table A2.1, the standard deviation of inflation is significantly and negatively associated with SWB, which is consistent with Wolfers (2003), whose research is based on SWB data from the Eurobarometer. My results suggest that people who experienced high inflation volatility in the past years tend to report lower SWB. I also find that, like the hedonic neutral inflation level, the adaptive inflation is not associated with SWB. This finding contradicts Wolfers (2003) who finds that the higher

the backward-looking average inflation, the lower the SWB. The difference between my findings and theirs may result from the difference between the adaptation behaviours of Western and Chinese people. According to Norenzayan *et al*. (2002) and Arkes *et al*. (2010), compared to Westerners, Asians are more malleable and adapt more easily to reference points formed by prior experiences.

Extension 1: Robustness checks and discussions

To check the robustness to different measures of backward-looking adaptive inflation, I follow Wolfers (2003) and look at the long-run inflation volatility where $k = 7$ (see column (2) of Table A2.1). To check the robustness to different regression methods, column (3) of Table A2.1 and Table A2.2 report the estimates of equation (A2-1) based on fixed effects Poisson and fixed effects ordered logit specifications. In general, both Table A2.1 and Table A2.2 show that the adaptive inflation is not associated with SWB, and that the higher the inflation standard deviation, the lower the SWB. Specifically, Table A2.2 reports the marginal effects from the ordered logit estimation. It shows that the larger the inflation standard deviation, the smaller the probabilities for the respondents to report "satisfied" or "very satisfied" with their lives. These results are therefore robust to using different estimation methods. Compared to my main results in Section 2.7.2 which use the deviations of inflation from the adaptive inflation as the measure of inflation instability, the standard deviation of inflation contains additional information about people's past experiences of inflation volatility. Therefore, in line with my previous findings, these results imply that, instead of the current inflation or

the average inflation level, inflation instability is more of a concern to respondents.

A2.2.2 Extension 2: Absolute inflation deviation and the nonlinear SWB function

Extension 2: Main Results

My main results in Section 2.7.2 (also see Table 2.6) show that people are equally averse to inflation deviations in both above-adaptation and below-adaptation scenarios. To further investigate the nonlinearity of the SWB function relative to the adaptive inflation, I include the absolute unexpected inflation and the quadratic term of the unexpected inflation in my model. The adaptive inflation is included as a control variable.[29] This leads to the following equation:

$$W_{ijt} = \alpha + [\beta_1 \pi_{jt}^A + \beta_2 |\pi_{jt}^U| + \beta_3 (\pi_{jt}^U)^2] + \gamma_1' M_{jt} + \gamma_2' Z_{it} + \varepsilon_{ijt} \quad \text{(A2-2)}$$

In equation (A2-2), notations are identical to equation (2-1) and (2-2). $|\pi_{jt}^U|$ reflects the distance between π_{jt} and π_{jt}^A. β_3 directly captures the nonlinear association between unexpected inflation and SWB. The adaptive inflation is measured by the 3-year backward-looking average inflation rate.

Column (1) of Table A2.3 reports the estimates of equation (A2-2). I find that the unexpected inflation squared is significantly and negatively associated with SWB, while the absolute unexpected inflation is not associated with SWB. According to the results in column (2), Figure A2.1 plots an inverse U-shaped (concave) SWB function relative to the adaptive inflation baseline. Firstly, consistent with my main results from

[29] Wolfers (2003) includes the squared term of inflation without considering the adaptive inflation as the reference rate. His results do not show any clear nonlinear association between inflation and SWB.

Section 2.7.2 (also see Table 2.6), the greater the deviations of current inflation from the adaptive level, the lower the SWB. Secondly, I also find a rising marginal sensitivity of SWB to greater inflation deviations from the adaptive level (rising levels of inflation instability). My results can be explained following Vendrik *et al*. (2007), who argue that life satisfaction is concave in relative income losses—the larger the loss, the greater the marginal decrease in SWB.[30] More intuitively, experiencing a current level of inflation that moves increasingly away from the adaptive reference level, people may suffer from rising marginal costs of well-being due to the increasingly risky economic environment.

Extension 2: Robustness checks and discussions

To check the robustness to different measures of the adaptive inflation, columns (2) and (3) of Table A2.3 report the estimates of equation (A2-2) based on short-run and long-run measures of adaptive inflation. I find that, in column (2), the parameters associated with unexpected inflation are all insignificant when the adaptive inflation is measured by the previous year's inflation. When the adaptive inflation is measure by the 7-year backward-looking moving averages of inflation, the inflation squared is significantly and negatively associated with SWB. Therefore, consistent with the result reported in column (1) of Table A2.3, I still find an inverse U-shaped SWB function relative to the adaptive inflation baseline. Also, consistent with my main result and the robustness checks in Section 2.7.2, people's inflation evaluations are more likely to follow the

[30] According to Vendrik *et al*. (2007), a relative income loss means a decline in income compared to the person's social reference group.

long-term measures of reference inflation rather than the short-term measure. I also check the robustness to different regression methods. Column (4) of Table A2.3 and Table A2.4 show that the above-mentioned results are robust to using fixed effects Poisson and fixed effects ordered logit estimators. Table A2.4 reports the marginal effects from the estimates of fixed effects ordered logit regressions. It shows that the higher the unexpected inflation squared, the lower the probability for people to report better life satisfaction.

Wolfers (2003) assumes that the higher the inflation the lower the SWB, with the marginal changes in SWB diminishing to zero as the inflation increases. The author includes the squared of inflation in his SWB function but does not find a clear nonlinear inflation-SWB association using individual-level SWB data. I provide a new perspective to better explain the nonlinearity of SWB in inflation movements by introducing the adaptive inflation. The intrinsic difference between my study and Wolfers' (2003) is the treatment of inflation movements. In this study, inflation movements are regarded as relative terms depending on the reference level. Therefore, instead of focusing on inflation *per se*, I shift my attention to the distance between the current inflation and the adaptive inflation. Regarding the inverse U-shaped SWB function I find (Figure A2.1), my results also provide a very intuitive implication to people's evaluations of inflation instability—the higher the inflation instability, the greater the degree of aversion against inflation instability.

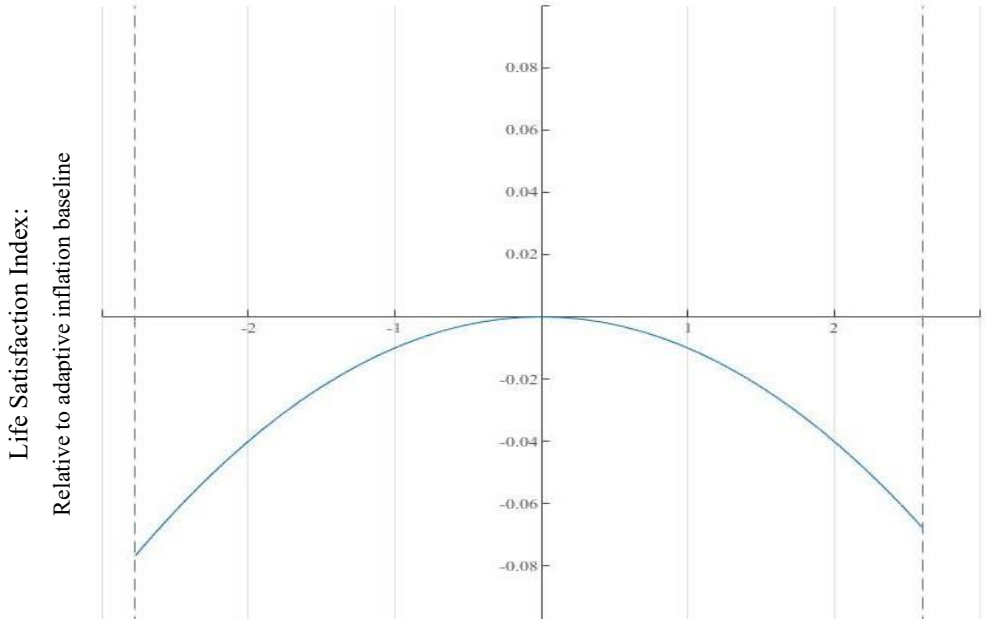
Figure A2.1 is also suggestive of the studies looking at the negative impacts of

economic crises on SWB. Compared to non-crisis periods, Welsch and Kühling (2016) and Gonza and Burger (2017) find that the negative impact of inflation on individual SWB significantly amplifies during the 2008-09 economic crisis. Figure A2.1 implies that the negative impact of unstable inflation rates on SWB amplifies when people experience drastic inflation fluctuations which are commonly observed during economic crises.[31]

[31] The annual inflation rate in China increased from 4.8% in 2007 to 5.9 in 2008. It then decreased to -0.7 in 2009. Similar patterns are also observed in the UK and the US from 2007 to 2009. For example, the annual inflation rates in the US from 2007 to 2009 were 2.9%, 3.8%, -0.4%.

Figures and Tables in Appendix A2

Figure A 2.1 Nonlinear SWB function relative to the adaptive inflation baseline



Notes: The graph plots the nonlinear SWB function subject to inflation deviations relative to the adaptive inflation baseline according to the estimated parameters reported in Table A2.3 Column (1). The graph corresponds to the estimated equation (A2-2) with adaptive inflation measured by 3-year backward-looking moving averages of annual inflation. The vertical dashed lines in both graphs are the lower-bound (-2.77%) and upper-bound (2.6%) of the unexpected inflation experienced by the respondents.

Table A 2.1 Extension 1: Main Results and Robustness Checks: CFPS 2010-2018. Dependent variable: Life Satisfaction

	Main result	Robustness Checks	
Fixed Effects Estimation Method	Fixed Effects OLS	Fixed Effects OLS	Fixed Effects Poisson
Measures of adaptive inflation	3-year MA	7-year MA	3-year MA
	(1)	(2)	(3)
Adaptive Inflation	0.0052	0.0073	0.0025
	(0.0091)	(0.0137)	(0.0056)
Inflation STD ($\pi^{SD}_{j,t-k\ldots t}$)	-0.0217**	-0.0378**	-0.0112*
	(0.0096)	(0.0173)	(0.0060)
Fixed effects and control variables	yes	Yes	Yes
Observations	84,911	84,911	73,509
R-squared	0.1438	0.1438	

*Note: * p<0.1, ** p<0.05, *** p<0.01. Individual clustered standard errors in parentheses. Inflation rates are in percent. All columns are estimates of equation (A2-1).*
Column (1) reports the estimate of main result based on the fixed effects OLS regression.
Column (2) checks the robustness to a long-run measure of adaptive inflation.
Column (3) checks the robustness to fixed effects Poisson regression. 11,402 observations were dropped because of only one observation per group.

Table A 2.2 Extension 1: Robustness Checks, Fixed effects Ordered Logit, Marginal effects CFPS 2010-2018

Estimation Methods	Ordered Logit				
Life Satisfaction score from 1 to 5	1-Very Unsatisfied	2-Unsatisfied	3-Fair	4-Satisfied	5-Very Satisfied
	(1)	(2)	(3)	(4)	(5)
Adaptive Inflation	-0.0007	-0.0013	-0.0023	0.0012	0.0031
	(0.0005)	(0.0010)	(0.0016)	(0.0008)	(0.0023)
Inflation STD ($\pi_{j,t-k\ldots t}^{SD}$)	0.0020**	0.0037**	0.0063**	-0.0032**	-0.0088**
	(0.0010)	(0.0018)	(0.0031)	(0.0016)	(0.0043)
Fixed effects and control variables			Yes		
Observations			62,172		
R-squared			0.1584		

*Note: * p<0.1, ** p<0.05, *** p<0.01. Individual clustered standard errors in parentheses. Inflation rates are in percent. All columns report marginal effects of fixed effects ordered logit estimates based on equation (A2-1). All columns report marginal effects evaluated at sample means. The adaptive inflation in all columns is measured by 3-year backward-looking moving averages of annual inflation rates.*

Table A 2.3 Extension 2: Main Results and Robustness Checks: CFPS 2010-2018. Dependent variable: Life Satisfaction

	Main result	Robustness Checks		
Estimation method	OLS	OLS	OLS	Poisson
Measures of adaptive inflation	3-year MA	Previous year	7-year MA	3-year MA
	(1)	(2)	(3)	(4)
Adaptive Inflation	0.0159	0.0017	0.0133	0.0063
	(0.0103)	(0.0060)	(0.0142)	(0.0072)
Absolute Unexpected Inflation ($\lvert\pi_{jt}^{U}\rvert$)	-0.0212	0.0138	-0.0053	-0.0013
	(0.0142)	(0.0131)	(0.0105)	(0.0043)
Unexpected Inflation squared $\left(\pi_{jt}^{U}\right)^{2}$	-0.0117***	-0.0023	-0.0084**	-0.0041**
	(0.0034)	(0.0020)	(0.0036)	(0.0017)
Fixed effects and controls	Yes	Yes	Yes	Yes
Provinces	25	25	25	25
Observations	84,911	84,911	84,911	73,509
R-squared	0.1438	0.1436	0.1438	

*Note: * p<0.1, ** p<0.05, *** p<0.01. Individual clustered standard errors in parentheses. Inflation rates are in percent. All columns are estimates of equation (A2-2).*
Column (1): Main result estimated based on the fixed effects OLS regression. The adaptive inflation is measured by 3-year backward-looking moving averages of annual inflation rates.
Column (2): Robustness check to the short-run measure of adaptive inflation (previous year's inflation).
Column (3): Robustness check to the long-run measure of adaptive inflation (7-year backward-looking moving averages of annual inflation rates inflation).
Column (4) reports the estimate based on the fixed effects Poisson regression. To compare with the main result in Column (1), the adaptive inflation is measured by 3-year backward-looking moving averages of annual inflation rates. 11,402 observations are dropped because of only one observation per group.

Table A 2.4 Extension 2: Robustness Checks, Fixed effects Ordered Logit, Marginal effects CFPS 2010-2018

Estimation Methods	Ordered Logit				
Life Satisfaction score from 1 to 5	1-Very Unsatisfied	2-Unsatisfied	3-Fair	4-Satisfied	5-Very Satisfied
	(1)	(2)	(3)	(4)	(5)
Adaptive Inflation	-0.0010	-0.0017	-0.0030	0.0015	0.0041
	(0.0006)	(0.0011)	(0.0019)	(0.0010)	(0.0026)
Absolute Unexpected Inflation ($\lvert\pi_{jt}^{U}\rvert$)	0.0008	0.0014	0.0024	-0.0012	-0.0033
	(0.0009)	(0.0016)	(0.0028)	(0.0015)	(0.0039)
Unexpected Inflation squared $\left(\pi_{jt}^{U}\right)^2$	0.0007*	0.0012*	0.0021*	-0.0011*	-0.0029*
	(0.0004)	(0.0007)	(0.0011)	(0.0006)	(0.0016)
Fixed effects and controls	Yes	Yes	Yes	Yes	Yes
Observations	62,172	62,172	62,172	62,172	62,172
R-squared	0.1589	0.1589	0.1589	0.1589	0.1589

*Note: * p<0.1, ** p<0.05, *** p<0.01. Individual clustered standard errors in parentheses. Inflation rates are in percent. All columns report marginal effects of fixed effects ordered logit estimates based on equation (A2-2). All columns report marginal effects evaluated at sample means. The adaptive inflation in all columns is measured by 3-year backward-looking moving averages of annual inflation rates.*

Chapter 3. Can Inflation Enhance Subjective Well-being?

3.1. Introduction

Rising inflation has been found to worsen peoples' subjective well-being (SWB) as it is generally associated with lower real wages and worse living standards (Di Tella *et al*., 2001, 2003; Frey and Stutzer, 2002; Welsch, 2007; Dolan *et al*., 2008; Blanchflower *et al*., 2014; Welsch and Kühling, 2016). Keeping inflation under control is therefore one of the major macroeconomic policy targets worldwide aiming at improving citizens' wellbeing.

Traditionally research linking inflation and SWB makes use of the official aggregate inflation rate, which is the average inflation rate of various categories of commodities based on the consumption basket of a representative household.[32] This paper is the first to analyse the impact of commodity-specific inflation rates on SWB accounting for the heterogeneity of household consumption patterns.

When looking at the association between inflation and SWB, it is particularly important to distinguish different categories of commodities for the following reasons. First, the SWB evaluations of inflation may be heterogeneous across commodities. For example, utilities are an essential part of life and higher bills are a source of concern for households as they are associated with higher living costs. By contrast, rising costs of upmarket dinners at restaurants may benefit SWB as they may be associated with

[32] Details about the making of Chinese aggregate inflation rates can be accessed at this site: http://www.stats.gov.cn/xxgk/tjbzhzd/gjtjdczd/201501/t20150106_1759048.html

experiential enjoyments of better taste, improved restaurant services, and enhanced social connectedness. Second, the inflation rates of different commodities may not be identically evaluated by all households because their consumption baskets are heterogeneous (Brachinger, 2008). Households are likely to put a larger weight on the price changes of those commodities that represent significant shares of their household's total expenditure

In order to investigate the impact of commodity-specific inflation rates on individual SWB, accounting for the heterogeneity of household consumption patterns, I create a unique dataset by matching data from the 2010- 2018 waves of the China Family Panel Studies (CFPS) with consumer price indices (CPI) inflation rates of different categories of commodities data taken from the National Bureau of Statistics of China (NBSC).

China provides an ideal setting to investigate this issue. First, as shown by the official inflation statistics from the NBSC, there were large variations in aggregate and commodity-specific inflation rates over the 2010-2018 period. The national annual aggregate CPI inflation rate decreased in fact from over 5% in 2011 to around 2% over the period 2012-2018. There were also several episodes in which the inflation rates of some commodities significantly deviated from the aggregate inflation rate. For example, in 2011, the food inflation rate was almost twice the aggregate inflation rate. Yet, there was an episode of food deflation in 2017, while the inflation rates of other categories of commodities were all positive. Additionally, the inflation rates of the same categories of commodities vary significantly across Chinese provinces. For example, in 2014,

there was deflation for utilities in Hebei, Shanxi, Heilongjiang, Henan, Shaanxi, and Gansu provinces, but not in other provinces. Second, according to the NBSC Consumer Price Indices Technical Manual, the weights of commodities in the representative household's consumption basket are adjusted every 5 years.[33] As a result, the aggregate inflation rate does not account for any changes of household consumption patterns between two adjustment periods. Third, Chinese people have been experiencing rapid modernization of consumption patterns in the past decade (Zipser, *et al*., 2016).

My results suggest that the inflation rates of food and entertainment are positively associated with SWB. By contrast, the inflation rates of utilities, rent, and communication are negatively associated with SWB. Furthermore, I find non-linear associations between the inflation rates and SWB after considering the expenditure share of each category of commodities. Specifically, the negative (positive) impact of the inflation rates of utilities and rent (clothing and entertainment) increases as the expenditure shares of these commodities increase. These findings imply that, on the one hand, the consumption upgrading towards high-quality advanced-need commodities (food, clothing, and entertainment) drives the positive impact of inflation on SWB. On the other hand, the inflation of basic-need commodities (utilities and rent) reflects the rising living costs and depresses SWB. I conclude that inflation policies aiming at improving people's well-being should not focus on the aggregate inflation rates which ignore the heterogeneity of commodities and household expenditure patterns.

[33] Adjustments of the weights of commodities happened in 2016 and 2021.

The remainder of this paper is structured as follows. Section 3.2 provides some economic background and highlights my specific contributions. Section 3.3 describes my data. Section 3.4 presents my econometric models and estimation methods. Section 3.5 presents some descriptive statistics. Section 3.6 describes my main results. Section 3.7 focusses on the association between food-away-from home and SWB, whilst Section 3.8 concludes and discusses some policy implications.

3.2. Economic background and contributions

A number of authors have studied how inflation relates to people's SWB. They generally find that rising inflation worsens people's SWB as it is associated with lower wages and worse living standards (Di Tella *et al*., 2001, 2003; Wolfers, 2003; Alesina et al., 2004; Frey and Stutzer, 2002; Welsch, 2007; Blanchflower *et al*., 2014; Welsch and Kühling, 2016). One drawback of this literature is that it has mainly focused on aggregate inflation rates. Yet, because SWB is reported at the individual-level and households have different consumption patterns, rather than focusing on aggregate inflation, it is preferable to focus on commodity-specific inflation at the household level. I hereafter discuss more in depth the rationale for focusing on this type of inflation rates. I then explain the importance of looking at heterogeneous household expenditure shares.

3.2.1. Importance of considering commodity-specific inflation

A recent report by the NBSC issued for the Fourth Session of the 13th National People's Congress Standing Committee lists some examples that intuitively explain the inconsistency between the aggregate inflation and the commodity-specific inflation

perceived by households (NBSC, 2021). According to this report, the heterogeneity in inflation rates at the household level can result from the characteristics of commodities. Considering the inflation of different categories of goods and services, households are likely to focus more on the price changes that matter the most to their living standards and household members' well-being.

From the well-being viewpoint, a strand of studies suggest that commodities play heterogeneous roles in a household consumption basket in terms of the extent to which they improve people's well-being (Van Boven and Gilovich, 2003; Howell and Hill, 2009; Heffetz, 2011; Zimmermann, 2014; Wang *et al*., 2019). For example, Van Boven and Gilovich (2003) argue that dining out at restaurants and watching movies bring greater well-being gains than purchasing housing products and paying for utilities because the former behaviours are related to acquiring pleasant life experiences rather than purely material goods. Similarly, according to DeLeire and Kalil (2010), Noll and Weick (2015), and Wang *et al*. (2019), the consumption of clothes, leisure, and entertainment significantly improves SWB because they fulfil people's advanced needs such as social status and connectedness. The SWB evaluations of inflation may also be heterogeneous across commodities for similar reasons. The inflation rates for utilities (water, gas, electricity) may concern households as a signal of high cost of living. However, inflation in the price of entertainment goods and services may not concern households much as these are not essential.

In light of these considerations, my first aim in this paper is to investigate the association between the inflation rates of different categories of commodities and SWB.

To the best of my knowledge, only Chen *et al*. (2014) has linked individual SWB data and the inflation rates of different categories of commodities. However, they only use cross-sectional data and, as a result, their analysis does not account for unobserved heterogeneity. More importantly, they do not consider the heterogeneity of household consumption patterns. Yet, these patterns play a key role in explaining the heterogeneity in individual perceptions of inflation rates. I hereafter explain why this is the case and how I take this into account.

3.2.2. Accounting for expenditure shares

From the consumer's perspective, the consumption choice of a certain category of goods during a given period is very subjective (Brachinger, 2008). Therefore, the aggregate price level experienced at the household level will be a function of the household's expenditure shares on various categories of commodities (D'Acunto, Malmendier and Weber, 2021). Specifically, the higher the share of a certain category of goods or services out of the total household's expenditure, the more likely the household will be to notice its inflation. For instance, households that spend a large fraction of their total expenditure on utilities will be strongly affected by utilities' inflation due to the rising cost of living (NBSC, 2021). As a result, the response of people's subjective well-being to inflation is also likely be heterogeneous because people focus on diverse components of inflation according to their own consumption patterns. I therefore investigate how the association between commodity-specific inflation rates and SWB varies across different household expenditure shares of the corresponding commodities. To the best of my knowledge, I am the first to investigate

the impact of commodity-specific inflation rates on individual subjective well-being (SWB), accounting for the heterogeneity of household consumption patterns.

3.2.3. Analysing the association between a household-specific aggregate inflation rate and SWB

I next construct a household-specific aggregate inflation rate, which takes into account the households' expenditure shares. I advance on previous SWB studies which relied on official aggregate inflation statistics failing to account for household expenditure patterns (e.g., Di Tella *et al*., 2003; Welsch and Kühling, 2016), by investigating, for the first time, the association between a household-specific aggregate inflation rate and SWB. I then compare how the association between my household-specific aggregate inflation rate and SWB differs from that between the official aggregate inflation rate provided by the NBSC and SWB. As inflation policies mainly focus on the changes in the general price level indicated by the aggregate inflation rates[34], this analysis could highlight the need to take into account the heterogeneity of commodities and household expenditure patterns.

3.3. Data

To analyse the association between commodity-specific inflation rates and SWB, I create a unique dataset by matching data from the 2010- 2018 waves of the China Panel

[34] More details can be found in the regular meeting minutes of the Monetary Policy Committee of the People's Bank of China. For example, contents of the 97th regular meeting of the Monetary Policy Committee of the People's Bank of China can be accessed at this site: http://www.pbc.gov.cn/zhengcehuobisi/125207/3870933/3870936/4590478/index.html

Family Studies (CFPS) with commodity-specific inflation data taken from the NBSC. Hereafter, I first present the CFPS. Next, I describe the commodity-specific inflation rates. I then discuss my matching algorithm before presenting a full set of descriptive statistics.

3.3.1. The China Family Panel Studies

The dataset

I use five waves of the CFPS over the period 2010 to 2018. The CFPS is a nationally representative longitudinal survey conducted every two years by Peking University. The baseline survey in 2010 includes over 13,000 households and 33,000 adults in 25 out of 31 Chinese provinces (including 4 municipalities: Beijing, Tianjin, Shanghai, and Chongqing).[35] I focus on adults aged over 18, which cover about 98% of the total sample in the 2010 baseline. After dropping the respondents with missing values for SWB, household expenditure and/or other variables included in my model, the sample used to estimate my baseline equation consists of 130,307 respondent-year observations. To avoid the potential estimation bias caused by singular values, all continuous variables are winsorised at the 1% and 99% levels.

Measures of SWB

My main focus is SWB. I initially measure SWB through "Life Satisfaction" which is a popular evaluative measure of SWB (Dolan *et al*., 2011; OECD, 2013). Each wave of the CFPS includes the question: "Are you satisfied with your life?" Respondents rank

[35] For a detailed description of the CFPS, see Xie and Hu (2014), Xie *et al*. (2014) and the CFPS website http://www.isss.edu.cn/cfps/EN/About/

their life satisfaction on a 5-point scale from "Not at all satisfied" to "completely satisfied". Therefore, a higher value means better life satisfaction.

I also verify whether my results are robust to using three alternative measures of SWB. First, following Li (2021), I consider happiness and social life satisfaction. Questions on these two alternative measures of SWB are available in the 2010, 2014, and 2018 waves of the CFPS. The 2010 wave of the survey reports respondents' evaluations on these two measures from low to high on a 5-point scale, but a 0-10 scale is used in the 2014 and 2018 waves. To ensure the consistency of measures across waves, I map the 0-10 based answers in the later waves into 5 groups. Next, according to Diener *et al*. (2017), people's positive expectations about the future (i.e, "optimism") can also be used as an alternative form of SWB. I therefore adopt the question that asks respondents to rank their "confidence in future life" on a five-point scale as a third measure of SWB. This "optimism" measure is available and consistent in all five waves of the CFPS. Details about all the above-mentioned SWB measures are provided in Appendix A3.1.

3.3.2. Commodity-specific inflation rates

The official aggregate inflation is constructed based on a representative household consumption basket and the average prices of various goods and services within the basket. Household expenditure surveys are conducted by the NBSC every 5 years to infer the representative household's expenditure pattern. However, the weights of commodities in the representative household's consumption basket are not published by the NBSC. In addition to the regularly published NBSC official aggregate inflation

rates, a series of commodity-specific CPI inflation rates are also provided by the NBSC and the provincial-level Bureaux of Statistics. Following the Classifications of Household Consumption Expenditure (NBSC, 2013), the commodity-specific inflation rates are classified into three tiers. Tier-1 covers the inflation rates of 8 major categories of goods and services, including food, housing, household necessities, transport & communication, clothing, education & entertainment, health care, and other miscellaneous goods and services. Tier-2 includes inflation rates of the subclassifications of commodities belonging to each major category (e.g., the second-tier food inflation rates include the inflation rates of meat, vegetables, food-away-from-home, and so on). Appendix A3 Table A1 shows the descriptions of the commodities covered by tier-1 and tier-2 inflation rates. Tier-3 includes the item-level inflation rates, which report the inflation rates of different bundles of items below each tier-2 subclassification (e.g., inflation rates of a bundle of meat products).[36]

All inflation rates used in the main analyses are annual growth rates of the Consumer Price Indices (CPI) collected from the NBSC website and provincial Statistics Yearbooks for the rural and urban areas of each province. [37] Hereafter, I discuss how I matched the tier-1 and tier-2 inflation rates with the household expenditure data according to the definitions of commodity categories given by the

[36] See Appendix A3.2 for more details about the three-tier NBSC inflation rates. The full description of the classifications of the commodities is provided by the National Bureau of Statistics of China and is available online at the site: http://www.stats.gov.cn/tjsj/tjbz/201310/P020131021349384303616.pdf

[37] The NBSC database can be accessed at: https://data.stats.gov.cn/index.htm. The provincial Statistics Yearbooks are available from the official websites of the provincial Bureaux of Statistics.

NBSC and the household expenditure questionnaire given by the CFPS.

3.3.3. Matching algorithm

The CFPS contains a series of questions asking about household expenditures on different categories of goods and services. I consider both the tier-1 and tier-2 inflation rates and apply the following criteria to match inflation rates with the CFPS household expenditure data.[38] For simplicity, I hereafter name the commodity categories covered by the NBSC commodity-specific inflation rates *NBSC categories*. Similarly, the commodity categories given by the CFPS household expenditure questions are named *CFPS categories*.

Criterion 1. The *CFPS categories* are consistent and comparable across the available CFPS survey waves.

Criterion 2. The commodities contained in a *CFPS category* are included as major component in the matched *NBSC category*.

According to the CFPS Instructions of Household Expenditure Variables (CFPS, 2018), the 20-question-based household expenditure variables in the 2010 wave were too general to reflect a detailed picture of household expenditure patterns. The household expenditure questionnaires in the 2012 wave therefore used a 30-question-based version. However, these 30 questions were too detailed and fragmented, and the

[38] The third-tier inflation rates are not used in matching because the NBSC and local Bureaux of Statistics only publish a few third-tier inflation rates every year. Also, the third-tier inflation rates only cover a small bundle of items (e.g., meat, vegetables, hats, shoes, etc.), whilst the commodities covered in each household expenditure question are much broader.

respondents could not recall the expenditures correctly.[39] Therefore, in the 2014 wave, the CFPS merged some household expenditure questions into more general ones. This led to the 26-question-based household expenditure variables, which were subsequently used in the 2016 and 2018 waves as well.[40]

For Criterion 1 to hold, I drop the 2010 wave of the CFPS as the 20-question-based household expenditure variables available in that wave are not comparable with those included in the other 4 waves. Also, two questions related to the expenditure on 'vehicle purchase and maintenance', and 'housing maintenance' are dropped because they are not included in the 2012 wave. For criterion 2 to hold, the following ten household expenditure variables are not matched with any commodity-specific inflation rates. First, 'property management' from the *CFPS categories* is not matched because it only represents a minor fraction of 'house maintenance, repairing and management' from the NBSC categories. Second, 'transport and communication tools excluding car-related purchase' from the *CFPS categories* is not matched because the NBSC categories provide separate inflation rates for transport and communication. Third, 'household durables' from the *CFPS categories* contains computers and musical instruments, which are defined as 'culture and entertainment durables' according to the *NBSC categories*. Also, 'cosmetic products and services' from the *CFPS categories* is not matched because cosmetic products are included in 'personal care products' while

[39] For example, the CFPS used four questions asking family weekly food expenditures in 2012 (e.g., food-at-home, and cigarettes and beverages.). From 2014 onwards, the survey only included two questions about family monthly expenditures on food-at-home and food-away-from-home in 2014.

[40] More details about the development of the CFPS household expenditure questionnaire can be found at this site: https://www.isss.pku.edu.cn/cfps/cjwt/cfpsxkt/1295284.htm

cosmetic services are defined as 'other services' according to the *NBSC categories*. Fourth, five additional *CFPS categories* are not matched because they are all defined as 'other miscellaneous goods and services' according to the *NBSC categories*.[41]

As a result, 14 *CFPS categories* are successfully matched with the inflation rates of 9 *NBSC categories* (food, utilities, rent, communication, transportation, clothing, education, entertainment, healthcare). Details about the matching results are shown in Table 3.1. All expenditure data are divided by household size, yielding per capita expenditure data.[42] All per capita expenditure data are expressed in logarithms in my equations.

3.4. Econometric models and estimation methods

3.4.1. Econometric models

Baseline analysis for the association between the commodity-specific inflation rates and SWB

To investigate the association between commodity-specific inflation and SWB, follow Di Tella *et al*. (2001, 2003) and Chen *et al*., (2014) and estimate the following model:

$$SWB_{ijt} = \beta\pi_{jt}^{c} + \gamma' M_{jt} + \theta' Z_{it} + \varepsilon_{ijt} \quad (3\text{-}1)$$

[41] The five unmatched categories are 'commercial insurance', 'financial assistance to relatives', 'financial assistance to other people', 'charitable donations', and 'other expenditures'.

[42] The household food expenditure question asks about weekly food expenditure in the 2012 wave and monthly food expenditure in the 2014 wave. The household entertainment expenditure data is monthly in the 2012 wave. Household expenditures on water, electricity, fuel, house rent, daily necessities, regular communication, regular local transportation are monthly in the 2012, 2014, 2016, and 2018 waves of the CFPS. To maintain a consistent series of household expenditures variables across the five waves of the CFPS, I convert all weekly and monthly expenditure data into annual data.

SWB_{ijt} is the subjective wellbeing of respondent i living in province j in year t. $\pi_{j,t}^{c}$ is the annual inflation rate of a commodity category c experienced by respondent i living in province j in year t. M_{jt} is a vector of macroeconomic control variables, which includes GDP per capita and the GDP growth rate in province j in year t. Z_{it} is a set of demographic characteristics. First, following Di Tella *et al*. (2003) and Welsch (2007), I include several provincial macroeconomic control variables collected from the NBSC, including GDP per capita and GDP growth rate. I do not include unemployment rates because the official unemployment rate is not representative of the true regional labour market situation. According to the National Bureau of Statistics of China, the unemployment rate only records the proportion of people who have reported and registered their unemployment status to the local government. [43] Second, following Di Tella *et al*. (2003), Dolan *et al*. (2008) and Knight *et al*. (2009), I include a consistent set of individual- and household-level control variables in all my models. These are the respondent's age, age squared, gender, residency status, marital status, household size, education, employment status, health status, individual relative income, household size, household relative income, household assets and household debt. Definitions of all control variables are included in Appendix A3 Table A2. The rationale for including the above-mentioned control variables is discussed in Appendix A3.3.

The error term ε_{ijt} in Equation (3-1) includes four components, that is, $\varepsilon_{ijt} = \mu_j + \eta_t + \xi_i + \upsilon_{ijt}$ where μ_j encompasses unobservable region-specific effects, η_t denotes

[43] The problem about unemployment rate data in China is also reported by Chen *et al*. (2014). The surveyed unemployment rate published by the National Bureau of Statistics of China starting from 2018 would be a better index to use in future studies.

time-specific effects, and ξ_i is an individual-specific effect. υ_{ijt} includes all remaining components of the error term and is assumed to be i.i.d.

Accounting for expenditure shares

Expenditure shares reflect the relative importance of each category of commodities in household consumption baskets. To take them into account, I estimate the following equation:

$$SWB_{ijt} = \beta_1 W_{it}^c + \beta_2 \pi_{jt}^c + \beta_3 W_{i,t}^c * \pi_{jt}^c + \gamma' M_{jt} + \theta' Z_{it} + \varepsilon_{ijt} \quad (3\text{-}2)$$

$$\text{where } W_{it}^c = \frac{Expenditure_{it}^c}{(Total\ Expenditure)_{it}}$$

represents respondent i's household expenditure of commodity category c over the total household expenditure at year t. All other terms in Equation (3-2) are identical to those included in Equation (3-1). β_3 highlights the extent to which SWB changes with the inflation rate of commodity category c when the relative importance of this category varies.

Household-specific aggregate inflation rate

Next, I investigate the association between a household-specific aggregate inflation rate and SWB. To this end, following Brachinger (2008) and D'Acunto *et al.* (2021), I calculate the household-specific aggregate inflation rate ($HH\_inflation_{i,t}$) using the commodity-specific inflation rates weighted by the household's expenditure share on each commodity. In other words:

$$HH\_inflation_{it} = \sum_{c=1}^{C} \pi_{jt}^c * W_{it}^c \quad (3\text{-}3)$$

$HH\_inflation_{i,t}$ is the household-specific aggregate CPI inflation rate for household i

at year t. $\pi_{j,t}^{c}$ is the annual CPI inflation rate of commodity c in province j at year t. $W_{i,t}^{c}$ is the expenditure share of commodity category c in in household i at year t.

3.4.2. Estimation methods

As my SWB variables are all measured on a five-point scale, for example, from "Not at all satisfied" to "Completely satisfied" with life, and considering that my dataset is a panel, I initially estimate my equations using fixed-effects linear models. Next, to assess the robustness of my baseline results to the use of different estimation methods, I also provide results based on a fixed effects ordered logit model using the "Blow-up and Cluster" (BCU) estimator (Baetschmann *et al*., 2020).[44]

3.5. Descriptive statistics

Table 3.2 presents the definitions and summary statistics of the subjective well-being measures. The mean response of life satisfaction is 3.63 (out of a maximum of 5). The mean response of happiness, social-life satisfaction, and optimism are respectively 3.91, 3.87, and 3.87. Consistent with Kahneman and Deaton (2010) and Li (2021), I also find that life satisfaction is positively correlated with the three alternative SWB measures I use in this study.

Table 3.3 reports the mean, standard deviation, minimum and maximum values of the annual commodity-specific CPI inflation rates used in my baseline analysis. First, in column (1), I observe that compared to the inflation rates of other categories of commodities, food inflation has the highest mean. The inflation rate of communication

[44] See Appendix A3.6 for more details about robustness checks.

is the lowest and actually negative. The negative communication inflation rate is a very special case due to the reforms of major Chinese telecoms and associated price setting policies in the past decade. Specifically, a 'speed-up and low-rate' policy aimed at improving the coverage and quality and reducing the price of broadband and mobile network services was implemented (Chinese General Office of the State Council, 2015).[45] This consisted in upgrading bandwidth for free, cutting unnecessary mobile phone charges, and discounting mobile data bundles, which, taken together, largely reduced the price of communication services. As a result, the average communication inflation rate was -1.8% and more than 93.5% (121,812/130,307) of respondents experienced episodes of deflation of communication over the period 2010-2018.

Second, the dispersion of inflation rates across different categories of commodities is considerable. Column (3) and (4) of Table 3.3 show that the minimum values of all inflation rates are negative, while the maximum values range from 1.2% to 15.4%. The lowest minimum annual inflation rate (-7.1%) belongs to communication, whilst the maximum (15.4%) belongs to the health care category.[46] To compare the commodity-specific inflation rates to the aggregate inflation rate, I also report descriptive statistics of the annual aggregate inflation rates in column (2). I observe that the standard deviation of the aggregate inflation rate is much lower than that of the commodity-specific inflation rates. Moreover, compared to commodity-specific inflation rates,

[45] The Chinese General Office of the State Council meeting report in May 2015 is available online at the site: http://www.gov.cn/zhengce/content/2015-05/20/content_9789

[46] The annual communication inflation rate experienced by the respondents in 2012 in Tianjin was -7.1%. The health care inflation rate in April 2018 in Tianjin was 15.4%.

column (3) and (4) show that the distance between the minimum (1.1%) and maximum (4.9%) values of the aggregate inflation rate is much smaller. Also, there is no deflation episode based on the aggregate inflation rates.

Table 3.4 reports the summary statistics of the household expenditure shares used in the estimation of equation (3-2). On average, households allocate the highest expenditure share (38.7%) to food commodities followed by health care, education, utilities, clothing, communication, transport, and entertainment. The average expenditure share of rent is the lowest among all categories. I observe that only 9% of the respondents paid rent over the period 2012-2018. According to Hu (2013), owning a house is crucial for Chinese people to achieve the most traditional and ideal state of life, namely 'living and working in peace and contentment (*An Ju Le Ye*)'. Renting a house in China is often regarded as a temporary resort before achieving the ideal state of life. Therefore, similar to previous studies focusing on Chinese households, I observe a low proportion of renters, with about 85% of respondents' families owning their primary houses (e.g., Zhang *et al*., 2018; Chen *et al*., 2020).[47] The unmatched commodities cover 16.5% of the total household expenditures. Descriptive statistics of all control variables used in my models can be found in Appendix A3.4.

[47] The CFPS provides a question asking respondents "who owns the house where you and your family currently live?" Among those respondents who did not rent or solely owned their primary houses, 2% of the respondents' houses were partly owned by family members, 1% of the respondents lived in public houses (*gongfang*) provided by their work unit (*danwei*), and 3% of the respondents' houses were owned by relatives or friends.

3.6. Results

3.6.1. Baseline results

Main results

Table 3.5 presents the estimates of Equation (3-1) obtained using a fixed-effects linear estimator. Columns (1) to (9) show in turn how the annual inflation rates on food, utilities, rent, transport, communication, clothing, education, entertainment, and health care relate to SWB. Columns (1) and (8) show that the inflation rates of food and entertainment are significantly and positively associated with SWB. Conversely, columns (2), (3) and (5) show that the inflation rates of utilities, rent and communication are significantly and negatively associated with SWB.[48]

To explore economic significance, I use the coefficients reported in Table 3.5 to calculate the marginal rate of substitution between inflation rates and the log of per capita household assets (Di Tella *et al*., 2003; Chen *et al*., 2014). Focusing on column (1), the ratio of the two coefficients implies that the effect on SWB of a 1% rise in the annual inflation rate of food and entertainment is respectively equivalent to a 7% ($0.0183/0.2613 \approx 0.07$) and a 3% ($0.0070/0.2697 \approx 0.03$) increase in the per capita household assets.[49] Similarly, focusing on columns (2) and (3), a 1% rise in the annual inflation rate of utilities, rent and communication is respectively equivalent to a 3% ($0.0092/0.2662 \approx 0.03$), 1% ($0.0030/0.2695 \approx 0.01$) and 6% ($0.0174/0.2715 \approx 0.06$) decrease in per capita household assets.

[48] The coefficients associated with each control variable are presented and discussed in Appendix A3.3.

[49] See Appendix A3.5 for details about the calculation of economic significance.

The findings from column (1) and (8) contradict the traditional argument according to which the aggregate inflation rate is always negatively associated with SWB (e.g., Di Tella *et al*., 2001, 2003; Frey and Stutzer, 2002; Welsch, 2007; Blanchflower *et al*., 2014). The positive associations I find between the inflation rates of food and entertainment commodities and SWB may be explained by commodity-specific inflation rates reflecting quality improvements. China has been experiencing rapid product turnover in the past decade, which means new products with higher quality quickly replace the old ones and more diversified products are available within each category of commodities (Nakamura *et al*., 2016). Empirical studies find that consumption in China has in fact been shifting towards high quality and luxurious goods, which deliver more well-being gains to Chinese households compared to the previously available low-quality products (Cui, 2018; Sheng and Song, 2019). For example, as their income increases, Chinese households tend to spend more on higher quality meat with better, texture, flavour, and nutrition content (Yu and Abler, 2009; Zheng and Wang, 2016). Sheng and Song (2019) predict that, by 2050, China will be characterised by an increase in food expenditure due to improved quality of around 12%. From a psychological viewpoint, Agarwal *et al*., (2022) argues that the upgrade of products positively contributes to people's inflation perceptions. Based on face-to-face and online experiments conducted in Singapore, the authors find that the high inflation perceived by people results from the exposure to prices of high-quality goods over time, with less stress being put on prior price information about low-quality goods. Therefore, within a category of commodities with rapid quality improvements, high

inflation may not be a psychological concern. Instead, households may upgrade their consumption towards these advanced products with higher prices, gaining greater well-being.

However, quality updates of utilities and rent are less likely to be prevalent as these are mainly basic-need household living materials (e.g., bills for water, electricity, fuel, and heating). Therefore, high inflation of these goods mainly implies rising bills and rental costs, which are, in turn, associated with lower SWB (columns (2) and (3)). I mentioned in section 3.5 that the cost of renting a house is not a common concern for Chinese households as less than 10% of the respondents were renters. Therefore, compared to utilities, I find that the equivalent per capita household assets loss of a 1% increase in annual rent price is much smaller.

The inflation rate of communication is also found to be negatively associated with SWB (see column (5)). This can be explained bearing in mind that communication is a special case, as communication services experienced a significant drop in prices over my sample period. In fact, as discussed in section 3.5, the Chinese low-price policy in the telecom market largely reduced the rates of communication services (e.g., broadband, and mobile data). Specifically, according to the Ministry of Industry and Information Technology (MIIT) of the People's Republic of China, the average prices of both per gigabyte mobile data and monthly broadband bundles decreased by more than 90% over the period 2014-2019.[50] This significant drop in prices enhanced

[50] Details about the MIIT meeting minutes can be accessed at this site: https://www.miit.gov.cn/xwdt/gxdt/sjdt/art/2020/art_84c9d456ed0d493e82cadad43de6fe17.html

people's SWB, which can explain the negative coefficient on the inflation rate of communication in column (5) of Table 3.5. My results confirm that people received significant SWB benefits from the largely decreased communication costs. Specifically, the effect of a 1% annual decrease in communication prices on SWB is equivalent to the effect of a 6.4% increase in per capita annual household assets.

Robustness checks

To check the robustness of the baseline results presented above, firstly, I provide further estimates based on fixed-effects ordered logit models (Frey and Stutzer, 2000; Ferrer-i-Carbonell and Fritjers, 2004; Layard *et al*., 2008). The results, which are presented in Appendix A3 Table A5 are very similar to the baseline results in Table 3.5.

Secondly, I re-estimate the baseline model using happiness, social life satisfaction, and optimism as the dependent variables using a fixed-effects linear specification. The results, which are respectively reported in Appendix A3 Table A6, A7, and A8 are, once again, consistent with the baseline results in Table 3.5.[51]

3.6.2. Accounting for expenditure shares

I next look at how expenditure shares of different categories of commodities ($W_{i,t}^{c}$) influence the association between inflation and SWB. Columns (1) to (9) of Table 3.6 report the estimates of equation (3-2), respectively focusing on annual inflation rates of food, utilities, rent, transport, communication, clothing, education, entertainment, and health care.

[51] These robustness tests are discussed in Appendix A3.6.

Columns (2) and (5) show that the expenditure shares of utilities and communication are positively associated with SWB (β_1). Households that allocate a greater proportion of total expenditure to utilities and communication may provide household members with warmer houses in the winter and cooler houses in the summer, better broadband and so on. By contrast, columns (3) and (9) show that the expenditure shares of house rent and health care are negatively associated with SWB. House renters usually report low SWB due to their low social economic status and unstable residential conditions (Graham *et al*., 2009; Yuan and Golpelwar, 2013; Zhang and Zhang, 2019). High expenditure shares of rent payment may reflect the renter's heavy burden on paying for a temporary residence. Similarly, people who spend a large share of expenditures on health care might suffer from poor health conditions, therefore, they are more likely to report low SWB.

Focusing on the coefficients associated with inflation rates (β_2) and the interaction terms between expenditure shares and the inflation rates (β_3), I first observe that, consistent with the baseline results, columns (1), (2), (3), (5), and (8) of Table 3.6 show that the inflation rates of food and entertainment are positively associated with SWB, whilst the inflation rates of utilities, rent, and communication are negatively associated with SWB. The negative and significant β_3 coefficient in columns (2) and (3) suggest that the negative inflation-SWB association is nonlinear for utilities and rent. Specifically, the negative impact of the inflation rates of utilities and rent on SWB is amplified as the expenditure shares of these items rise. Similarly, the significant and positive β_3 coefficient in column (6) and (8) suggest that the positive impact of the

inflation rates of clothing, and entertainment on SWB is amplified when the expenditure shares of these commodities increase.

To quantitatively discuss the importance of the variations of expenditure shares, I calculate the equivalent per capita asset change of a 1% annual increase in a commodity price for low, high, and top spenders, which are respectively defined as those in the 25th, 75th and 95th percentile of expenditure shares.

First, given that the 25th, 75th, and 95th percentile of utilities' expenditure shares are 2.8%, 8.7%, and 18.7%, column (2) of Table 3.6 suggests that the equivalent per capita household asset loss of a 1% annual increase in the price of utilities is considerably smaller for low utilities spenders (2.9%) than high and top utilities spenders (4.3% and 6.7%).

Second, in line with my findings in Sections 3.5 and 3.6.1, column (3) of Table 3.6 suggests that the inflation of rent is a significant concern for renters. Specifically, for a respondent at the 95th percentile who spends about 10% of total expenditures on rent, a 1% annual increase in rent price is equivalent to a 4.3% loss in per capita household assets.

Third, column (6) shows that the positive impact of the inflation of clothing on SWB is generally negligible compared to food even for high and top spenders. This can be explained by discussing the motivations for purchasing fashion apparels. Parker and Wenyu (2019) argue that luxury fashion expenditures (more than 1,000 CNY per month) are significantly motivated by gratification and idea shopping which involves intentions

of alleviating negative moods and keeping up with latest fashion trends, while low expenditures on apparels (less than 1,000 CNY per month) are mainly driven by value shopping which involves seeking value for money (i.e. paying a reasonable price by seeking sales and discounts).[52] Using online survey data covering 1,023 randomly selected Chinese respondents, Xiao *et al*. (2022) finds that enthusiastic consumers enjoying both gratification and idea shopping report much higher life satisfaction compared to rational consumers who mainly seek value for money. However, my data shows that the average annual per capita expenditure on clothes of a top spender is around 2,500 CNY, which is much smaller compared to luxury fashion expenditures suggested by Parker and Wenyu (2019). In fact, my data in 2018 shows that less than 1% of respondents spent more than 1,000 CNY per month on clothing. Given that a high spender spent around 800 CNY annually on clothes and the average prices for men's cotton shirts and women's sweaters are respectively about 350 CNY and 410 CNY over the period 2012-2018, a high spender can only afford 2 men's shirts per year.[53] Therefore, very few (less than 1%) respondents in my data are likely to be enthusiastic consumers who regularly seek new fashions and benefit a lot from buying expensive and high-quality clothes. My result from column (6) is also consistent with Xiao *et al*.'s (2022) who argue that seeking value for money is one of the strongest motivations of Chinese consumers due to the tradition of Chinese culture. In summary,

[52] See Arnold and Reynolds (2003) for details about the typology of hedonic shopping motivations.

[53] Data about the provincial-level average prices of clothes can be found at the official sites of provincial Development and Reform Commission. For example, men's cotton shirt price in Sichuan province is reported monthly at this site:
http://fgw.sc.gov.cn/sfgw/rygy/2019/1/18/094c1d4972e24df8862661a29a479c97.shtml

I do find a positive association between clothing inflation and SWB and people with higher clothing expenditure shares enjoy more from clothing consumption upgrades. However, given that the expenditure on clothing is generally low, the enjoyment of consuming better clothes is limited.

Fourth, I see from column (8) that the equivalent per capita household asset gains of a 1% annual increase in entertainment price is much higher for top spenders (3%) compared to both low and high entertainment spenders (0.1% and 0.3%). This finding implies that entertainment is an important part of the top spenders' lifestyle which enables them to enjoy much from high quality entertainment activities. Specifically, a top spender of entertainment allocates about 8% of his/her total expenditures to entertainment, which is more than 10 times larger than the share allocated by a high spender (0.7%). According to Table 3.4, the average expenditure share on clothing is about six times greater than entertainment. However, column (6) and (8) show that the equivalent per capita asset gains from a 1% inflation of clothing does not surpass entertainment even among the top spenders. This finding is suggestive of two important arguments regarding the price elasticity of demand for clothing and entertainment in China proposed by Fan *et al*. (1995), Tan *et al.* (2017), and Gu *et al*. (2019). First, the authors find that the demand for clothing is price-inelastic for all income groups. This implies that Chinese clothing consumption is mainly driven by the demand for clothing necessities. In accordance with this argument, I discussed in the previous paragraph that the positive impact of clothing inflation on SWB is actually negligible due to the low clothing budget. Second, the authors also find that the price elasticity of demand for

entertainment is positive and greater than unity. In other words, the demand for entertainment is strong even if its price increases and the demand for entertainment is definitely not driven by necessities. Therefore, my results confirm Gu *et al*.'s (2019) speculation that the top entertainment spenders enjoy a lot to from consuming better and more expensive entertainment goods and services.

3.6.3. Synthesis: taking into account the characteristics of commodities

Assigning characteristics to commodities

A number of studies conclude that the consumption of some commodities significantly delivers greater well-being than that of others. For instance, following Van Boven and Gilovich (2003)'s intention-based approach, experiential goods are superior for improving SWB compared to material goods because the former satisfy people's intentions of acquiring life experiences rather than tangible living materials (Van Boven, 2005; Howell and Hill, 2009; Zimmermann, 2014). Similarly, according to Heffetz (2011), DeLeire and Kalil (2010), and Noll and Weick (2015), consuming conspicuous commodities that satisfy people's advanced needs (e.g., signalling status, keeping socially connected) delivers greater well-being than consuming material-well-being-need commodities that satisfy people's basic needs. Hereafter, I apply two modified approaches to classify commodities based on the intention-based approach (Van Boven and Gilovich 2003), the visibility-based approach (Heffetz, 2011) and the need-based approach (DeLeire and Kalil, 2010; Noll and Weick, 2015). [54]

[54] See Appendix A3.7 for a detailed discussion of the characteristics of commodities and how different classifications can be applied.

Column (1) of Table 3.7 shows the modified intention-based approach which distinguishes between material and experiential commodities. Yet, food and health care commodities are ambiguous to classify. Food is not a pure material good as the enjoyment of food can be interpreted as the experience of taste, vision, and smell. Except for the enjoyment of food itself, dining out is a special case that also emphasises the experiential enjoyment of restaurant service and social connectedness. The consumption of some health care goods and services such as fitness services can also be experiential. Therefore, under the modified intension-based approach, food and health care can be seen as mixed-intention commodities which cover both material and experiential components.

Column (2) of Table 3.7 applies the modified need-based approach which contains basic and advanced-need goods.[55] To provide accurate classifications, I additionally refer to Heffetz's (2011) survey-based visibility index which quantitatively defines the extent to which the consumption of each category of goods satisfies advanced needs.[56] I assign commodities with visibility indices higher than 0.6 to the conspicuous category that satisfies people's advanced-needs. According to DeLeire and Kalil (2010) and the visibility indices, food-away-from-home, personal care, and fitness are strongly conspicuous and satisfy people's social or status needs. At the same time, food-at-home and basic health care are defined as basic-need commodities. Therefore, similar to

[55] Advanced needs include status and social needs. See Appendix A3.7 for more details about DeLeire and Kalil's (2010) need-based approach and Heffetz's (2011) visibility-based approach.

[56] Heffetz (2011) provides the visibility index for a list of 31 categories of goods. The visibility index ranges from 0 to 1.

column (1), food and health care are defined as mixed-need commodities.

The inflation-SWB association and the characteristics of consumption

Under the guidance of Table 3.7, I can now systematically explain the mixed results I presented in section 3.6.1 and 3.6.2 making use of the classifications of commodities based, in turn, on the modified intention- and need-based approaches.

Material and basic-need commodities: utilities and rent

According to Heffetz (2011), DeLeire and Kalil (2010), and Zimmermann (2014), utilities and rent are typical material and non-conspicuous goods. Specifically, water, electricity, fuel, heating, and rental payment are all essential housing necessities that are also not likely to show significant quality changes. Therefore, column (2) and (3) of Table 3.5 suggest that the inflation rates of these products mainly reflect rising basic costs which undermines people's SWB. It is also reasonable to infer that respondents who have to spend larger share of expenditures on utilities and rent are more averse to their inflation (see column (2) and (3) of Table 3.6).

Experiential and advanced-need commodities: clothing, entertainment, and communication

Commodities included in the clothing and entertainment categories are regarded as highly experiential and conspicuous commodities that meet people's social and status needs. The goods and services included in the clothing and entertainment categories are very likely to upgrade quickly over time (e.g., fashion, bars, and movies). Therefore, the results in column (6) and (8) of Table 3.5 and 3.6 can be interpreted bearing in mind that the upgrades of clothing and entertainment makes people feel satisfied especially

for households with high clothing and entertainment expenditure budgets. For example, 3D IMAX movies are more expensive than 2D ones but will definitely bring superior audio-visual experiences.

According to DeLeire and Kalil (2010), and Want et al., (2019), the consumption of communication is associated with significant well-being by maintaining social connectedness. However, as I discussed in sections 3.5 and 3.6.1, communication price largely decreased due to the 'speed-up and low-rate' policy aiming at improving the coverage, quality and reducing the price of broadband and mobile network services. As a result, my findings about communication reflect that people received large benefits from decreased communication costs.

Mixed-intention and mixed-need commodities: food and health care.

The results in column (1) of Table 3.5 and 3.6 show that food inflation benefits people's SWB among all respondents. Food expenditure is the most important component of household expenditure. Over 64% of the households in my sample allocate more than 30% of their total expenditure to food. Food includes a wide range of items such as grains, meat, eggs, milk, vegetables, fruits, beverages, and food-away-from-home. According to the definitions provided by the NBSC, food inflation not only covers the price changes of raw ingredients but also the price changes of processed food (i.e., tofu, bread, cakes, ham, sausages, and so on). Evidence has shown that in recent years, Chinese people have been enjoying the fast development of food products in terms of food quality and diversity. Diversified and high-quality processed animal products (including both food-at-home and away-from-home) are now becoming important parts

of Chinese food consumption patterns (Yuan *et al.,* 2019). Therefore, food consumption now includes a significant experiential component. The enjoyment of upgraded food consumption contributes to the positive impact of food inflation on SWB.

Different from the results related to food inflation rates mentioned above, I did not find any significant impact of health care inflation rates. Health care is the second largest category in terms of expenditure shares (see table 3.4). However, the expenditure on experiential or advanced-need related health care commodities (i.e., fitness) is generally very low. Focusing on the sample used in column (9) of Table 3.6, I see that, on average, only about 4.5% of total household health care expenditure is spent on fitness and the per capita fitness expenditure is about 75 CNY per year. [57] Moreover, 87% of the households in my sample do not spend any money on fitness. These statistics suggest that the vast majority of health care expenditure is still material or basic. This may explain the insignificant coefficients I uncovered on the health-care expenditure inflation.

3.6.4. Household-specific aggregate inflation and SWB

Before calculating the household-specific aggregate inflation rate according to equation (3-3), it is necessary to check the coverages of commodities defined by the official aggregate CPI inflation rates and the household-level aggregate CPI inflation rates. The official aggregate CPI inflation rates provided by the NBSC cover the full set of commodities and details about the major categories and subclassifications of

[57] The ratio is calculated using the following equation: $\frac{(Fitness\ expenditure)_{i,t}}{(Health\ care\ expenditure)_{i,t}}$

commodities are shown in Table 3.1. As I explained in section 3.3.3, only 9 categories of commodities' expenditures are successfully matched with the corresponding inflation rates $\pi_{j,t}^{c}$. The expenditures on the 9 matched categories of commodities are generally recurrent (e.g., regular purchases are made in this category throughout the year), while the unmatched commodities include most of the commodities that are purchased occasionally, such as cars, housing maintenance, and household durables.

According to the CFPS Introductions to the Household Expenditure Variables (2018), recurrent household expenditures matter the most to household daily lives because it makes up about 85% of total household total expenditure.[58] The summary statistics in Table 3.4 show that the average household expenditure share of the matched categories of commodities is about 83.5%. Therefore, the household-specific aggregate inflation rate I construct is representative and comparable to the official aggregate CPI inflation rate.

Table 3.8 reports the estimates of equation (3-1) using the official NBSC annual aggregate inflation rates and the household-specific aggregate CPI inflation rates. The sample I use in both columns only includes respondents with complete information for the 9 successfully matched household expenditures variables. The negative β_1 in column (1) seems in line with the traditional view that inflation is bad for SWB.

[58] The CFPS Introductions to the Household Expenditure Variables (2018) summarise that the remaining 15% of household occasional expenditures contain transfer expenditures (i.e., financial support to relatives and friends, charitable donations), welfare expenditures (i.e., commercial insurance, medical insurance, and pension), and real-estate-related expenditures (i.e., house-building, house-purchase, and housing mortgage).

However, β_1 is not statistically significant. As for column (2), it tells a different story: The household-specific aggregate inflation is significantly and positively associated with SWB. Table 3.4 shows that food dominates the household consumption basket as its expenditure share is over 38%. As such, the positive impact of the household-level aggregate inflation rates on SWB is clearly dominated by the positive impact of food inflation on SWB.

Generally speaking, the comparison between the results in columns (1) and (2) of Table 3.8 highlights the differences between the information contained in the NBSC official aggregate inflation rate and the household-level inflation rates. The NBSC official aggregate inflation rate reflects the average price changes of all commodities although some commodities are not even included in a family's consumption basket (e.g., there is a considerable number of respondents in my sample who did not spend anything on rent). By contrast, the household-level aggregate inflation rate I constructed considers the matched commodity-specific inflation rates together with the heterogeneity of household consumption patterns. Therefore, the association between the household-level aggregate inflation rate and SWB is driven by people's consumption patterns and the utility derived from consuming different kinds of commodities. In my case, using Chinese data over the period 2012-2018, the enjoyment from the quality improvements of the goods and services making up the largest shares of households' expenditure are likely to drive the positive impact of household-level aggregate inflation rates on SWB.

3.7. Food-away-from-home (FAFH) inflation and SWB

3.7.1. Motivation

I noted from table 3.4 that food plays a crucial role in households' consumption baskets, as it makes up 38% of households' total expenditures. As I discussed in section 3.6.3, Heffetz (2011), DeLeire and Kalil (2010), and Zimmermann (2014), consistently defined food-away-from-home (FAFH) commodities as highly experiential and conspicuous commodities which significantly improves SWB. Zipser, *et al*. (2016) and Zheng and Wang (2016), argue that FAFH commodities have dramatically improved in quality and diversity as Chinese consumers are now more willing to purchase expensive and advanced food in terms of its appearance, texture, texture, and so on. I therefore expect that the enjoyment of upmarket FAFH results in a positive association between FAFH inflation rates and SWB.

Additionally, respondents are not likely to benefit from the upgrade of FAFH consumption equally because Chinese households' dining-out consumption is largely influenced by income and the place of residence. Specifically, based on household surveys focusing on household weekly FAFH expenditures in six Chinese cities in 2007, 2009, 2010, and 2011, Liu *et al*. (2015) find that household income growth significantly increases the likelihood of dining out and expenditure on FAFH. Using data from China Statistical Yearbooks over the period 2001-2013, Zheng *et al*. (2019) argue that rural residents allocate much smaller share of expenditure on FAFH compared to urban residents because rural farmers may face budget constraints when making decisions of

dining out. Therefore, I expect that the enjoyment from consuming high-quality FAFH is greater for richer respondents from urban areas.

3.7.2. Results

Column (1) of Table 3.9 reports the estimates of equation (3-1) using the annual inflation rate of FAFH. Consistent with the baseline result in column (1) of Table 3.5, the association between the FAFH inflation rate and SWB is significant and positive. The quality improvements of FAFH are easy to be perceived as the consumption of FAFH involves a wide range of enjoyable aspects, e.g., attractive, and delicious dishes, explorations of diversified regional or international cuisines, good restaurant environment and services, basis for socialising.

Column (2), (3), and (4) report the estimates of equation (3-1) including respectively the interaction terms between the FAFH inflation rate and the share of FAFH over total food expenditures, the log of household income per capita, and a dummy equal to 1 if the respondent lives in an urban area, and 0 otherwise. Consistent with my expectations, I find that the coefficients associated with all three interaction terms are significant and positive, suggesting that the SWB gains from FAFH quality improvements are more pronounced for respondents who spend more on dining out, from richer households, and living in urban areas.

To gauge the economic significance of my findings, I again calculate the equivalent per capita asset change of a 1% increase in the price of FAFH. Column (1) of Table 3.9 suggests that a 1% annual increase in the price of FAFH is equivalent to about a 6%

increase in per capita household assets. Compared to the equivalent changes of household assets of a 1% increase in the prices of utilities (-3%), rent (-1%), communication (-6%), and entertainment (+3%), the impact of FAFH inflation on SWB is generally large.

Column (2) reports the equivalent per capita asset change of a 1% annual increase in FAFH prices for low, high, and top FAFH spenders, defined as those in the 25th, 75th and 95th percentile of expenditure share of FAFH in the total household food expenditure. I can see that a 1% increase in the FAFH price is equivalent to an 8%, 10%, and 13.7% increase in per capita household assets for low, high, and top FAFH spenders respectively. Its noticeable that the equivalent gain in per capita household assets of top FAFH spenders is about 40% higher than that of high FAFH spenders. This finding results from the huge difference between the habits of top and high FAFH spenders: according to my data, top FAFH spenders allocated over 41% of their food budgets to dining out but this number is only 15% for high FAFH spenders.

Column (3) reports the equivalent per capita asset change of a 1% annual increase in FAFH prices for poor, rich, and the richest respondents that are defined as those in the 25th, 75th and 95th percentile of per capita family income. The results suggest that a 1% increase in FAFH price is equivalent to a 7.9%, 9.4%, and 10.2% increase in per capita household assets for poor, rich, and the richest respondents respectively. Bearing in mind that the per capita household income of a rich respondent (17,795 CNY) is more than four times that of a poor respondent (4,183 CNY), I find that rich respondents with per capita household income higher than 17,795 CNY spend about 13% of their

food budget on FAFH, while poor respondents with per capita household income lower than 4,183 CNY only spend 6% of their food budget on FAFH. Therefore, my results suggest that rich people benefit more from the upgrade of FAFH than the poor because high income implies increased frequency and budget for dining out.

Column (4) suggests that the equivalent household per capita assets change of a 1% increase in the price of FAFH is 8.5% for urban respondents and only 4% for rural respondents. According to my findings in column (2) and (3), such a big difference between rural and urban samples highlighted in column (4) can be explained as follows. First, compared to rural areas, urban cities provide people with diversified and high quality FAFH choices, such as restaurants, tea houses, and snack bars. Second, the average per capita annual household income is 18,525 CNY for urban respondents and only 9,515 CNY for rural respondents. Therefore, the high income enables urban respondents to spend more on luxury dining experiences. Third, compared to rural respondents, dinning out is a more popular lifestyle among urban respondents. According to my data, the average expenditure share of FAFH in the total household food expenditure is in fact 10.5% for urban respondents and only 6.7% for rural respondents.

3.8. Conclusion

This paper is the first to investigate the impact of commodity-specific inflation rates on individual subjective well-being (SWB), accounting for the heterogeneity of household consumption patterns. To this end, I create a unique dataset by matching data from the

2010- 2018 waves of the China Panel Studies (CFPS) with consumer price indices (CPI) of different categories of commodities data taken from the National Bureau of Statistics of China (NBSC).

First, my findings suggest that the annual inflation rates of food, clothing, and entertainment are positively associated with SWB. I explain this bearing in mind that food, clothing, and entertainment contain significant experiential components that satisfy people's advanced needs such as keeping socially connected and signalling social status. These commodities are likely to upgrade and diversify quickly. As a result, although these products are increasingly expensive, the upgrade of consumption towards high-quality products improves people's well-being. I also find that the inflation rates of utilities and rent are negatively associated with SWB. I explain this considering that utilities and rent are material commodities that satisfy people's basic needs. As such, these commodities are not likely to experience quality improvements and their inflation mainly reflects the rising living costs. I also find that the "speed-up and low-rate" policy largely reduced communication costs and therefore improved people's SWB.

Second, my results suggest that the household expenditure shares are crucial to capture the non-linear association between inflation rates and SWB. Specifically, the negative (positive) impact of the inflation rates of utilities and rent (clothing and entertainment) on SWB becomes larger as the expenditure shares of these commodities increase. Finally, making use of a household-level expenditure-share-weighted-average aggregate inflation rate, I find that the quality improvements of food inflation are

pervasive among various bundles of food items, and drive the positive impact of household-level inflation rates on SWB.

In general, contrary to the traditional conclusion that inflation is bad for people's well-being, I find that, for certain commodities satisfying people's advanced needs, inflation rates may enhance well-being. I also argue that the extent to which people are concerned about price changes may depend on their expenditure patterns. My findings suggest that policies aiming at improving people's living standards and well-being using the official aggregate inflation rate as a tool may be misleading because the aggregate inflation rate ignores the heterogeneity of commodities and household expenditure patterns.

My work has a number of limitations but also implies potential future studies. First, over 15% of the household expenditures are unmatched with commodity-specific inflation rates (i.e., car-related commodities, household durables). This somehow reduces the representativeness of the household-level aggregate inflation rate that I construct. Second, the CFPS only allows me to identify the respondent's province of residence. Therefore, city-level inflation data cannot be matched to the CFPS. Third, SWB reflects the overall evaluations of people's life. Better data is needed which directly collects people's changes in the 'experienced' wellbeing of prices change of different commodities. Fourth, the CFPS does not allow me to directly infer the quality changes that took place in households' expenditure of various commodities. For example, detailed survey data about people's food consumption choices is needed to understand whether people are indeed shifting towards premium food with higher prices.

Using hedonic pricing methods, future studies can also identify the hedonic contributors of price increase and then investigate their impacts on people's wellbeing.

Tables in Chapter 3

Table 3.1 Matching of NBSC inflation rates and household expenditure data from the CFPS

NBSC categories of commodities	Commodities covered by CFPS expenditure questions
Successfully matched categories	
Food	Total household food expenditure including food-away-from-home
Utilities	Water bills Electricity bills Fuel bills Heating bills
Rent	House rent (only includes residential rent)
Transport	Regular local transportation (public transportation and petrol costs)
Communication	Regular communication (bills for mobile phone, the Internet, and postage)
Clothing	Clothing
Education	Education (textbooks, stationery, tuition, etc.)
Entertainment	Entertainment (i.e., books, magazines, DVDs, movies etc.) Tourism
Health care	Total medical treatment expenditure excluding reimbursements (i.e., medications, medical services, etc.) Fitness (personal health care products and services)
Unmatched categories	Property management (i.e., parking, residential cleaning) Household daily necessities (i.e., detergent, soap, etc.) Transport and communication tools excluding car-related purchases (i.e., bicycles, mobile phones.) Household durables (i.e., furniture, washing machines, televisions, computers, musical instruments) Cosmetic products and services Commercial insurance; Financial assistance to relatives and other people; Charitable donations Other expenditures

Notes: The NBSC inflation rates of the 9 categories of commodities (in bold) are successfully matched with 14 questions from the CFPS household expenditure questionnaire. The unmatched CFPS household expenditure questions are also reported in this table. The matching results are applicable to the 2012, 2014, 2016, and 2018 waves of the CFPS.

Table 3.2 Definitions and summary statistics of subjective well-being measures

Variable name	Response code	Mean (SD)	Obs.	min	max
Evaluative measures:					
Life satisfaction	Not at all satisfied-completely satisfied	3.6268 (1.0664)	130,307	1	5
Happiness	Not at all happy-very happy	3.9100 (0.9947)	77,744	1	5
Social-life satisfaction	Not at all satisfied-completely satisfied	3.8692 (0.8560)	77,719	1	5
Measure of positive expectations about the future:					
Optimism	Not at all confident-completely confident	3.871 (1.0710)	130,016	1	5

Notes: Life satisfaction and optimism data are from the 2010, 2012, 2014, 2016 and 2018 waves of the CFPS. Happiness and Social-life satisfaction data are from the 2010, 2014 and 2018 waves of the CFPS. All variables are measured on a 1-5 scale. Standard deviations are in parentheses.

Table 3.3 Summary statistics of inflation rates

	Annual inflation rates (%)			
	(1)	(2)	(3)	(4)
	Mean	STD	Min	Max
Inflation rates:				
Food	3.94	4.40	-1.8	14.4
Utilities	1.94	2.33	-3.3	10.2
Rent	3.67	2.56	-1.9	13.3
Transport	0.43	2.11	-5.3	5.1
Communication	-1.81	1.53	-7.1	1.2
Clothing	1.17	2.37	-6.7	7.3
Education	2.34	1.22	-0.9	8.2
Entertainment	0.94	0.96	-3.5	5.4
Health care	2.92	2.16	-0.2	15.4
Aggregate inflation rate	2.37	0.70	1.1	4.9
No. of respondents		130,307		

Note: Column (1), (2), (3), and (4) respectively present the mean, standard deviations, minimum and maximum of annual CPI inflation rates of the 9 matched categories of commodities used in the baseline analyses. All Inflation rates are in percentages.

Table 3.4 Summary statistics of inflation rates and expenditure shares

	Expenditure shares	No. of respondents
	(1)	(2)
Categories of commodities:		
Food	0.39 (0.20)	97,077
Utilities	0.07 (0.07)	96,873
Rent	0.01 (0.06)	97,057
Transport	0.05 (0.06)	97,047
Communication	0.06 (0.05)	97,074
Clothing	0.06 (0.05)	97,077
Education	0.08 (0.13)	97,020
Entertainment	0.01 (0.04)	97,020
Health Care	0.11 (0.16)	97,003
Unmatched commodities	0.17 (0.20)	96,780

Note: This table reports the expenditure shares data used in the estimation of equation (3-2). Expenditure shares are from the 2012, 2014, 2016 and 2018 waves of the CFPS. Standard deviations are in parentheses.

Table 3.5 Baseline results: Subjective well-being and annual inflation

Measure of annual inflation	Annual CPI inflation rates at survey years								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Inflation rates (β_1):									
Food	0.0183***								
	(0.0031)								
Utilities		-0.0092***							
		(0.0020)							
Rent			-0.0030**						
			(0.0013)						
Transport				0.0019					
				(0.0033)					
Communication					-0.0174***				
					(0.0032)				
Clothing						0.0017			
						(0.0033)			
Education							0.0030		
							(0.0029)		
Entertainment								0.0070**	
								(0.0034)	
Health Care									0.0024
									(0.0024)
Log per capita household assets	0.2613***	0.2662***	0.2695***	0.2701 ***	0.2715***	0.2705***	0.2699***	0.2697***	0.2701***
	(0.0339)	(0.0339)	(0.0339)	(0.0339)	(0.0339)	(0.0339)	(0.0339)	(0.0339)	(0.0339)
Eq. asset changes	+7.0%	-3.4%	-1.1%	N/A	-6.4%	N/A	N/A	+2.6%	N/A
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	130,307	130,307	130,307	130,307	130,307	130,307	130,307	130,307	130,307
R-squared	0.1444	0.1442	0.1441	0.1440	0.1440	0.1440	0.1440	0.1441	0.1440

*Note: This table reports the estimates of equation (3-1) using the annual inflation rates of the 9 matched categories of commodities All models were estimated using a fixed-effects linear estimator. The dependent variable in all models is life satisfaction. Data from the 2010 to 2018 waves of the CFPS were used in estimation. 'Eq. asset changes' is the equivalent per capita asset change of a 1% increase in the price of a commodity. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Table 3.6 Taking into account expenditure shares

	Measure of inflation: Annual inflation rates of survey waves.								
	Food	Utilities	Rent	Transport	Communication	Clothing	Education	Entertainment	Health Care
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$W_{i,t}^{c}$	-0.0269	0.3022***	-0.3278**	0.0363	0.2169*	-0.0122	-0.1097	0.0158	-0.1556***
--(β_1)	(0.0291)	(0.0771)	(0.1355)	(0.0711)	(0.1160)	(0.0867)	(0.0765)	(0.1121)	(0.0459)
$\pi_{j,t}^{c}$	0.0221***	-0.0044*	-0.0003**	0.0022	-0.0229***	0.0035	0.0035	0.0042	0.0028
--(β_2)	(0.0044)	(0.0026)	(0.0002)	(0.0042)	(0.0051)	(0.0031)	(0.0038)	(0.0030)	(0.0029)
$W_{i,t}^{c} * \pi_{j,t}^{c}$	0.0019	-0.0496**	-0.0946**	0.0166	0.1008	0.0030**	0.0289	0.0749*	0.0998
--(β_3)	(0.0041)	(0.0253)	(0.0411)	(0.0256)	(0.0703)	(0.0015)	(0.0223)	(0.0444)	(0.0109)
Log per capita household assets	0.1863***	0.2002***	0.2030***	0.1966***	0.2022***	0.1955***	0.1978***	0.1984***	0.1917***
	(0.0437)	(0.0439)	(0.0436)	(0.0438)	(0.0438)	(0.0437)	(0.0437)	(0.0437)	(0.0438)
Eq. asset changes:									
at 25th	11.9%	-2.9%	-0.1%	N/A	-11.3%	0.03%	N/A	0.1%	N/A
at 75th	11.9%	-4.3%	-0.1%	N/A	-11.3%	0.1%	N/A	0.3%	N/A
at 95th	11.9%	-6.9%	-4.3%	N/A	-11.3%	0.2%	N/A	3.0%	N/A
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	97,077	96,873	97,057	97,047	97,074	97,077	97,020	97,020	97,003
R-squared	0.1578	0.1581	0.1576	0.1573	0.1576	0.1575	0.1574	0.1574	0.1580

*Note: This table reports the estimates of equation (3-2) using annual inflation rates of the 9 matched categories of commodities. $W_{i,t}^{c}$ is the expenditure share of commodity c. $\pi_{j,t}^{c}$ is the annual inflation rate of commodity category c. All models were estimated using a fixed-effects linear estimator. The dependent variable in all models is life satisfaction. Data from the 2012 to 2018 waves of the CFPS were used in estimation. 'Eq. asset changes' is the equivalent per capita asset change of a 1% increase in commodity price evaluated at the 25th, 75th and 95th percentile of expenditure shares. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Table 3.7 Characteristics of commodities

	(1)	(2)
Categories of commodities	Intention-based	Need-based
Food	Material & Experiential	Basic & advanced
Utilities	Material	Basic
Rent	Material	Basic
Communication	Experiential	advanced
Transport	Not classified	Basic
Clothing	Experiential	advanced
Education	Not classified	Basic
Entertainment	Experiential	advanced
Health care	Material & Experiential	Basic & advanced

Notes: This table reports the characteristics of the 9 matched categories of commodities. Column (1) reports the classifications under the modified intention-based approach. Column (2) reports the classifications under the modified need-based approach

Table 3.8 NBSC and household-level annual aggregate inflation and subjective wellbeing

Measures of inflation	NBSC aggregate annual inflation	Household-level annual aggregate inflation
	(1)	(2)
Inflation	-0.0018	0.0027**
--(β_1)	(0.0099)	(0.0012)
Control variables	Yes	Yes
Obs.	96,728	96,728
R-squared	0.1585	0.1586

*Note: Both columns report estimates of equation (3-1). Column (1) uses the NBSC aggregate annual inflation rate. Column (2) uses the household-level annual aggregate inflation rate constructed according to equation (3-3). All models were estimated using a fixed-effects linear estimator. The dependent variable in all models is life satisfaction. Data from the 2012 to 2018 waves of the CFPS were used in estimation. The sample only include respondents with complete information on the 9 matched per capita expenditure variables. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Table 3.9 Inflation on food-away-from-home (FAFH) and subjective wellbeing

Measures of inflation	Annual FAFH inflation rates			
	(1)	(2)	(3)	(4)
FAFH inflation	0.0157***	0.0148***	-0.0070	0.0110***
	(0.0024)	(0.0028)	(0.0086)	(0.0025)
Interaction terms				
FAFH inflation * FAFH/food		0.0254***		
		(0.0078)		
FAFH inflation * log household income per capita			0.0026***	
			(0.0010)	
FAFH inflation * urban				0.0122***
				(0.0021)
Log per capita household assets	0.2661***	0.1847***	0.2711***	0.2732***
	(0.0339)	(0.0423)	(0.0339)	(0.0339)
Eq. asset changes	+5.9%	at 25th: +8.0% at 75th: +10.0% at 95th: +13.7%	at 25th: +7.9% at 75th: +9.4% at 95th: +10.2%	Rural: +4.0% Urban: +8.5%
Control variables	yes	yes	yes	yes
Obs.	130,307	101,776	130,307	130,307
R-squared	0.1445	0.1584	0.1446	0.1448

*Note: FAFH/food refers to the expenditure share of food-away-from-home in the total household food expenditure. "urban" is a dummy that equals to 1 if the respondent lives in an urban area, and 0 if the respondent lives in rural area. 'Eq. asset changes' is the equivalent per capita asset change of a 1% increase in commodity price. 'Eq. asset changes' in column (2) and (3) are evaluated at the 25th, 75th, and 95th percentile of FAFH/food and household income per capita. Data from the 2010 to 2018 waves of the CFPS were used in column (1), (3), and (4). Data from the 2012 to 2018 waves of the CFPS were used in column (2) because the CFPS does not collect household FAFH expenditure data in 2010. All models were estimated using a fixed-effects linear estimator. The dependent variable in all models is life satisfaction. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Appendix A3

A3.1 Subjective well-being measures and the wording of questions in the CFPS

As I explained in section 3.4.1, I use life satisfaction as the main measure of SWB. I also use three alternative measures of SWB (happiness, social-life satisfaction, and optimism) as robustness checks.

According to Li (2021), questions asking individuals about their life satisfaction, happiness, and social-life satisfaction measure the evaluative dimension of SWB.[59] All measures report respondents' evaluations from low to high on a 5-point scale in the 2010. The same 0-5 scale is used for life satisfaction in subsequent waves, but a 0-10 scale is used in the 2014 and 2018 waves for happiness and social life satisfaction.[60] To ensure the consistency of measures across waves, I therefore convert the 0-10 based answers into a 1-5 scale using a linear transformation (Kalmijn, 2010).[61]

Following Diener *et al*. (2017), "optimism" is also an alternative form of SWB which is related to people's positive expectations about the future. To measure "optimism", I use a question that asks respondents to rank their "confidence in future life".

Below, I describe the survey questions I use to measure the above-mentioned dimensions of SWB. I also provide the original Chinese wording of each questions.

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[59] See Benjamin *et al*. (2014), Dolan *et al*. (2011), and OECD (2013) for details about multi-dimensional measures of SWB.

[60] Happiness and social-life satisfaction are not available in the 2012 and 2016 wave of the CFPS.

[61] This approach can be justified bearing in mind that, according to Kaiser and Vendrik (2020), respondents are likely to use the SWB scales in an approximately linear manner.

These questions are drawn from CFPS (2010, 2012, 2014, 2016, 2018)

A3.1.1 Evaluative measures

Life satisfaction

How satisfied are you with your life as a whole?

(Original wording in Chinese: 您对自己生活的满意程度？)

5-point scale (in all 5 waves of the CFPS)

Not at all satisfied

to

Completely satisfied

Happiness

How happy are you?

(Original wording in Chinese: 您觉得自己有多幸福？)

5-point scale (in the CFPS 2010), 10-point scale (in the CFPS 2014 and 2018)

Not at all happy

to

Very happy

Social-life Satisfaction

How satisfied are you with your social life?

(Original wording in Chinese: 您认为自己的人缘关系有多好？)

5-point scale (in the CFPS 2010), 10-point scale (in the CFPS 2014 and 2018)

Not at all satisfied

to

Completely satisfied

A3.1.2 "Optimism" and positive expectations

Confidence in future life

How confident are you in your future life?

(Original wording in Chinese: 您对自己未来的信心程度？)

5-point scale (in all 5 waves of the CFPS)

Not at all confident
to
Very confident

A3.2 The structure of the official inflation rates.

Table A3.1 presents the three-tier inflation rates provided by the National Bureau of Statistics of China (NBSC). The provincial-level rural/urban tier-1 and tier-2 CPI inflation rates are available from both the website of the NBSC (https://data.stats.gov.cn/index.htm) and the provincial Statistical Yearbooks. The tier-3 covers inflation rates of various bundles of items within each subclassification from the second tier; it is also known as the item-level inflation rates. The full description of the bundles of items included in the third tier is available online (http://www.stats.gov.cn/tjsj/tjbz/201310/P020131021349384303616.pdf). The provincial-level rural/urban tier-3 CPI inflation rates are provided by the provincial Statistical Yearbooks. However, the tier-3 inflation rates are only available for a few bundles of items.

A3.3 Control variables

A3.3.1 Details about the selection of control variables

Table A3.2 presents the definition of control variables I use in this study. Following Dolan *et al*. (2008), I include a consistent set of individual- and household-level control variables. First, to control for basic personal and family characteristics, age, age squared, gender, and household size are included. My sample includes all adults aged over 18. According to Blanchflower and Oswald (2004), Ferrer-i-Carbonell, and Gowdy, (2007),

and Chen *et al*. (2020), SWB is U-shaped in age with lowest life satisfaction occurring in middle age (between about 32 and 50). Therefore, age squared is considered to capture the nonlinear association between age and SWB. As for gender, males usually tend to report lower SWB (see, e.g., Alesina, Di Tella, and MacCulloch, 2004; Welsch, 2007; Chen *et al.,* 2020). According to Wunder (2012) individuals living in larger families are more likely to report high SWB.

Second, to control for individuals' social characteristics, I include several categorical variables related to the highest education degree attained, employment and exercise status, and self-rated health status. According to Dolan *et al*. (2008), individuals with a poor health status, a low education level, and who are unemployed and do not exercise consistently report low SWB.

Third, to control for individuals' relationships, I include marital status. Generally speaking, individuals who are part of a partnership (married or cohabitating) are likely to report higher SWB than individual who live alone (Dolan *et al*., 2008).

Fourth, to control for household finances, I include several variables related to income, assets, and debt. Following Blanchflower and Oswald (2004) and Wang and Tapia Granados (2019), I include household income quartiles calculated within counties to measure household relative income. Mentzakis and Moro (2009) suggest that subjective measures of relative income are informative because they require no speculation about the actual reference group that people compare their income to. Therefore, I include a 5-point-scale self-rated relative income ladder. As for household

assets and debt, I include the log of per capita household assets, and two dummy variables measuring whether or not the household has housing debt and financial debt. According to Turunen and Hiilamo (2014) and Chen *et al*. (2020), individuals with high household assets and low or no debt report higher SWB.

In addition to the above-mentioned determinants of SWB, I additionally introduce a categorical variable to reflect individuals' residence status. Hukou is China's residence administrative registration system. A Chinese citizen holds either an "agricultural" or "non-agricultural" hukou. Following Wang and Tapia Granados (2019), I define four types of residents as follows. Urban (rural) individuals with non-agricultural (agricultural) hukou are local urban (rural) residents. Urban (rural) individuals with agricultural (non-agricultural) hukou are rural-to-urban (urban-to-rural) migrants. Hukou determines the accessibility to various local public services and welfare benefits (Chan, 2013; Song, 2014). The mismatch between the current residential location and hukou location may largely reduce people's well-being, especially for rural-to-urban migrants. For example, purchasing houses in many urban cities (especially big cities) is restricted if the resident does not hold a local non-agricultural hukou. The social insurance programs are attached to the resident's hukou location rather than the location of residence. Furthermore, there exists labour market discrimination against agricultural hukou holders in high-wage sectors (Song, 2014). Compared to local urban residents, I therefore expect SWB to be lower for local rural, rural-to-urban, and urban-to-rural residents.

A3.3.2 Discussion of the coefficients associated with the control variables

Table A3.4 reports the full table of the baseline regression results using annual inflation rates of food, housing, utilities, rent, transport, communication, clothing, education, entertainment, and health care.

I do not find significant associations between GDP per capita/GDP growth and SWB. Consistent with Zhou and Xie (2016), GDP per capita is not significantly associated with SWB because it only captures the regional differences in per capita GDP. Intuitively, given that SWB is measured at individual level, individuals do not experience large regional variations of GDP per capita. Therefore, living in a region with higher per capita GDP does not contribute much to personal well-being. Second, Zhou and Xie (2016) find a positive and significant association between GDP growth rate and SWB because GDP growth rate captures the temporal changes in regional income within the same region. However, the authors argue that the impact of GDP growth rate on SWB may be weakened when a full set of individual socio-demographic and socio-economic control variables are included. In other words, individual/family socio-economic status (i.e., personal employment status and family income growth) will also change when the regional economic growth is rapid. Therefore, in line with Zhou and Xie (2016), I do find a significant association between GDP growth rate and SWB.

Consistent with Blanchflower and Oswald (2004) and Chen *et al*. (2020), I find that the association between SWB and age is U-shaped with lowest life satisfaction occurring in middle age. Consistent with Dolan *et al*. (2008) and Wunder (2012) SWB

is higher among respondents who are married, employed, healthier, richer, have more family members, and exercise frequently.

Compared to local urban residents, local rural residents and migrants report lower SWB. These results are consistent with Wang and Tapia Granados (2019). Consistent with Turunen and Hiilamo (2014), SWB is found to be lower if the respondent's family holds debts. I do not find clear evidence showing a significantly positive association between education and SWB. According to Dolan *et al*. (2008), the association between education and SWB is often found to be insignificant in panel models due to the following two reasons. First, fully controlling for health and income may silence the contribution of education to SWB. Second, fixed effects models usually show insignificant education-SWB associations because most adult respondents are unlikely to improve their education level over the survey years.

A3.4 Descriptive statistics

The steps of sample selections are explained as follows. Fist, 172,611 respondents from 25 provinces and aged 18 and older were retained after appending the five waves of the CFPS. Second, I dropped 23,233 respondents who did not answer to questions about individual demographic information including age, gender, residency status, highest educational degree, marital status, and employment status. Third, I dropped 10,860 respondents who did not answer to self-reported questions about life satisfaction, income, health and exercise. Forth, I dropped 8,211 respondents who did not answer to household-level questions including agriculture production, household size, relative

household income per capita, log of per capita household assets, housing debts, and bank debts. Finally, the number of observations with complete information of all variables is 130,307.

Table A3.3 reports the descriptive statistics of the control variables based on the sample used for the estimation of equation (3-1). The sample includes 130,307 observations. The mean, standard deviation, minimum and maximum values are reported for each control variable. For individual-level control variables, I observe that the average age of the respondents is 47 years old and about 51% of them are male. The total sample covers about 25% local rural residents, 48% local urban residents, and 23% rural-to-urban migrants. Urban-to-rural migration is rare and covers about 4% of my sample. Less than 25% of the respondents hold an educational degree above senior high school. I also observe that 85% of the respondents are married or cohabitating, 2% are unemployed, and 5% are retired. As for family-level control variables, I observe that over 55% of households mainly engage in agricultural production. About 16% and 8% of households have housing loans and other bank loans respectively.

A3.5 The calculation of economic significance

Equation (3-1) can be rewritten as follows, taking the log of per capita household assets out of the vector *Z*:

$$SWB_{ijt} = \beta\pi^{c}_{j,t} + \alpha\, ln(Assets_{it}) + \gamma' M_{jt} + \theta' Z_{it} + \varepsilon_{ijt} \qquad \text{(A1)}$$

To calculate the marginal rate of substitution between inflation rates and the log of per capita household assets, I differentiate $Assets_{it}$ with respect to $\pi^{c}_{j,t}$. Assuming that

SWB is fixed at a constant level, the equivalent monetary benefit/loss of inflation can be calculated as follows:

$$\frac{dAssets_{it}}{d\pi^{c}_{j,t}} = -\frac{\beta}{\alpha} Assets_{it} \text{ , where } d\left(SWB_{ijt}\right) = 0 \quad \text{(A2)}$$

Keeping the SWB level unchanged, $\frac{\beta}{\alpha}$ indicates the proportional changes in per capita household assets that counteracts the impact of inflation on SWB. In Table 3.5 (and subsequent tables), I present the percentage values of $\frac{\beta}{\alpha}$ for each category of commodities. When $\frac{\beta}{\alpha} > 0$ $\left(\frac{\beta}{\alpha} < 0\right)$ and the price of commodity category c increases by 1%, the equivalent monetary benefit (loss) to respondent i is approximately equal to $\frac{\beta * 100}{\alpha}$% of his family's per capita assets.

A3.6 Robustness checks

To check the robustness of the baseline results, I provide two series of further estimates.

A3.6.1 Robustness to the use of different estimation methods

Responses to SWB questions are usually treated as cardinal or ordinal, and SWB equations are usually estimated using ordinary least squares (OLS) or ordinal regression models such as ordered logit or probit (Ferrer-i-Carbonell and Frijters, 2004). The cardinal assumption of SWB data assumes that SWB scores reflect the absolute magnitude of well-being judgement and SWB scores are interpersonally comparable. The Ordinal assumption of SWB data posits that SWB scores show the rank order of different states (OECD, 2013). Focusing on the determinants of well-being, there is no virtual qualitative difference between the regression results from microeconomic equations under cardinal and ordinal assumptions (Frey and Stutzer, 2000; Ferrer-i-

Carbonell and Fritjers, 2004; Layard *et al*., 2008; Dolan *et al.,* 2008; Dickerson *et al*., 2014).

My baseline results so far are based on fixed-effects linear regressions. To assess the robustness to the ordinal assumption of SWB data, I estimate the baseline model (equation (3-1)) using a fixed-effects ordered logit model. To this end, I use the Stata command "feologit", which applies the 'Blow-up and Cluster'(BUC) estimator proposed by Baetschmann et al. (2015). All columns of Table A3.5 report marginal effects (evaluated at means) of the fixed-effects ordered logit estimates. Respondents who are observed only once or have always the same life satisfaction scores over time are excluded (because their log likelihood contribution is zero). As a result, 25,063 respondents are dropped. Consistent with my baseline results reported in Table 3.5, column (1) and (8) ((2), (3). And (5)) of Table A3.5 suggest that the likelihood of reporting high life satisfaction increases (decreases) with the inflation rates of food and entertainment (utilities, rent, and communication).

A3.6.2 Robustness to the use of different measures of SWB

As I mentioned in Section 3.3.1 and Appendix A3.1, I use happiness, social-life satisfaction, and optimism as alternative measures of SWB. Table A3.6, A3.7, and A3.8 report the fixed-effects linear estimates of equation (3-1) using the above-mentioned three measures of SWB. Column (1) and (8) of Table A3.6, A3.7, and A3.8 suggest that the inflation rates of food and entertainment are positively associated with SWB. Column (2), (3) and (5) of Table A3.6, A3.7, and A3.8 suggest that the inflation rates of utilities, rent, and communication are negatively associated with SWB. Therefore, these

results are consistent with my baseline results based on life satisfaction.

A3.7 The characteristics of commodities and SWB

There are three popular approaches to classify commodities according to their characteristics. First, according to the intention-based approach, consumption of commodities can be differentiated according to people's intensions of acquiring material goods or life experiences (Van Boven and Gilovich 2003). Therefore, material commodities include tangible objects such as food and beverages consumed at home, utilities, housing products and services, and so on. On the other hand, experiential commodities include events that people live through, such as dining out at restaurants, watching movies, and fitness. According to Van Boven (2005), Howell and Hill (2009), and Zimmermann (2014), experiential commodities are superior for improving SWB compared to material commodities. Experiential commodities can in fact provide long-lasting psychological benefits as they are open to positive re-evaluations (e.g., pleasant memories) in the future and generate social value by keeping people connected to others.

Second, according to the visibility-based approach, commodities can be classified into basic commodities and conspicuous commodities (Heffetz, 2011). Under the guidance of Maslow's (1943) hierarchy of needs and the visibility-based approach, the consumption of basic commodities which satisfies people's basic needs (including security needs), such as utilities, household products and services, and health care is low in visibility. By contrast, consumption of conspicuous commodities such as dining out at restaurants, entertainment, and clothing is highly visible and satisfies people's

social and status needs after their basic needs are satisfied (Charles *et al*., 2009; Heffetz, 2011; Kaus. 2013). As a result, the consumption of conspicuous commodities is found to improve SWB more than the consumption of basic commodities (Perez-Truglia, 2013; Zimmermann, 2014; Wang *et al*., 2019).

Third, according to DeLeire and Kalil (2010) and Noll and Weick (2015), the need-based approach classifies the commodities into three groups: status-need commodities (i.e., clothing, personal care, vehicles), social-need commodities (i.e., leisure and entertainment), and material-well-being-need commodities (i.e., utilities, household products and services, food). Both status-need and social-need commodities are found to improve people's well-being more than material-well-being-need commodities. The idea behind the need-based approach is similar to that of the visibility-based approach as they both look at how consumption can satisfy different types of needs.

I apply two approaches to classify different categories of commodities according to their characteristics (see Table 3.7). First, I apply the modified intention-based approach proposed by Zimmermann (2014). The author highlights that food should not be defined as a pure material commodity for two reasons. First, the enjoyment of food can be interpreted as the experience of taste, vision, and smell. Second, food-away-from-home is typically experiential because the experiences of stylish dishes, restaurant environment and services contribute much to a pleasant dining experience. The consumption of some health care goods and services such as personal care and fitness can also be experiential. According to the CFPS household expenditure questionnaire, food expenditure covers both food-at-home and food-away-from-home, and health care

expenditure covers medical treatment, personal care, and fitness (also see Table 3.1). Therefore, food and health care are defined as mixed-intention commodities that contain both material and experiential components.

Second, I apply a modified need-based approach following the spirit of the visibility-based approach and the need-based approach introduced by Heffetz (2011), DeLeire and Kalil (2010), and Noll and Weick (2015). As I discussed above, the visibility-based and need-based approaches are quite similar in terms of their intrinsic idea related to the satisfaction of needs from consuming different goods. Heffetz (2011)'s visibility-based approach relies on the survey-based visibility index which specifically reflects the extent to which the consumption of each category of goods satisfies advanced needs (social and status needs).[62] In line with his argument, I define goods with visibility indices higher than 0.6 as conspicuous. This results in food-at-home being non-conspicuous and food-away-from-home, cigarettes and alcohol being conspicuous. Heffetz (2011) does not provide the visibility indices for personal care and fitness. Therefore, I follow DeLeire and Kalil (2010)'s need-based approach and define personal care and fitness as status goods. Consistent with my modified intention-based approach, food and health care contain diverse commodities that satisfy not only basic but also advanced needs.

A3.8 Mortgage, aggregate inflation rates and SWB

China experienced rapid increase in household debt in the past decade due to rising

[62] See Table 3 of Heffetz (2011) for the visibility indices of 31 categories of goods

mortgage lending. According to Han *et al*. (2019), the mortgage to total household debt ratio in China increased from less than 20% in 2011 to about 70% in 2018. The CFPS data used by this chapter shows that over 15% of the observations' families were paying for mortgage over the period 2010-2018 and the median of their per capita annual mortgage payment was 12,500 CNY (also see Table A 3.3). This amount was about 3 time that of the average per capita annual food expenditure.

Most mortgage contracts in China over the period 2010-2018 are on fixed rates, therefore, inflation can depreciate the real value of mortgage payments (Doepke and Schneider, 2006; Mostafa, Wong and Hui, 2006; Ding *et al*., 2017; Han *et al*., 2019). Does the devaluation of money due to inflation benefits mortgage holders' SWB in China? I estimate equation (3-1) again by including an interaction term between the regional aggregate inflation rate and the log of per capita mortgage payment. The regression results are reported in Table A 3.9. First, similar to my findings in section A 3.3.2, the association between the log of per capita mortgage payment and SWB is significantly negative. Second, the interaction term between the regional aggregate inflation rate and the log of per capita mortgage payment is significantly positive. Therefore, SWB significantly benefits more from the rising aggregate inflation rate when the annual per capita mortgage payment increases. How large is this positive impact? I calculated the equivalent per capita asset change of a 1% increase in aggregate inflation rates given that the median of mortgage holders' per capita annual mortgage payment was 12,500 CNY.[63] The result suggests that the equivalent per capita asset gain

[63] See section A 3.5 for the calculation of economic significance.

was 1%, which is more than 3 times smaller than that of a 1% decrease in utilities inflation (see Table 3.5). A possible explanation is that the benefit from the devaluation of mortgage payments due to inflation is implicit as it is not instantly converted to noticeable monetary gains. On the contrary, the benefits from low utilities inflation are very obvious as it means cheaper utilities bills and lower cost of living. Therefore, the SWB gains due to the devaluation of mortgage payment only brought minor SWB gains.

Tables in Appendix A3

Table A 3.1 Three-tier inflation rate structure

Tier-1	Tier-2	Tier-3
Major categories of commodities	Subclassifications of commodities	
Food	Food (excluding beverages, liquor and tobacco, food-away-from-home)	Bundles of items within each subclassifications from tier-2
	Beverages	
	Liquor and Tobacco	
	Food-away-from-home	
Housing	Utilities (i.e., water, electricity, fuel, and heating)	
	House maintenance, repairing and management (i.e., renovation, property management)	
	House rent (only includes residential rent)	
Household necessities	Household daily necessities (i.e., toilet rolls, detergent, table set, wine/tea/coffee set,)	
	Personal care products (i.e., cosmetics, perfume)	
	Furniture and decorations	
	Household appliances (i.e., refrigerator, washing machine, and cooking facilities)	
	Household textiles (i.e., duvet set, curtains)	
	Household services (i.e., housekeeping)	
Transport & communication	Transport (including purchasing and maintaining means of transport, petrol cost and public transportation cost)	
	Communication (i.e., communication tools, bills for mobile phone, the Internet, post, etc.)	
Clothing	Clothes (including clothing, tailoring services)	
	Footwear	
Education & entertainment	Education (textbooks, stationery, tuition, etc.)	
	Entertainment (including tourism)	
Health care	Health care and fitness products	
	Health care and fitness services	

Notes: The 8th Tier-1 category "other miscellaneous goods and services" is not reported in this table.
The full description of the bundles of items included in the third tier is available at the site: http://www.stats.gov.cn/tjsj/tjbz/201310/P020131021349384303616.pdf).

Table A 3.2 Definitions of control variables

Control variable	Abbreviation	Description
Macroeconomic variables		
Log GDP per capita	LGDP_pc	Log of annual provincial GDP per capita (*in Purchasing Power Parity at 2010 constant ¥*)
GDP growth rate	GDPg	Annual provincial GDP growth rate
Individual- and household-level controls		
Individual-level		
Age	age	Respondent's age
gender	gender	1=male; 0=female
Residency status	residency	4 categories of residency according to current living area and registered residency (hukou) Local rural resident (rural resident with agricultural hukou) Local urban resident (urban resident with non-agricultural hukou) Rural-to-urban migrant (urban resident with agricultural hukou) Urban-to-rural immigrant (rural resident with non-agricultural hukou)
Highest educational degree	education	4 categories of highest attained educational degree: Illiterate/Semi-literate Primary school Junior high school At least senior high school
Marital status	married	1=Married or cohabiting 0=Never married, divorced, or widowed
Employment status	employment	4 categories of employment status: Employed Unemployed Out of labour market Retired
Self-rated relative income	sr_income	5-point scale of self-rated income rank from low to high
Self-rated health status	sr_health	5-point scale of self-rated health status: 1=Excellent; 2=Very good; 3=Good; 4=Fair; 5=unhealthy
Self-rated health status compared to a year ago	sr_health_cp	3-point scale of self-rated health status compared to previous year: 1=Better; 2=No change; 3=Worse.
Exercise	exercise	1=respondent exercised last week. 0=respondent did not exercise last week.
Household-level		
Agriculture production	agricultural_f	1=household engaged in agricultural production last year, 0 otherwise
Household size	householdsize	Number of members of the household
Relative household income per capita	relative_fincome	Household income per capita quartile by county.
Log of per capita household assets	lassets	Log of per capita household total assets
Housing debts	housedebts	Outstanding housing loans: 1=yes, 0=no
Bank debts	bankdebts	Other bank loans except for housing loans: 1=yes, 0=no
Other controls		
Geographical division dummies	regions	25 provinces are divided into 6 geographical regions according to the NBSC definition: North, Northeast, East, South-Central, Southwest, Northwest.
Survey wave dummies	waves	5 waves from 2010 to 2018

Table A 3.3 Descriptive statistics of control variables

Variables	Mean	Std. Dev.	Min	Max
Macroeconomic control variables				
Log GDP per capita	10.6403	(0.4730)	9.4513	11.8262
GDP growth rate	9.0094	(3.0793)	-2.5	17.4
Individual-level controls				
Age	47.3362	(15.3914)	18	101
Gender	0.5064	(0.5000)	0	1
Residence (*reference category: Local rural residents*)				
Local urban residents	0.4833	(0.4997)	0	1
Rural-to-urban migrants	0.2308	(0.4213)	0	1
Urban-to-rural migrants	0.0374	(0.1898)	0	1
Highest educational degree (*reference category: Illiterate/Semi-literate*)				
Primary school	0.2179	(0.4128)	0	1
Junior high school	0.2839	(0.4509)	0	1
At least senior high school	0.2307	(0.4213)	0	1
Marital status	0.8502	(0.3569)	0	1
Employment status (*reference category: employed*)				
Unemployed	0.0225	(0.1483)	0	1
Out of labour market	0.2266	(0.4186)	0	1
Retired	0.0515	(0.2210)	0	1
Self-rated relative income	2.4600	(1.0332)	1	5
Self-rated health status (*reference category: unhealthy*)				
Excellent	0.1913	(0.3934)	0	1
Very good	0.2142	(0.4103)	0	1
Good	0.3077	(0.4615)	0	1
Fair	0.1509	(0.3580)	0	1
Self-rated health status compared to a year ago (*reference category: no change*)				
Better	0.1074	(0.3097)	0	1
Worse	0.3201	(0.4665)	0	1
Exercise	0.3870	(0.4871)	0	1
Household- level controls				
Agricultural production	0.5563	(0.4968)	0	1
Household size	4.2361	(1.9530)	1	26
Household income per capita quartiles (*reference category: 1st quartile*)				
2	0.2461	(0.4307)	0	1
3	0.2511	(0.4336)	0	1
4	0.2557	(0.4362)	0	1
Log per capita household assets	10.0900	(1.5233)	0	17.5060
Housing debts	0.1563	(0.3631)	0	1
Bank debts	0.0781	(0.2684)	0	1
Other controls				
Geographical divisions (*reference category: west*)				
Northeast	0.1512	(0.3583)	0	1
East	0.2060	(0.4044)	0	1
South-central	0.2651	(0.4414)	0	1
Southwest	0.1205	(0.3256)	0	1
Northwest	0.1410	(0.3480)	0	1
Survey waves (*reference category: 2010*)				
2012	0.2053	(0.4040)	0	1
2014	0.1887	(0.3913)	0	1
2016	0.2036	(0.4027)	0	1
2018	0.1981	(0.3985)	0	1

Note: The descriptive statistics of all variables are based on the sample used for the estimation of equation (3-1). The number of observations is 130,307. GDP per capita is in Purchasing Power Parity at 2010 constant ¥. GDP growth rates are in percentages.

Table A 3.4 Baseline results (full table): Inflation and subjective well-being

Measure of annual inflation	Annual CPI inflation rates at survey years								
Commodity categories	Food	Utilities	Rent	Transport	Communication	Clothing	Education	Entertainment	Health care
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Inflation rates (β_1):	0.0183***	-0.0092***	-0.0030**	0.0019	-0.0174***	0.0017	0.0030	0.0070**	0.0024
	(0.0031)	(0.0020)	(0.0013)	(0.0033)	(0.0032)	(0.0033)	(0.0029)	(0.0034)	(0.0024)
LGDP_pc	0.0050	0.0286	0.0390	0.0361	0.0226	0.0396	0.0451	0.0310	0.0450
	(0.0356)	(0.0353)	(0.0352)	(0.0356)	(0.0353)	(0.0352)	(0.0356)	(0.0354)	(0.0355)
GDPg	0.0006	0.0010	0.0002	0.0005	0.0021	0.0006	0.0001	0.0001	0.0001
	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0021)	(0.0020)	(0.0021)
age	-0.0385***	-0.0382***	-0.0382***	-0.0384***	-0.0394***	-0.0384***	-0.0383***	-0.0382***	-0.0383***
	(0.0088)	(0.0088)	(0.0088)	(0.0088)	(0.0088)	(0.0088)	(0.0088)	(0.0088)	(0.0088)
age squared	0.0003***	0.0003***	0.0003***	0.0003***	0.0003***	0.0003***	0.0003***	0.0003***	0.0003***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
gender	-0.0761	-0.0736	-0.0739	-0.0728	-0.0730	-0.0728	-0.0730	-0.0731	-0.0728
	(0.0998)	(0.0997)	(0.0997)	(0.0998)	(0.0998)	(0.0998)	(0.0998)	(0.0998)	(0.0998)
residence (reference group: local urban resident)									
# Local rural resident	-0.0590**	-0.0614**	-0.0615**	-0.0629**	-0.0650**	-0.0630**	-0.0631**	-0.0641**	-0.0628**
	(0.0267)	(0.0267)	(0.0267)	(0.0267)	(0.0267)	(0.0267)	(0.0267)	(0.0267)	(0.0267)
# Rural-to-urban migrants	-0.0561**	-0.0574**	-0.0562**	-0.0572**	-0.0600***	-0.0570**	-0.0570**	-0.0572**	-0.0570**
	(0.0227)	(0.0227)	(0.0227)	(0.0227)	(0.0227)	(0.0227)	(0.0227)	(0.0227)	(0.0227)
# Urban-to-rural migrants	-0.0598**	-0.0610**	-0.0624**	-0.0641**	-0.0713**	-0.0640**	-0.0637**	-0.0641**	-0.0634**
	(0.0298)	(0.0297)	(0.0297)	(0.0297)	(0.0298)	(0.0297)	(0.0297)	(0.0297)	(0.0297)
education (reference group: Illiterate/Semi-literate)									
#Primary school	0.0374	0.0384	0.0382	0.0386	0.0377	0.0385	0.0388	0.0386	0.0388
	(0.0301)	(0.0301)	(0.0301)	(0.0301)	(0.0301)	(0.0301)	(0.0301)	(0.0301)	(0.0301)
#Junior high school	0.0671*	0.0678*	0.0672*	0.0681*	0.0656*	0.0678*	0.0681*	0.0684*	0.0679*
	(0.0384)	(0.0384)	(0.0384)	(0.0384)	(0.0384)	(0.0384)	(0.0384)	(0.0384)	(0.0384)
# At least senior high school	0.0335	0.0336	0.0347	0.0353	0.0335	0.0349	0.0352	0.0358	0.0347
	(0.0493)	(0.0493)	(0.0493)	(0.0493)	(0.0493)	(0.0493)	(0.0493)	(0.0493)	(0.0493)
married	0.0841***	0.0847***	0.0840***	0.0845***	0.0846***	0.0845***	0.0844***	0.0847***	0.0845***
	(0.0187)	(0.0187)	(0.0187)	(0.0187)	(0.0187)	(0.0187)	(0.0187)	(0.0187)	(0.0187)
employment (reference group: employed)									

#Unemployed	-0.0671***	-0.0662***	-0.0676***	-0.0654***	-0.0651***	-0.0654***	-0.0654***	-0.0650***	-0.0653***
	(0.0239)	(0.0239)	(0.0239)	(0.0239)	(0.0238)	(0.0239)	(0.0239)	(0.0239)	(0.0239)
#Out of labour market	0.0022	0.00399	0.00343	0.0041	0.00404	0.0041	0.0038	0.0038	0.0039
	(0.0102)	(0.0102)	(0.0102)	(0.0102)	(0.0102)	(0.0102)	(0.0102)	(0.0102)	(0.0102)
#Retired	0.0350**	0.0326**	0.0324**	0.0336**	0.0313**	0.0329**	0.0336**	0.0333**	0.0336**
	(0.0137)	(0.0137)	(0.0138)	(0.0138)	(0.0137)	(0.0138)	(0.0137)	(0.0137)	(0.0137)
sr_income (reference group: lowest self-rated income group, rank=1)									
#2	0.1329***	0.1323***	0.1323***	0.1323***	0.1328***	0.1322***	0.1323***	0.1323***	0.1322***
	(0.0104)	(0.0104)	(0.0104)	(0.0104)	(0.0104)	(0.0104)	(0.0104)	(0.0104)	(0.0104)
#3	0.3536***	0.3533***	0.3534***	0.3534***	0.3537***	0.3534***	0.3534***	0.3534***	0.3534***
	(0.0104)	(0.0104)	(0.0104)	(0.0104)	(0.0104)	(0.0104)	(0.0104)	(0.0104)	(0.0104)
#4	0.5346***	0.5351***	0.5355***	0.5355***	0.5355***	0.5355***	0.5357***	0.5356***	0.5356***
	(0.0143)	(0.0143)	(0.0143)	(0.0143)	(0.0143)	(0.0143)	(0.0143)	(0.0143)	(0.0143)
#5	0.7553***	0.7566***	0.7554***	0.7554***	0.7536***	0.7553***	0.7553***	0.7554***	0.7554***
	(0.0191)	(0.0191)	(0.0191)	(0.0191)	(0.0191)	(0.0191)	(0.0191)	(0.0191)	(0.0191)
sr_health (reference group: unhealthy)									
#Excellent	0.3329***	0.3337***	0.3330***	0.3330***	0.3330***	0.3330***	0.3331***	0.3329***	0.3333***
	(0.0161)	(0.0162)	(0.0162)	(0.0162)	(0.0161)	(0.0162)	(0.0162)	(0.0162)	(0.0162)
#Very good	0.2213***	0.2222***	0.2219***	0.2217***	0.2222***	0.2218***	0.2219***	0.2216***	0.2220***
	(0.0142)	(0.0142)	(0.0142)	(0.0142)	(0.0142)	(0.0142)	(0.0142)	(0.0142)	(0.0142)
#Good	0.1232***	0.1239***	0.1232***	0.1235***	0.1239***	0.1235***	0.1236***	0.1234***	0.1237***
	(0.0125)	(0.0125)	(0.0125)	(0.0125)	(0.0125)	(0.0125)	(0.0125)	(0.0125)	(0.0125)
#Fair	0.0837***	0.0854***	0.0850***	0.0857***	0.0856***	0.0858***	0.0858***	0.0855***	0.0859***
	(0.0129)	(0.0129)	(0.0129)	(0.0129)	(0.0129)	(0.0129)	(0.0129)	(0.0129)	(0.0129)
sr_health_cp (reference group: No change)									
#Better	0.0691***	0.0693***	0.0693***	0.0696***	0.0689***	0.0696***	0.0695***	0.0695***	0.0695***
	(0.0109)	(0.0109)	(0.0109)	(0.0109)	(0.0109)	(0.0109)	(0.0109)	(0.0109)	(0.0109)
#Worse	-0.0350***	-0.0354***	-0.0354***	-0.0351***	-0.0351***	-0.0352***	-0.0352***	-0.0352***	-0.0352***
	(0.0080)	(0.0080)	(0.0080)	(0.0080)	(0.0078)	(0.0080)	(0.0078)	(0.0080)	(0.0080)
exercise	0.0604***	0.0605***	0.0604***	0.0606***	0.0600***	0.0607***	0.0605***	0.0607***	0.0604***
	(0.0073)	(0.0073)	(0.0073)	(0.0074)	(0.0073)	(0.0073)	(0.0073)	(0.00734)	(0.0074)
agricultural_f	0.0159	0.0166	0.0174	0.0177	0.0185*	0.0178	0.0179	0.0181	0.0180
	(0.0112)	(0.0112)	(0.0112)	(0.0112)	(0.0112)	(0.0112)	(0.0112)	(0.0112)	(0.0112)
householdsize	0.0102***	0.0103***	0.0105***	0.0104***	0.0107***	0.0104***	0.0105***	0.0103***	0.0104***
	(0.0030)	(0.0030)	(0.0030)	(0.0030)	(0.0030)	(0.0030)	(0.0030)	(0.0030)	(0.0030)
relative_fincome (reference group: first income quartile)									

#2nd	0.0091	0.00884	0.0087	0.0088	0.0091	0.00877	0.00877	0.00885	0.0088
	(0.0092)	(0.00919)	(0.0092)	(0.0092)	(0.0092)	(0.0092)	(0.0092)	(0.0092)	(0.0092)
#3rd	0.0240**	0.0237**	0.0234**	0.0236**	0.0239**	0.0236**	0.0236**	0.0237**	0.0237**
	(0.0097)	(0.0097)	(0.0097)	(0.0097)	(0.0097)	(0.0097)	(0.0097)	(0.0097)	(0.0097)
#4th	0.0414***	0.0408***	0.0407***	0.0408***	0.0414***	0.0408***	0.0409***	0.0411***	0.0409***
	(0.0106)	(0.0106)	(0.0106)	(0.0106)	(0.0106)	(0.0106)	(0.0106)	(0.0106)	(0.0106)
lassets	0.2613***	0.2662***	0.2695***	0.2701***	0.2715***	0.2705***	0.2699***	0.2697***	0.2701***
	(0.0339)	(0.0339)	(0.0339)	(0.0339)	(0.0339)	(0.0339)	(0.0339)	(0.0339)	(0.0339)
housedebts	-0.0140	-0.0141	-0.0139	-0.0136	-0.0146	-0.0136	-0.0136	-0.0133	-0.0135
	(0.0094)	(0.0094)	(0.0094)	(0.0094)	(0.0094)	(0.0094)	(0.0094)	(0.0094)	(0.00944
bankdebts	-0.0244*	-0.0234*	-0.0242*	-0.0234*	-0.0234*	-0.0234*	-0.0233*	-0.0234*	-0.0232*
	(0.0128)	(0.0128)	(0.0128)	(0.0128)	(0.0128)	(0.0128)	(0.0128)	(0.0128)	(0.0128)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	130,307	130,307	130,307	130,307	130,307	130,307	130,307	130,307	130,307
R-squared	0.1444	0.1442	0.1441	0.1440	0.1440	0.1440	0.1440	0.1441	0.1440

Note: *This table reports the estimates of equation (3-1) using the annual inflation rates of the 9 matched categories of commodities. All models were estimated using a fixed-effects linear estimator. The dependent variable in all models is life satisfaction. Data from the 2010 to 2018 waves of the CFPS were used in estimation. Inflation and GDP growth rates are in percentages. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Table A 3.5 Inflation and subjective well-being: using a fixed-effects ordered logit estimator

Measure of inflation	Annual CPI inflation rates at survey years								
Inflation rates (β_1)	Food	Utilities	Rent	Transport	Communication	Clothing	Education	Entertainment	Health care
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Life Satisfaction score from 1 to 5									
1-Very Unsatisfied	-0.0017***	0.0006***	0.0005***	-0.0004	0.0014***	-0.0000	0.0001	-0.0006**	-0.0003
	(0.0003)	(0.0002)	(0.0001)	(0.0003)	(0.0003)	(0.0002)	(0.0003)	(0.0003)	(0.0002)
2-Unsatisfied	-0.0030***	0.0011***	0.0008***	-0.0008	0.0025***	-0.0000	0.0002	-0.0012**	-0.0006
	(0.0005)	(0.0003)	(0.0002)	(0.0006)	(0.0006)	(0.0004)	(0.0006)	(0.0006)	(0.0004)
3-Fair	-0.0054***	0.0020***	0.0015***	-0.0014	0.0045***	-0.0000	0.0003	-0.0021**	-0.0010
	(0.0010)	(0.0007)	(0.0004)	(0.0011)	(0.0011)	(0.0007)	(0.0011)	(0.0011)	(0.0008)
4-Satisfied	0.0026***	-0.0010***	-0.0007***	0.0007	-0.0022***	0.0000	-0.0014	0.0010**	0.0005
	(0.0005)	(0.0003)	(0.0001)	(0.0005)	(0.0005)	(0.0004)	(0.0005)	(0.0005)	(0.0004)
5-Very Satisfied	0.0075***	-0.0028***	-0.0021***	0.0019	-0.0063***	0.0000	-0.0004	0.0029**	0.0014
	(0.0013)	(0.0009)	(0.0006)	(0.0015)	(0.0015)	(0.0010)	(0.0015)	(0.0015)	(0.0011)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	105,244	105,244	105,244	105,244	105,244	105,244	105,244	105,244	105,244
Pseudo R-squared	0.1554	0.1551	0.1552	0.1550	0.1552	0.1550	0.1550	0.1551	0.1550

*Note: This table reports the estimates of equation (3-1) using the annual inflation rates of the 9 matched categories of commodities. All models were estimated using the 'Blow-up and Cluster' (BUC) estimator for fixed effects ordered logit model. All columns report marginal effects evaluated at sample means. The dependent variable in all models is life satisfaction. Data from the 2010 to 2018 waves of the CFPS were used in estimation. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Table A 3.6 Inflation and subjective well-being: using happiness as a measure of subjective wellbeing

Measure of inflation	Annual CPI inflation rates at survey years								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Inflation rates (β_1):									
Food	0.0209***								
	(0.0048)								
Utilities		-0.0095***							
		(0.0017)							
Rent			-0.0077***						
			(0.0020)						
Transport				0.0006					
				(0.0051)					
Communication					-0.0131***				
					(0.0045)				
Clothing						-0.0008			
						(0.0037)			
Education							0.0007		
							(0.0045)		
Entertainment								0.0122***	
								(0.0035)	
Health Care									-0.0038
									(0.0035)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	77,382	77,382	77,382	77,382	77,382	77,382	77,382	77,382	77,382
R-squared	0.0541	0.0537	0.0510	0.0520	0.0518	0.0519	0.0519	0.0527	0.0526

*Note: This table reports the estimates of equation (3-1) using the annual inflation rates of the 9 matched categories of commodities All models were estimated using a fixed-effects linear estimator. The dependent variable in all models is happiness. Data from the 2010, 2014, and 2018 waves of the CFPS were used in estimation. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Table A 3.7 Inflation and subjective well-being: using social life satisfaction as a measure of subjective wellbeing

Measure of annual inflation	Annual CPI inflation rates at survey years								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)		
Inflation rates (β_1):									
Food	0.0191***								
	(0.0044)								
Utilities		-0.0047**							
		(0.0023)							
Rent			-0.0081***						
			(0.0066)						
Transport				0.0034					
				(0.0069)					
Communication					-0.0104**				
					(0.0041)				
Clothing						-0.0.0002			
						(0.0033)			
Education							0.0029		
							(0.0041)		
Entertainment								0.0146***	
								(0.0032)	
Health Care									-0.0049
									(0.0033)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	77,357	77,357	77,357	77,357	77,357	77,357	77,357	77,357	77,357
R-squared	0.0333	0.0328	0.0333	0.0330	0.0330	0.0328	0.0328	0.0334	0.0330

*Note: This table reports the estimates of equation (3-1) using the annual inflation rates of the 9 matched categories of commodities All models were estimated using a fixed-effects linear estimator. The dependent variable in all models is social-life satisfaction. Data from the 2010, 2014, and 2018 waves of the CFPS were used in estimation. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Table A 3.8 Inflation and subjective well-being: using optimism as a measure of subjective wellbeing

Measure of annual inflation	Annual CPI inflation rates at survey years								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)		
Inflation rates (β_1):									
Food	0.0110***								
	(0.0032)								
Utilities		-0.0051**							
		(0.0021)							
Rent			0.0041***						
			(0.0014)						
Transport				0.0021					
				(0.0034)					
Communication					-0.0141***				
					(0.0033)				
Clothing						-0.0039			
						(0.0030)			
Education							0.0023		
							(0.0029)		
Entertainment								0.0086***	
								(0.0025)	
Health Care									0.0010
									(0.0024)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	130,016	130,016	130,016	130,016	130,016	130,016	130,016	130,016	130,016
R-squared	0.0850	0.0849	0.0850	0.0849	0.0849	0.0850	0.0849	0.0850	0.0849

*Note: This table reports the estimates of equation (3-1) using the annual inflation rates of the 9 matched categories of commodities All models were estimated using a fixed-effects linear estimator. The dependent variable in all models is optimism. Data from the 2010 to 2018 waves of the CFPS were used in estimation. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Table A 3.9 Mortgage, aggregate inflation rate and SWB

Measures of inflation	NBSC aggregate annual inflation
	(1)
Inflation	0.0006
	(0.0021)
Log per capita annual mortgage payment	-0.0035**
	(0.0015)
Inflation* Log per capita annual mortgage payment	0.0011*
	(0.0006)
Log per capita household assets	0.2642***
	(0.0340)
Eq. asset changes	1%
Control variables	Yes
Obs.	130,307
R-squared	0.1441

*Note: Column (1) was estimated using a fixed-effects linear estimator. The dependent variable is life satisfaction. Data from the 2010 to 2018 waves of the CFPS were used in estimation. 'Eq. asset changes' is the equivalent per capita asset change of a 1% increase in aggregate inflation rates when the annual per capita mortgage payment equals 125,000 CNY. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Chapter 4. Inflation Concerns and Subjective Well-being

4.1. Introduction

This is the first study to explore the association between search-data-based people's concerns about inflation and individual subjective well-being (SWB). A vast literature has consistently shown that aggregate inflation rates are negatively associated with individual SWB in Europe (Di Tella *et al*., 2001, 2003; Wolfers, 2003; Blanchflower *et al*., 2014; Welsch and Kühling, 2016) and the United States (Di Tella *et al*., 2003; Alesina *et al*., 2004; Ruprah and Luengas, 2011; Welsch and Kühling, 2016). SWB captures information on how people experience and evaluate their lives as a whole (OECD, 2013). Inflation, which reflects rising living costs, is no doubt an important part of people's daily experiences. However, I believe that the connection between inflation and individual SWB would be better established by focusing on people's direct experiences and perceptions on price changes rather than on official inflation statistics. I therefore revisit the association between inflation and SWB using a novel measure of inflation which directly reflects people's concerns about high commodity prices.

To this end, I use the Baidu Search Volume Index (BSVI) to measure people's concerns about inflation. The BSVI provides city-level data indicating the frequency of keyword-based search queries on the most popular Chinese search engine website, Baidu.[64] I use the BSVI to measure people's concerns about inflation for the following reasons. First, search volume data represent a direct and intuitive measure of revealed

[64] The Baidu search engine website can be accessed at: http://www.baidu.com/.

attention and people's concerns (Ettredge, Gerdes and Karuga, 2005; Da *et al*., 2011). For example, when internet users search for 'commodity price', they definitely pay attention to this topic. The intensity of people's concerns about this topic increases if the search frequency of 'commodity price' soars in a given time period. Second, due to the increasing popularity of the internet among Chinese users and the high penetration rate of search engine usage in the past decade[65], search volume data captures millions of internet users' search behaviours.[66] Third, Baidu has been the most popular search engine website for Chinese internet users since May 2009. The search-engine-user market share of Baidu increased from about 60% in 2011 to 70% in 2018.[67] In other words, the BSVI provides broad-reaching search volume data based on various keywords searched by about 477 million users in 2018.[68]

The use of search-data-based people's concerns about inflation in the Chinese context is of great importance as I observe that the people's concerns about inflation did not coincide with official inflation statistics in the recent years. For example, the

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[65] The search engine penetration rate is the ratio of search engine users to the total internet users.

[66] According to the 2011 and 2018 Statistical Reports on Chinese Internet Development published by the China Internet Network Information Centre (CNNIC henceforth), over the period 2011-2018, the total number of Chinese internet users (internet penetration rate) increased from 513 million (38.3%) to 829 million (59.6%). The 2011 and 2018 Statistical Reports on Chinese Internet Development are available at the following sites:
http://www.cac.gov.cn/files/pdf/hlwtjbg/hlwlfzzkdctjbg029.pdf; and
http://www.cac.gov.cn/wxb_pdf/0228043.pdf. The CNNIC (2018) also shows that the search engine penetration rate increased from 79.4% in 2011 to 82.2% in 2018.

[67] Data about Chinese search engines' market shares can be downloaded from this site: https://gs.statcounter.com/search-engine-market-share/all/china.

[68] The total number of internet users is 829 million in 2018. Given that 82.2% of internet users use search engine and the search engine market share of Baidu is 70% in 2018. The total number of Baidu users equals (829*82.2%*70%) 477 million.

BSVI of ‘price rise’ in 2021 was twice that in 2019 due to people’s excessive worries about price hikes during multiple lockdowns since the outbreak of COVID-19 in early 2020. However, the CPI inflation rates published by the National Bureau of Statistics of China (NBSC) decreased from 2.9% in 2019 to 0.85% in 2021. In this context, relying on the traditional argument that low inflation rates benefit SWB may lead to misleading policy implications.

My analyses focus on the middle-aged and elderly Chinese population. Specifically, I make use of SWB data taken from the 2011 to 2018 waves of the China Health and Retirement Longitudinal Study (CHARLS), which covers respondents residing in all Chinese provinces aged 45 and above and their spouses. This is important considering that, since 2000, China has become an aging society. Considering that the old-age dependency ratio increased from 9.9% to 20.8% over the period 2000-2021, the World Population Prospects (2022) predict that Chinese old-age dependency ratio will soar to more than 50% in 2050.[69] Therefore, understanding middle-aged and elderly respondents’ concerns about inflation is particularly important for future inflation policies aiming at an age-friendly economic environment.

I find that unexpected concerns about inflation, measured by the gap between the current and the previous year’s adjusted BSVI, are significantly and negatively associated with SWB. My results also suggest that the elderly, retired, and the poorest respondents are more averse to inflation than their younger counterparts, the employed,

[69] The old-age dependency ratio equals the ratio of the number of people aged 65 and above to the population aged 15–64 years.

and the richest respondents. Finally, I find that Chinese respondents aged 45 and above are significantly more concerned about the prices of medicines than food although food is generally much more important than medicines in terms of its expenditure shares. I thus propose a straightforward and effective method for Chinese policy makers to evaluate whether the low and stable inflation environment in the past years truly performed well in enhancing people's well-being.

The remainder of the paper is structured as follows. Section 4.2 provides some economic background. Section 4.3 presents the hypotheses. Section 4.4 introduces the methodology for processing the raw BSVI data and my econometric models. Section 4.5 describes my data. Section 4.6 presents my main results. Section 4.7 presents an extension. Section 4.8 concludes.

4.2. Economic background

4.2.1. Inflation and SWB

This paper is related to two strands of literature. First, it builds on previous longitudinal studies that investigate the impact of inflation on people's SWB. Using national-level aggregate Consumer Price Indices (CPI) and controlling for individual characteristics and region and year fixed effect, these studies find a negative impact of inflation on individual SWB in Europe (Di Tella *et al*., 2001, 2003; Wolfers, 2003; Blanchflower *et al*., 2014; Welsch and Kühling, 2016) and the United States (Di Tella *et al*., 2003; Alesina *et al*., 2004; Ruprah and Luengas, 2011; Welsch and Kühling, 2016).

Focusing on China, the association between inflation and SWB was mainly studied

in a cross-sectional setting by Zhang and Ou (2013), Chen *et al*. (2014) and Yan and Wen (2020).[70] These three studies, which also find a negative association between inflation and SWB, are, however, less convincing compared to the above-mentioned panel studies focusing on European countries and the US because they do not account for unobservable heterogeneity and the impact of inflation on SWB over time. To the best of my knowledge, only Gao *et al*. (2014) looked at the association between inflation and SWB in the Chinese context using panel data, namely the 2003, 2005, and 2006 waves of the General Social Survey (CGSS). The authors fail to find a significant association between inflation rates and individual SWB, which they explain noting the low variations of regional inflation rates during the study period. However, Chinese inflation rates in the past decade experienced considerable changes at the national level and large variations across provinces.[71] Additionally, since 2012, maintaining low annual inflation rates at around 3% has been a consistent focus of the Chinese government's implicit inflation targeting policy aiming at improving people's livelihood.[72] New panel studies that re-establishing the association between inflation and individual SWB in China are needed to assess whether these policy has been successful.

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[70] Zhang and Ou (2013) use data from the Chinese Household Income Project Survey (CHIPS) in 2002, Chen et al. (2014) use data from the General Social Survey (CGSS) in 2010, Yan and Wen (2020) use data from the General Social Survey (CGSS) in 2013

[71] According to the NBSC, the inflation rate declined from 5.4% in 2011 to 2.1% in 2018. There were considerable variations in inflation rates across provinces over the past decade. For example, the inflation rate in Shanghai (3.2%) was more than twice that in Beijing (1.4%) in 2016.

[72] See the annual Reports on the Work of the Government, for more details. These can be accessed at the site: http://www.gov.cn/guowuyuan/zfgzbg.htm

4.2.2. Search data and inflation

The second strand of literature related to this paper focuses on the applications of internet search data to measure inflation. According to Ettredge *et al*. (2005), web-based search data reveals people's needs, wants, interests, and concerns about the keywords they search. Studies focusing on inflation started to use search data since the most popular search engine, Google, launched advanced and comprehensive keyword-based daily search volume trends index, known as the Google Trends Index (GTI henceforth).[73]

Choi and Varian (2011, 2012) argue that search volume data have the ability to nowcast (predict the present) economic statistics because they reflect what happens instantly without lags. For example, focusing on CPI nowcasting, search volume data help to predict the September CPI statistics which are usually officially published in the second week of October. Therefore, the inflation-related GTI is frequently used to predict the near-term inflation statistics in Europe, the US, and Asia (Wei *et al*., 2017; Bicchal and Raja Sethu Durai, 2019). Inflation related search data also show the ability to forecast long-term inflation statistics because they reflect people's expectations of future inflation. Using GTI based on the keyword 'inflation', Guzmán (2011) finds that the GTI-based inflation expectations significantly anticipate the growth rate of the

[73] Google launched the Google Insights for Search in 2008. It provided comprehensive and advanced keyword search trends data. The Google Insights for Search services were merged into Google Trends in 2012. The announcements related to the Google Insights for Search are published at these sites:
https://adwords.googleblog.com/2008/08/announcing-google-insights-for-search.html
https://search.googleblog.com/2012/09/insights-into-what-world-is-searching.html
Google Trends can be accessed from https://trends.google.com.

personal consumption expenditures price index by 12 months.

The selection of inflation-related keywords is important for studies using search data of inflation-related keywords. Guzmán (2011) only use one keyword (‘inflation’) to construct his data. However, using the keyword ‘inflation’ only provides limited information about people’s attention to price changes. Therefore, Wei *et al*. (2017) uses two keywords including ‘inflation’ and ‘CPI’. Bicchal and Raja Sethu Durai (2019) use a GTI based on ‘inflation’ and ‘price rise’ to measure public expectations of the general price level, and a GTI based on ‘fuel prices’ to measure people’s expectations of a specific commodity price. Li *et al*. (2015) provides a detailed discussion about the selection of inflation-related keywords in Chinese. The authors argue that people search terms such as ‘price’ together with connotations such as ‘increase’ or ‘decrease’ to obtain supportive facts that coincide with their concerns. For example, if a person searches ‘price rise’, he/she definitely worries about positive price trends. Using GTIs and Chinese CPI statistics from 2004 to 2012, Li *et al*. (2015) finds that the GTIs of ‘commodity price’ and ‘price rise’ show the strongest positive correlation with CPI. The authors argues that the search data of the above-mentioned keywords is strongly related to people’s concerns about inflation because they are commonly used in daily conversations about high commodity prices.

4.3. Hypotheses

4.3.1. Baseline hypothesis

Similar to previous SWB studies who concluded that inflation means worse living

standard and is therefore associated with lower SWB (Di Tella *et al*., 2001, 2003; Wolfers, 2003; Alesina *et al*., 2004; Blanchflower *et al*., 2014; Welsch and Kühling, 2016), I expect that people's concerns about inflation, measured through search data, reflect people's worries about high living costs that harm people's SWB. Therefore, my exploration starts from the following baseline hypothesis:

Hypothesis 1. People's high concerns about inflation is associated with lower SWB

4.3.2. Taking into account unexpected people's concerns

As I discussed in section 4.2.2, inflation-related search data not only measure people's instant perceived inflation but also their long-term inflation expectations. Specifically, people may notice from their daily purchasing experiences that the prices of some commodities became higher than before (e.g., price tags). Some sensitive consumers may search for keywords related to rises in prices to confirm their experiences at grocery stores. When search queries about rising prices of various commodities become popular on the internet, people may expect a high inflation in the future. This mechanism is consistent with the economic psychology of a layperson's inflation expectation. According to Ranyard *et al*. (2008), Malmendier and Nagel (2016), and Cavallo *et al*. (2017), a layperson's perception of past inflation experiences is a significant source of their expectations about future inflation. A consumer who experienced high prices in the previous period may form an expectation of high inflation in the future simply because he/she assumed that past price trends will continue (Ranyard *et al*., 2008). Following this argument and using data from an online

survey conducted in New Zealand in 2016, Hayo and Neumeier (2022) find a significant one-to-one relationship between respondents' self-reported inflation expectation and the previous year's inflation rate. On top of that, the consumer may feel very worried when he/she discovers that the current inflation environment becomes much more pessimistic compared to his expectation. Therefore, I use the inflation-related search volume in the previous year to proxy for people's expectations about next year's inflation. I then take into account the unexpected people's concern about inflation captured by the gap between the current and previous inflation-related search volume. I hypothesise that it is this unexpected concern which negatively affects SWB. In other words:

Hypothesis 2. The unexpected people's concern about inflation is negatively associated with SWB.

4.3.3. Taking into account various inflation-related keywords

According to Li *et al*. (2015), 'commodity price' and 'price rise' are the most commonly used keywords when people talk about inflation and their search volumes are strongly and positively associated with Chinese inflation statistics. The search volumes of several other keywords including 'price', 'CPI', and 'inflation' are also found to be positively associated with Chinese inflation statistics (Li *et al*., 2015; Wei *et al*., 2017). However, searching for different inflation-related keywords may reflect different information seeking incentives and I do not know the search volumes of which keywords are the most appropriate to reflect people's concerns about inflation that lead

to low SWB. Therefore, I hereafter discuss the features of five keywords, the possible links between search volume of these keywords and concerns about inflation, and the corresponding hypotheses (see Table 4.1 for the keywords in Chinese as well as their Chinese alphabetic expressions and English definitions).

First, I consider the search volume of 'price' as a general measure of people's concerns about inflation. However, topics about 'price' can be largely diverse. Consumers may search 'price of iPhone' for the prices of new mobile devices. Consumers may also search 'price cut' for discounts. These searches do not necessarily show a concrete sign of concerns about high price. Therefore, the search volume of 'price' is not expected to be associated with low SWB because it contains sizable noise unrelated to concerns about inflation.

Second, I include the search volumes of 'commodity price' and 'CPI' as topic-specific measures of people's concerns about inflation. Compared to 'price', 'commodity price' and 'CPI' are narrowed down to specific topics related to concerns about the general price level. According to the annual Reports on the Work of the Government over the period 2010-2018, 'commodity price' and 'CPI' are the most used price-related keywords focusing on policies about price level. For example, 'Commodity price' appeared 13 times in the 2011 Report on the Work of the Chinese Government when describing the 'high commodity price' situation in 2010 and future policies about 'reducing and stabilising the commodity price level' and 'preventing the

rebound of high commodity price'.[74] 'CPI' appeared three times in the 2011 Report on the Work of the Government when talking about inflation targets (e.g., 'controlling the growth rate of CPI around 4% annually'). Therefore, high search volumes of 'commodity price' and 'CPI' imply intensive concerns about issues regarding price level and means lower SWB.

Third, I include the search volumes of 'inflation' and 'price rise' as negative-sentiment-related measures of people's concerns about inflation. As I mentioned in section 4.2.2, Li *et al*. (2015) argue that judgemental terms are necessary to capture people's specific concerns about unfavourable price trends (e.g., in the case of price changes, an unfavourable price trend is characterised by a positive price trend). The authors also argue that search data of keywords with negative sentiments shows stronger correlation with CPI series compared to those without a negative sentiment. Additionally, "inflation" is often used as a professional economic term describing a general increase in the prices of goods and services in an economy. For example, 'inflation' appeared twice in the 2011 Report on the Work of the Government when summarising the macroeconomic concerns in 2010 (e.g., 'Emerging economies faced pressures of both inflation and economic slowdown').

According to the above-mentioned discussions about different inflation-related

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[74] 'Commodity price' also regularly appears in other government reports addressing issues about the general price level. For example, the Chinese National Bureau of Statistics report talking about the commodity price in April 2018 can be accessed at this site:
http://www.stats.gov.cn/xxgk/jd/sjjd2020/201804/t20180411_1764603.html
The 2011 Report on the Work of the Government can be accessed at this site:
http://www.gov.cn/test/2012-03/15/content_2067314.htm

keywords, I therefore hypothesise that:

Hypothesis 3. High search volumes of 'commodity price', 'CPI', 'inflation' and 'price rise' are significantly associated with lower SWB

4.4. Methodology

Search data related to inflation is proposed to measure people's attention and concerns about inflation. This approach extracts Baidu search volume indices (BSVI) of different keywords searched by internet users on the most popular search engine website named Baidu.com. In the following subsections I first discuss the capability of BSVI to reflect people's concerns about inflation. Second, I explain the features of BSVI and the procedures to collect and pre-process the raw BSVI data. Third, I present the econometric models where I introduce the BSVI into SWB equations.

4.4.1. The inherent mechanism of information search behaviour and inflation

Search data is capable of reflecting people's concerns about inflation because it matches the inherent mechanism of laypersons' information search behaviour after experiencing price changes in daily life. Following Li *et al*. (2015), I illustrate this mechanism from the consumer's viewpoint. Inflation may start from the price adjustments of several products by producers due to specific market conditions (e.g., rises of the costs of raw materials). Consumers who purchase those products may notice the price rises and want to know if others also have the same experiences. Therefore, consumers may search for confirmative information on the internet. For example, 'is pork price increasing?' may be searched by consumers who noticed high pork price at the grocery store recently.

When rises in prices become prevalent and large numbers of consumers experienced high prices across various products, there will be massive internet search queries for keywords related to inflation (e.g., search queries for online prices, reports, news, and online discussions about rises in prices.)

4.4.2. Baidu Search Volume Index (BSVI)

Features of the Baidu Index

Baidu is the most popular search engine website in mainland China.[75] Figure 4.1 shows the market shares of search engine websites in China. Baidu has been dominating the Chinese search engine market since Google shut down Google.cn in mainland China in 2010.[76] The average market share of Baidu in mainland China is more than 60% over the period 2010-2022. Baidu launched the Baidu Index platform in 2007. This provides city-level and daily BSVI based on queries users entered into Baidu.[77] The Baidu Index only reports the BSVI of personal computer users over the period 2007-2010. BSVI data of both personal computer and mobile device users is available since 2011. Vaughan and Chen (2015) provide a comprehensive comparison between BSVI and GTI and discuss an important feature of BSVI, which is very different from GTI. GTI reports normalised search volume indices relative to the total number of searches for a given time period, while BSVI is constructed based on the absolute internet search

[75] Baidu can be accessed at www.baidu.com

[76] The announcement of shutting down Google.cn is available at this site: https://www.google.cn/press/new-approach-to-china/update.html

[77] The Baidu Index can be accessed at http://index.baidu.com/. The Baidu Index help centre can be accessed at https://index.baidu.com/Helper/.

volumes (Bank *et al*., 2011; Zhang *et al*., 2013; Vaughan and Chen, 2015).[78] Absolute internet search volume is flexible to be compared across regions, therefore, it is suitable for my study where multiple cities in China are involved. In the next subsection, I explain in detail the acquisition and pre-processing of raw BSVI data.

The acquisition and pre-processing of raw BSVI data

I collect city-level raw BSVI on a daily basis from 2010 to 2018. I then transform the daily data to annual BSVI by calculating the daily average of BSVI in a year. To avoid collecting the daily BSVI manually by sending data requests repetitively, I develop a web crawling programme using Python with the BeautifulSoup package. More details about the acquisition of raw BSVI data are provided in Appendix A4.1.

As I mentioned in section 4.4.2, the raw BSVI is not adjusted for the general trend in the popularity of the internet searches. The unadjusted city-level raw BSVI transformed to annual indices may not correctly reflect people's attention and concerns over time for the following reasons. First, the increase (decrease) of BSVI over time may partially result from the growth (decline) of the total search engine queries. For example, the increase of Baidu's market share implies more users logging in Baidu.com, therefore, I may observe rises in BSVI of different keywords at the same time. Second, the total numbers of search queries are different across cities during a given period of time. For example, I observe that the annual BSVI of 'CPI' in 2018 is 156,220 in Beijing

[78] According to the definitions at https://trends.google.com, the GTI is normalised based on the highest GTI for the given region and time. A value of 100 is the peak popularity for the term. A value of 50 means that the term is half as popular. A score of 0 means that there was not enough data for this term.

and 74,460 in Nanjing. However, according to the National Bureau of Statistics of China (NBSC), the population of Beijing is more than twice that of Nanjing in 2018.[79] Therefore, the above-mentioned observation may simply result from the larger number of internet users in Beijing than in Nanjing. To take the popularity of internet searches into account, an ideal approach is to use data about the page view (PV) of Baidu.[80] To the best of my knowledge, there is no available PV data at city level. Therefore, I follow Xu and Gao (2017) and use the BSVI of a neutral keyword '百度 (Baidu)' to proxy the general trend in the popularity of internet searches. Xu and Gao (2017) discover that the search volume of '百度' is strongly correlated with the general trend of the total search queries using Baidu and the neutral keyword itself is not related to people's concerns about inflation.

Figure 4.2 shows an example of the daily BSVI of the neutral keyword and 'commodity price'. I observe that the BSVI of 'commodity price' was high in 2011 and 2015. I also observe that the BSVI of '百度' soared over the period 2011-2015. This trend results from the growth of internet searches from three possible aspects. First, China experienced a boom of the population of internet users through mobile devices. Also, accessing the internet through mobile devices became the dominant approach. According to the 2018 CNNIC report, the population of Chinese mobile internet users increased from 356 to 620 million over the period 2011-2015. During the same period, the percentage of internet users from mobile devices increased from 69% to 90%

[79] The NBSC website can be accessed at http://www.stats.gov.cn/

[80] PV is a good measure of the popularity of internet use. It refers to the total number of web pages being loaded or reloaded during a given period of time.

(CNNIC 2011, 2018). Second, over the period 2011-2015, the CNNIC (2018) reports that the average online time spent by a Chinese internet user increased rapidly from 18.7 to 26.2 hours per week. Third, Baidu became even more popular over the period 2011-2015 since Google's withdrawal from the Chinese market. According to Figure 4.1, the market share of Baidu increased from about 60% in 2011 to 70% in 2015. As a result, the BSVI of "(commodity) price" is underrated in 2011 if I do not adjust for the popularity of internet searches. Similarly, the BSVI of "(commodity) price" is overrated in 2015 because the popularity of internet searches is high.

I therefore use the following equation to adjust the daily inflation-related BSVI:

$$aBSVI_{ct} = \frac{BSVI_{ct}}{BSVI_{ct}^{neutral}} * 100 \quad (4\text{-}1)$$

where $BSVI_{ct}$ is the raw BSVI of my interest in city c. $BSVI_{ct}^{neutral}$ is the BSVI of the neutral keyword in city c. I transform the raw BSVI on a daily basis and yield the $aBSVI_{ct}$ (adjusted daily BSVI). Therefore, $aBSVI_{ct}$ can be interpreted as a projection of the percentage points of daily search volume of a keyword out of the total internet search volume using Baidu.com. The adjusted daily BSVI is further transformed to annual data by calculating the mean of adjusted daily BSVI over a year.

4.4.3. Econometric models

Baseline analysis with current-year adjusted BSVI

Based on the SWB equation applied by Di Tella *et al*. (2001, 2003) and Chen *et al*. (2014), I estimate the following model using adjusted BSVI to measure the current people's concerns about inflation:

$$SWB_{ict} = \beta * \overline{aBSVI}_{ct} + \theta' Z_{it} + \varepsilon_{irt} \quad (4\text{-}2)$$

where SWB_{ict} is the SWB score of individual i in city c over year t. $\overline{aBSVI}_{ct}$ is the mean of daily adjusted inflation-related BSVI in city c over year t. For hypothesis 1 to hold, I expect β to be significant and negative. Z_{it} is a set of demographic characteristics. Following Di Tella *et al*. (2003), Dolan *et al*. (2008) and Knight *et al*. (2009), I include age, age squared, gender, residence, educational degrees, marital status, employment status, health status, household size, household relative income, household assets and household debt.[81] The error term ε_{irt} in Equation (4-2) includes four components, that is, $\varepsilon_{irt} = \mu_r + \eta_t + \xi_i + \upsilon_{irt}$ where μ_r encompasses unobservable region-specific effects, η_t denotes time-specific effects, and ξ_i is an individual-specific effect. υ_{irt} includes all remaining components of the error term and is assumed to be i.i.d.

Accounting for the unexpected adjusted BSVI

Following section 4.3.2, I next use the inflation-related search volume in the previous period to proxy for people's expectations about future inflation and take into account the unexpected people's concern about inflation. I therefore estimate the following equation:

$$SWB_{ijt} = \beta * gap(\overline{aBSVI}_{ct}) + \theta' Z_{it} + \varepsilon_{ijt} \quad (4\text{-}3)$$

where $gap(\overline{aBSVI}_{ct}) = \overline{aBSVI}_{ct} - \overline{aBSVI}_{ct-1}$ refers to the unexpected people's concerns measured by the gap between current and previous year's adjusted BSVI in

[81] See Appendix A4.3 for more details about the selection of control variables and their expected signs.

city c. For Hypothesis 2 to hold, I expect β to be significant and negative. All other terms in Equation (4-3) are identical to those included in Equation (4-1).

Estimation methods

The SWB variable is measured on a five-point scale from "Not at all satisfied" to "Completely satisfied" with life. Responses to SWB questions can be treated as cardinal or ordinal, and SWB equations are usually estimated using ordinary least squares (OLS) or ordinal regression models such as ordered logit or probit.[82] Considering that my dataset is a panel, I initially estimate my equations using fixed-effects linear models. Next, to assess the robustness of my baseline results to different estimation methods, I also provide results based on a fixed effects ordered logit model using the 'Blow-up and Cluster' (BCU) estimator (Baetschmann *et al*., 2020).[83]

4.5. Data

4.5.1. The China Health and Retirement Longitudinal Study

I use four waves of the China Health and Retirement Longitudinal Study (CHARLS) collected in 2011, 2013, 2015, and 2018. The CHARLS is a nationally representative longitudinal survey focusing on Chinese residents ages 45 and older, which includes information on variables at individual, household, and community levels. Therefore, given that the aging of Chinese population is an inevitable trend in the coming decades, the CHARLS is suitable for my research aiming at providing suggestions for future

[82] The cardinal assumption of SWB data assumes that SWB scores reflect the absolute magnitude of well-being judgement and SWB scores are interpersonally comparable. The Ordinal assumption of SWB data posits that SWB scores show the rank order of different states (OECD, 2013).

[83] See Appendix A4.6 for more details about robustness checks.

inflation policies in China. The baseline survey in 2011 covers 17,708 individuals (main respondents and their spouse) from 124 cities and 28 provinces. These individuals were followed up in the next three waves. The attrition rate across any two consecutive waves is lower than 18%. As I mentioned in section 4.4, people's concern about inflation is measured by the annual mean of daily adjusted BSVI of each city. I therefore match the search volume data with the survey data according to year of interview and respondent's city of residence. At this stage, 73,398 individual-year respondents (respondents henceforth) aged 45 and over were retained with complete information about the city of residence. The number of observations with complete information of all control variables is 56,595. Details about the sample selection are included in Appendix A4.4.

4.5.2. Dependent variable

My main dependent variable is "Life satisfaction" which is used as a popular evaluative measure of SWB (Dolan *et al*., 2011; OECD, 2013). Each wave of the CHARLS includes the question: "Please think about your life-as-a-whole. How satisfied are you with it?" Respondents rank their life satisfaction on a 1-5 scale from "Not at all satisfied" to "completely satisfied". To assess the robustness of my results to an alternative SWB measure focusing on mental well-being, I include the Center for Epidemiological Studies 10-item depression scale (CES-D-10) which captures negative affects including subjective distress and negative mood states (Linton *et al*., 2019). The CES-D-10 collect self-reported frequencies of experiencing 10 depressive symptoms in the last week based on a 0-3 scale. Therefore, the total CES-D-10 score ranges from 0 to 30 (a higher score indicates more serious depressive symptoms). The original wordings of

the above-mentioned SWB measures are included in Appendix A4.2.

4.5.3. Independent variables

The adjusted BSVI of inflation-related keywords

Following the explanations in section 4.4, the independent variables I use are the adjusted BSVI of seven keywords including 'price', 'commodity price', 'CPI', 'inflation', 'price rise'. These BSVI are adjusted using equation (4-1) where the BSVI of '百度' serves as the proxy of the popularity of total internet searches. All adjusted BSVI are collected on a daily basis and then transformed to annual data by calculating the mean of daily data over a year. All adjusted BSVI are at the city-level and matched with the cities where the respondents live.

Control variables

Following Di Tella *et al*. (2003), Dolan *et al*. (2008) and Knight *et al*. (2009), I include a consistent set of individual- and household-level control variables in all my models. These are the respondent's gender, age, age squared, residency status, household size, education, marital status, employment status, health status, household relative income, household financial assets and household debts. Definitions of all control variables are included in Appendix A4 Table A4.1. The rationale for including the above-mentioned control variables is discussed in Appendix A4.3.

Descriptive Statistics

Table 4.2 presents the summary statistics of SWB measure and adjusted BSVI. Similar to Lu (2022) and Qian and Yan (2021), I observe that the mean response of life

satisfaction is 3.20 with a standard deviation of 0.76. Similar to Wang *et al*. (2020) and Fu *et al*. (2022), I observe that the mean CES-D-10 score is 9.20 with a standard deviation of 6.65.

I report the summary statistics of adjusted BSVI regarding five inflation-related keywords mentioned in section 4.3.3. The adjusted BSVI are transformed to the average daily data in each year and matched with the cities that respondents live in. First, I observe that the mean adjusted BSVI of 'price' is higher than that of 'commodity price'. This is consistent with my argument in section 4.3.3 that, compared to 'price', 'commodity price' is applied to topics specifically talking about the general price level. Second, the mean adjusted BSVI of 'CPI' and 'inflation' are significantly higher than other keywords. According to the explanations in section 4.4.2, the high average search volume for keywords related to inflation statistics partly results from the surge of investors' attention to the release of inflation statistics on the regular announcement dates. Third, I observe that the minimum values of all adjusted BSVI are zero. These zeros do not result from missing BSVI in specific cities because the BSVI of neutral keyword does not include any zero across all cities and years. Baidu Index help centre explains that the BSVI equals zero when the search volume of a keyword is very low. More details about the descriptive statistics of other variables can be found in Appendix A4.4.

4.6. Main results

4.6.1. Current people's concerns vs. unexpected people's concerns

To test hypothesis 1, I first estimate equation (4-2) containing current people's concerns about inflation measured by the mean of adjusted BSVI ($\overline{aBSVI}_{ct}$). Following Li *et al*. (2015), I initially focus on two keywords that are most used by the public when talking about inflation— 'commodity price' and 'price rise'. Column (1) and (2) in Table 4.3 suggest that the association between current people's concerns and SWB is not statistically significant. Therefore, hypothesis 1 is rejected. Column (3) and (4) in Table 4.3 report the estimates of equation (4-3) which considers the unexpected people's concerns about inflation measured by the gap between current and previous year's mean adjusted BSVI ($gap(\overline{aBSVI}_{ct})$). In line with Hypothesis 2, the results show significant and negative associations between the unexpected people's concerns about 'commodity price' and 'price rise' and SWB.

The results from Table 4.3 leads to the following discussions. First, my results imply that Chinese respondents' judgements of inflation rely on an adaptive inflation expectation mechanism. In accordance with Ranyard *et al*, (2008), adaptive inflation expectation is built on a simple mechanism—people generally assume that past price trends will continue. Using data from an online survey conducted in New Zealand in 2016, Hayo and Neumeier (2022) find a significant one-to-one relationship between respondents' self-reported inflation expectations and the previous year's inflation rate. Using quarterly survey data about individual inflation perceptions and expectations

provided by the People's Bank of China over the period 2001-2014, Xu *et al*. (2017) argue that adaptive inflation expectation is the driving mechanism of Chinese inflation judgments. Second, Chinese respondents are likely to evaluate current inflation relative to their inflation expectations. Given that a high inflation-related BSVI in the previous period means high expectations of future inflation, people will feel more worried when they discover that the current inflation is surprisingly higher than their expectations. Third, the above-mentioned results suggest that the cross-sectional comparison of people's inflation concerns across Chinese cities does not explain the regional heterogeneity of SWB. For example, I observe that the $\overline{aBSVI}_{ct}$ of 'price rise' in Shanghai (0.25) was more than twice that in Chongqing (0.12) in 2015. Such difference between cities suggests that the general price level in Shanghai is higher than Chongqing. However, it does not mean the citizens in Shanghai should report lower SWB than Chongqing. This can be explained by the fact that respondents in Shanghai have adapted to the living standard in a well-developed modern city with a high price level. Therefore, individual SWB is sensitive to increases in inflation concerns over time which imply the deterioration of people's adapted living standard.

4.6.2. Comparisons between various inflation-related keywords

Following the results in section 4.6.1, I expand my keyword base and estimate equation (4-3) using the unexpected people's concerns about inflation. In line with my expectation in section 4.3.3, column (1) of Table 4.4 shows an insignificant association between the $gap(\overline{aBSVI}_{ct})$ of 'price' and SWB. Keyword 'price' refers in fact neither to specific contexts nor to judgmental terms. Searching for 'price' on the internet is

associated with a broad range of incentives and many of them do not necessarily mean concerns about high inflation. Consistent with my expectation from section 4.3.3, column (2) of Table 4.4 shows significant and negative association between the $gap(\overline{aBSVI}_{ct})$ of 'commodity price' and SWB. However, Hypothesis 3 is partially rejected as I do not find a significant association between the $gap(\overline{aBSVI}_{ct})$ of 'CPI' and SWB from column (3). Last, in line with Hypothesis 3, columns (4) and (5) show that the $gap(\overline{aBSVI}_{ct})$ of 'inflation' and 'price rise' are all significantly and negatively associated with SWB.

I also interpret the economic significance by calculating the equivalent monetary loss of a one-standard-deviation increase in $gap(\overline{aBSVI}_{ct})$ ('equivalent monetary loss' henceforth).[84] Specifically, columns (2), (4), and (5) suggest that, when the unexpected adjusted BSVI of 'commodity price', 'inflation', and 'price rise' increase by one standard deviation, the equivalent monetary loss to a respondent is approximately equal to 0.85%, 0.08%, and 2.34% of his/her household's per capita financial assets. Exercising the 'equivalent monetary loss' is crucial because it allows me to compare the performance of BSVI across keywords regarding their ability to reflect people's concerns about inflation. The above-mentioned findings can be explained as follows.

Noise in search volume data: abnormal spikes in daily BSVI

I do not find a significant association between unexpected people's concerns about 'CPI' and SWB in column (3) although 'CPI' is characterised as a commonly used keyword

[84] See Appendix A4.5 for details about the calculation of economic significance.

when talking about issues related to the general price level. Also, column (3) and (4) suggest that, compared to 'price rise', the equivalent monetary loss of 'inflation' is about 30 times smaller. This finding is also surprising because searching for 'inflation' is obviously related to people's concerns about a positive price trend that may lead to high cost of living. However, I discover crucial issues regarding the patterns of daily BSVI focusing on 'CPI' and 'inflation'.

Daily BSVI of 'CPI' and 'inflation' contain abnormal spikes which feed considerable noise and outliers that are unrelated to concerns about high inflation and low SWB. Figure 4.3 shows the national daily BSVI of 'CPI', 'inflation', and 'price rise' in 2015. I observe regular spikes in the daily BSVI of 'CPI' and most of them appear exactly on the NBSC inflation statistics-release dates in all months.[85] Specifically, the average daily BSVI of 'CPI' on the statistics-release date is more than five time that on the non-statistics-release dates. Chen *et al*., (2016) argue that the surge in the BSVI of 'CPI' results from the great attention paid by financial investors who closely trace the newest CPI data. A professional practitioner in economics or finance may type in 'CPI' and search for statistics, news, reports, and articles about CPI for many times in a statistics-release day. Specifically, according to Figure 4.3, the annual mean of daily BSVI of 'CPI' in 2015 is overrated by about 13% due to the regular spikes associated with the release of inflation statistics. I also observe from Figure 4.3 that the BSVI of "inflation" increased by about 400% on the next day after the NBSC released

[85] The NBSC monthly inflation statistics release date is usually around the 10th of every month. The full release date schedule for each year can be checked at this site:
http://www.stats.gov.cn/tjsj/xxgbrc

the monthly inflation statistics on the 10th of August 2015. This may result from financial investors' consensus about high inflation after the analysing the newest inflation statistics. Similar spikes in the BSVI of 'CPI' and 'inflation' are consistently found in my collected data over the period 2010-2018.

I do not observe regular spikes or extremely high peaks in the BSVI of other keywords over the period 2010-2018. For example, Figure 4.3 shows that the BSVI of 'price rise' was high on 10th and 11th of May 2015 but still at a reasonable level compared to the general trend of the BSVI of 'price rise' in 2015. Therefore, the BSVI of 'price rise' is not likely to be misleading due to the noise information.

The future trajectory of inflation concerns

As I discussed in section 4.6.2, the BSVI of 'CPI' and 'inflation' contains sizable noise unrelated to people's concerns about inflation and could lead to misleading interpretations. Therefore, I no longer take them into consideration in the upcoming analyses. The two keywords that I will focus on hereafter are therefore 'commodity price' and 'price rise'. I see from column (2) and (5) that the equivalent monetary loss of 'price rise' is about 2.75 times larger than that of 'commodity price'. This can be explained by the extra negative-sentiment-related term contained in 'price rise'. In accordance with Li *et al*., (2015), compared to price fluctuations, laypeople are more sensitive to concrete signs of unfavourable price trends. Therefore, I conclude that the search data about 'price rise' is the best to capture inflation-related people's concerns that lead to low SWB. In the following discussions, I will particularly focus on the BSVI of 'price rise' and its possible applications in inflation policies.

Did the low and stable inflation environment in China perform well in improving Chinese people's well-being in the past decade? I can now answer this question by looking at people's unexpected inflation concerns measured by the $gap(\overline{aBSVI_{ct}})$ using 'price rise'. I observe from my data that the average $gap(\overline{aBSVI_{ct}})$ are -0.44, -0.75, 0, -0.04 in 2011, 2013, 2015 and 2018. These figures suggest that the people's concerns about inflation in each above-mentioned year were lower than its previous year. Given that people's unexpected inflation concerns are negatively associated with SWB, I conclude that the low and stable inflation environment did improve Chinese well-being. I then look at the future trajectory of people's concerns about inflation. Figure 4.4 shows the adjusted daily BSVI of 'price rise' from 2019 to 2021. I observe a surge of inflation concerns in mid-April 2020, high levels of people's concerns about 'price rise' in the fourth quarter of 2020, extremely high spikes of inflation concern in the first five months of 2021 and a high peak of inflation concerns in September and October 2021 (indicated by the shaded areas in Figure 4.4).

These high inflation concerns may largely result from the resurges of COVID-19 pandemic and corresponding lockdown policies in multiple provinces in 2020 and 2021.[86] Using vegetable price data in 151 wholesale markets across China in 2019 and 2020, Ruan *et al*. (2021) argue that lockdown policy caused immediate surges in

[86] Datils about Chinese COVID-19 epidemic figures and regional COVID-19 policy announcements can be accessed at this site: http://www.nhc.gov.cn/xcs/xxgzbd/gzbd_index.shtml
For example, the number of confirmed cases resurged in Heilongjiang, Neimenggu, and Shanxi in early-mid April 2020. The largest wave of COVID-19 pandemic in China appeared in March, April and May 2020 with about 30,000 positive cases per day in mid-April 2020. Multiple cities located in provinces including Fujian, Zhejiang, Shaanxi, Gansu, Shandong and Guangdong were put into strict lockdown due to the outbreak of Coronavirus Delta variant.

cabbage price due to the supply chain disruption.[87] Using data from an online survey covering 1,006 randomly selected Chinese consumers in June 2020, Li *et al*. (2020) finds that the surveyed consumers predicted a 54% probability of food price increase in the future six months with 51.30% and 8.4% of the them experiencing food price increase and food shortages during the COVID-19 outbreak. Consistent with previous studies that find a significant and positive association between hikes of food price and high levels of social unrests and psychosocial stress (Hadley *et al*., 2012; Bellemare, 2015), my main results predict large decreases in Chinese SWB due to the surges of inflation concerns since the outbreak of COVID-19 in early 2020. However, the annual inflation rates actually decreased from 2.9% in 2019 to 0.85% in 2021, which went into the opposite direction of people's inflation concerns suggested by Figure 4.4. This result implies that people's inflation concerns during extreme periods my largely deviate from general inflation statistics. People can suffer from excessive worry and fear about future price hikes due to the unpredicted trend of pandemic and lockdown policies.

4.6.3. Robustness check

To check the robustness of the main results presented above, I provide further estimates based on fixed-effects ordered logit models (Frey and Stutzer, 2000, 2002; Ferrer-i-Carbonell and Fritjers, 2004; Layard *et al*., 2008). The results, which are presented in Appendix A4 Table A4.4 are consistent with the main results in Table 4.4 in terms of the direction and significance of the parameters associated with unexpected people's

[87] The authors also find that the price hikes were more pronounced in vegetable-importing areas than vegetable-producing areas as the former areas' vegetable supplies largely rely on effective supply chains.

concerns about inflation.

I also check the robustness of the main results to an alternative SWB measure focusing on mental well-being—CES-D-10. The results, which are presented in Appendix A4 Table A4.5 are very similar to my main results. More details about the robustness checks are included in Appendix A4.6.

4.7. Extension

4.7.1. Does the BSIV represent inflation concerns of both internet users and non-internet users?

The representativeness of search data is considered as a crucial limitation because search data only concerns the search queries generated by internet users (Mavragani and Ochoa, 2019; Kamiński *et al*., 2020)). This is an important question considering that not all people use the internet. This concern is particularly valid in my dataset which covers a large proportion of older respondents. Hence, one could argue that the BSIV only represents the inflation concerns of internet users and non-internet users are indifferent about such concerns because they do not perceive high inflation.

I use three dummy variables to indicate household internet access and individual internet access, and individual recent internet use. The first, '*broadband*', equals 1 if the respondent's household has access to broadband, and 0 otherwise.[88] The second, '*pc_mphone*', equals 1 if the respondent and/or his/her spouse own personal computers

[88] The CHARLS only provides a question asking respondent's internet usage in the previous month of the survey interview. In future studies, variables that capture respondent's long-term internet usage over a year would be preferred because the SWB data and BSVI I use are annual data.

or/and mobile phones, and 0 otherwise. The third, '*r_internet*', equals 1 if the respondent used the internet in the past month, and 0 otherwise. Table 4.5 reports the descriptive statistics of these three variables by year. I observe that the percentage of having family broadband increased rapidly from 17% in 2011 to 48% in 2018. According to the CNNIC (2018), the "speed-up and low-rate" policy launched in 2015 largely increased the penetration rate of broadband. Specifically, the promotion of fibre broadband contributed significantly to the increasing coverage of broadband.[89] I also observe that about 88% of the respondents and their spouses own personal computers or/and mobile phones. However, very few respondents (7%) reported internet use in the previous month. This figure suggests that most respondents aged 45 and above did not frequently use the internet although they had broadband and device access to the internet.[90] In 2011, 2013, and 2015, only about 3%, 5% and 6% of the respondents reported recent internet use. This figure increased dramatically to 15% in 2018. Such observations are consistent with the CNNIC (2011, 2015, 2018) according to which the percentage of Chinese internet users aged 50 and above increased from 4% in 2011 to about 8% in 2015 and 13% in 2018.

Taking the potential difference between internet users and non-internet users into account, I investigate the heterogeneity of the association between people's unexpected inflation concerns and SWB across respondents with and without internet access and

[89] According to the CNNIC 2018 report, the number of fibre broadband users increased from less than 20 million in 2011 to 368 million in 2018. In 2018, over 90% of broadband users used fibre broadband.

[90] Lu and Kandilov (2021) observe the same pattern using the 2018 wave of the China Family Panel Studies. The authors explain that older people are usually short of internet knowledge or media literacy. These people may, however, be able to make phone calls and send text messages.

internet use. Therefore, based on equation (4-3), I include interaction terms between $gap(\overline{aBSVI}_{ct})$ and the three dummy variables including *pc_mphone*, *broadband* and *r_internet.* The regression results are presented in Table 4.6. First, consistent with the main results in Table 4.4, all columns in Table 4.6 suggest that the unexpected people's concerns about 'commodity price' and 'price rise' are significantly and negatively associated with SWB. Second, column (2) and (4) of Table 4.6 also suggests that respondents report significantly higher SWB if their households have access to broadband. This can be explained by the fact that households with access to broadband are generally rich and have better material living conditions. I observe from my data that the per capita income of households with access to broadband is in fact about 3 time that of households without broadband access.[91] Third, the parameters associated with the interaction between $gap(\overline{aBSVI}_{ct})$and dummies of internet access and recent internet use are all insignificant. These results suggest that the significant and negative association between the unexpected people's concerns about 'commodity price' and 'price rise' and SWB applies to both respondents with and without internet access and recent internet use.

The above-mentioned results support my argument that the BSVI is a valid measure

[91] I do not find significant association between SWB and *pc_mphone* and *r_internet*. Owning or using mobile devices have no direct impact on Chinese older adults' SWB because they do not tell how people use mobile phones (Lu and Kandilov, 2021). For example, Chan (2015) discovers a positive correlation between mobile voice communication and well-being, but not for mobile online communication. The author also argues that using mobile devices for passing time activities (e.g., watching movies, reading e-books or magazines, playing mobile games) are associated with more negative emotions. However, I cannot take this into account because the CHARLS only includes questions about how people use the internet in the 2018 wave.

of people's concerns about inflation both for internet users and people without access or who did not recently use the internet. Why are people without internet use also affected by inflation concerns? As I explained in section 4.4.1, search-data-based inflation concerns derive from internet users' experience of high commodity price in daily life. However, this does not mean that non-internet users should not experience the same inflation environment. For example, different consumers will go to grocery stores for similar necessities regardless of whether or not they use the internet. The increase of aggregate commodity prices is in fact an external social phenomenon that feeds into all people's perceptions The only difference between non-internet users and internet users is that non-internet users do not search on the internet for information to confirm their inflation concerns.[92]

4.7.2. Heterogeneity analysis

The main results in section 4.6 suggest that the maintaining low and stable inflation performed well by enhancing middle-aged and elderly Chinese people's well-being as I observe a decreasing trend of people's inflation concerns over the period 2011-2018. However, except for the implicit inflation targeting at a 3% annual inflation rate, *ad hoc* government policies are also applied in China which protect vulnerable cohorts if

[92] However, these explanations cannot not be generalised to other studies without concerns. For example, using search volumes related to COVID-19 symptoms to predict epidemic trends may be misleading because the older population has the highest COVID-19 morbidity coupled with a low rate of internet use (Sousa-Pinto *et al*., 2020). See Eysenbach (2011) for more discussion regarding the concerns about search data's representativeness in public health studies. Similarly, search volumes of well-being related keywords (e.g., sadness, sleep, stress and worry) may potentially be a biased measure of public well-being because the older people are less likely to use the internet but may be more likely to suffer from low well-being than the younger people (Brodeur *et al*., 2021).

maintaining the low and stale inflation fails. For example, according to the Chinese National Development and Reform Commission (CNDRC), to buffer the risk of high commodity prices during the COVID-19 pandemic, a city-level temporary Social Assistance and Security Subsidy (SASS) could be activated since November 2021 if the local monthly aggregate CPI inflation rates exceed 3.5% or the monthly food inflation rates exceeded 6%.[93] To carry out this policy efficiently, the CNDRC suggested that the local authorities should carefully identify the eligible recipients of the temporary subsidy, such as minimum living allowance and unemployment insurance recipients. I learn from the CNDRC that the SASS is a long-term policy guidance that aims at maintaining a high level of Chinese well-being and the criteria of eligible recipients will be amended accordingly buy the local governments.[94] Given the fact that the aging of the Chinese population has been an inevitable trend since 2000, one could ask which cohorts should be the prior recipients of long-term government protective subsidies in the future? The following analysis answers this question and provides a general guidance for the future implementations of tailored SASS policies in China.

First, compared to high income respondents, poor respondents are expected to be more concerned about high inflation because they have limited resources to maintain

[93] The SASS was firstly introduced in 2010 and the details can be accessed at this site:
http://www.gov.cn/zwgk/2010-11/20/content_1749484.htm
Details about the temporary SASS in 2021 can be accessed at this site:
https://www.ndrc.gov.cn/xwdt/tzgg/202111/t20211116_1304081.html?code=&state=123

[94] According to the CNDRC, governments of provinces or prefecture-level cities have the right to amend and activate the SASS policy according to local economic situations.

their living standards when facing increasing cost of living (Easterly and Fischer 2001). Second, compared to the employed cohort, respondents without a job are expected to be more concerned about high inflation because they are less likely to have a stable income source to buffer the risk of high inflation. Third, Vlandas (2018) argues that the elderly are more inflation averse because they are more concerned about the real value of their savings and pension income compared to the younger population who relies on wage earnings.[95] Therefore, based on equation (4-3) and using keyword 'price rise', I include interaction terms between people's unexpected inflation concerns and family per capita relative income, unexpected inflation concerns and employment status, and unexpected inflation concerns and *elderly* (a dummy variable which equals 1 for respondents aged 65 years and above, and 0 otherwise). The regression results are presented in Table 4.7.

Column (1) and (2) of Table 4.7 suggest that, compared to the respondents with the highest per capita income quartile within communities and employed, respondents who are from households with the lowest per capita relative income, no longer working and retired are significantly more concerned about inflation. Column (3) suggests that people's inflation concerns have a significantly stronger negative effects on SWB for the elderly their younger counterparts. These results are consistent with my expectations. Moreover, in line with Welsch and Kühling (2011) who study the inflation-SWB association among respondents in all age groups from 30 OECD

[95] Using individual inflation attitude data from the International Social Survey Program (ISSP) covering 21 OECD countries, Vlandas (2018) finds that being 65 and over is associated with a higher likelihood of identifying inflation as a first or second priority of governments' policies.

countries over the period 1990-2008, my results suggest that low income middle-aged and elderly Chinese people are also the most concerned about high inflation. Put my results in column (1), (2) and (3) together, elderly respondents in the lowest income quartile who are no longer working may be the most vulnerable cohort when facing high inflation environments. Specifically, focusing on respondents with the lowest per capita relative family income, I observe from my data that more than 40% of them are no longer working and 39% of them are aged 65 and above. As I mentioned in previous paragraph that unemployment insurance recipients are eligible to benefit from the SASS policy. However, this policy may need to be amended before it is generalized to a long-term policy in the future, because I observe from my data that about 26% of the middle-aged and elderly Chinese respondents were out of labor market, but less than 1% of them were registered to the unemployment insurance.[96] Therefore, considering the rapid aging of Chinese population I suggest an expansion of the eligible recipients of the SASS policy in the future to provide special protection for the low-income and non-working elderly population.

4.7.3. The BSVI of commodity-specific keywords

As I explained in the previous section, the current SASS policy in China can be

[96] According to the Chinese Regulations on Unemployment Insurance, an eligible unemployment insurance recipient needs to fulfil the following requirements. First, the individual and his former employer have fulfilled the insurance payment obligation for over a year. Second, the individual is unemployed unwillingly, has reported his unemployment to local authorities, and is looking for other jobs. The low unemployment insurance registration rate in my data may result from the fact that older people may quit the labor market due to poor health and most of them are not likely to find other jobs. Details about the requirements can be accessed at the site: http://www.gov.cn/zhengce/2020-12/26/content_5574281.htm

activated when the monthly food CPI growth rate exceeds 6%. This condition reminds a discussion about formulating commodity-specific inflation policies. The SASS policy chooses a 6% food inflation rate threshold because the hikes of food price is extremely harmful to low-income residents during the COVID lockdowns. Maintaining low and stable inflation rates focusing on specific commodities may benefit target cohorts of the population. For example, Chen *et al*. (2014) argue that low-income Chinese people are more concerned about food inflation than their high-income counterparts because food constitutes a considerable part of their expenditure. In a similar vein, middle-aged and elderly Chinese people may be particularly concerned about medicine prices than other commodities' prices because of the high prevalence of chronic illnesses among the old population in China which requires regular expenditures on medication (Zhou *et al*., 2019).

The flexibility of BSVI in terms of the selection of keywords is one of the outstanding advantages of search volume data. To assess the heterogeneity of the association between unexpected people's concerns about inflation and SWB across commodities among middle-aged and elderly Chinese people, I extract the BSVI of three keywords including 'food price', utilities price' and 'medicine price". Unfortunately, the Baidu Index does not provide a BSVI of the sentiment related version of the three above-mentioned keywords (e.g., 'rise in medicine price'). The selection of keywords is explained as follows (see Table 4.8 for Chinese wordings of the keywords).

First, I include 'food price' because food is the most frequently purchased category

which accounts for the highest weighting basis of the official aggregate inflation statistics (Ranyard *et al*., 2008; Abildgren and Kuchler, 2021).[97] More importantly, using detailed diary-based consumption data from the Urban Household Survey conducted by the NBSC, Dong and Yang (2017) argue that the per capita food expenditure in China declines upon retirement because the elderly prefer to purchase low-price food. Therefore, high food price is expected to be a significant concern of the respondents in the CHARLS. Second, expenditures on household utilities include bills for water, electricity, fuel, natural gas and so on. They are regularly paid and essential for household functioning such as heating and cooking. High utilities prices are expected to be a significant concern for individuals. However, compared to 'food price', the magnitude of the negative impact of the people's concerns about 'utilities price' is expected to be smaller because utilities are less important in the household consumption basket in terms of their expenditure share.[98] Third, 'medicine price' is likely to be an important keyword because the middle-aged and elderly usually allocate sizable percentages of expenditure to health care. I find from the CHARLS that the median expenditure share of family medical expenditure is more than 27% over the period 2011-2018, which is very close to the Engel coefficient given by the NBSC. Therefore, I expect that concerns about 'medicine price' has a significant and considerable negative impact on SWB.

Table 4.9 reports the estimates of equation (4-3) using unexpected people's

[97] According to the NBSC, the Engel coefficient is around 30% over the period 2011-2018.

[98] I observe from the 4 waves of CHARLS that the average expenditure shares of food and utilities are about 46% and 6%.

concerns about the above-mentioned three keywords. All columns of Table 4.9 suggest that the unexpected BSVI of all five keywords are significantly and negatively associated with SWB. I also provide the equivalent monetary loss to compare the economic significance of β between commodities (see Appendix A4.5 for details about the calculation of economic significance). When the unexpected adjusted BSVI of 'food price', 'utilities price', and 'medicine price' increase by one standard deviation, the equivalent monetary loss to a respondent is respectively equal to 4.5%, 2.7% and 5.6% of his/her household's per capita financial assets.

Consistent with my expectations, the equivalent monetary loss of 'food price' is much higher than that of 'utilities price' because food is more important in the household's consumption basket in terms of expenditure and frequency of purchase. Lastly, I discover that the equivalent monetary loss of 'medicine price' is higher than that of 'food price'. The medical insurance schemes in China only cover part of the recipients' medical bills. Therefore, the respondents in my sample may still need to pay a lot for medical treatments. For example, Chinese medical insurance schemes contain the New Rural Cooperative Medical Scheme (NCMS), and the Urban Resident Medical Insurance (URMI), Urban Employee Medical Insurance (UEMI). Using the 2011 wave of the CHARLS, Zhang *et al*. (2017) find that the median values of the reimbursement rates of NCMS, URMI and UEMI are 25%, 33% and 66%. According to the Circular Concerning Opinions on Advancing the Drug Pricing Reform (CNDRC, 2015), the pricing of non-reimbursed drugs follows a market-driven pricing system rather than a government-led pricing system. That is to say the prices of non-reimbursed drugs are

set freely by the manufacturers which accurately reflect their costs, supply and demand. Therefore, high inflation rates of medicine can sometimes be observed. [99] The above-mentioned results suggest that middle-aged and elderly population in China are particularly concerned about high medicine prices. On the one hand, high medicine prices may reduce the affordability of medicine for individuals who need regular medical treatments. On the other hand, the fear of future high medical costs may also lead to low SWB among healthy individuals because the aging population are more vulnerable to illness.

4.8. Conclusion

I am the first to explore the association between search-volume-data-based people's concerns about inflation and individual SWB. I propose an adjusted BSVI of inflation-related keywords to measure people's concerns about inflation. The adjusted BSVI are at city-level and account for the popularity of total internet searches. Using individual SWB data for more than 56,000 middle-aged and elderly Chinese from 2011 to 2018 waves of the CHARLS, my main results suggest that the unexpected people's concerns about inflation measured by the gap between current and previous adjusted BSVI are significantly and negatively associated with SWB. I also find that the search data of 'price rise' is the best to reflect people's concerns about inflation in terms of the economic significance of its negative impact on individual SWB.

I extended my analyses by looking at the variations of the association between

[99] For example, the annual inflation rate of "medicine and medical instruments" in Beijing was 3.7% in 2016. It was even higher than the annual inflation rate of food (3.3%) in Beijing in 2016.

unexpected people's concerns about inflation and SWB across different demographic groups and commodity-specific keywords. The results suggest that the BSVI of inflation-related keywords describes the general inflation environment experienced by people with and without internet access. Moreover, non-working elderly population with low family income are vulnerable to high inflation. Finally, middle-aged and elderly people in China are more concerned about medicine prices than food prices.

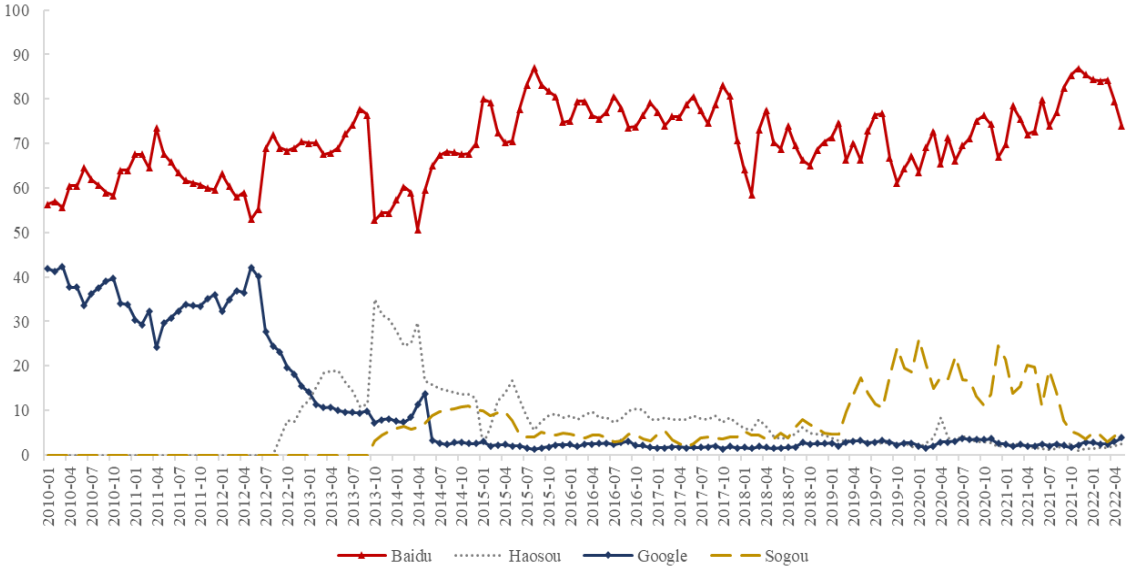
My results have important policy implications. First, search data provides an alternative channel for policy makers to evaluate the performance of previous inflation policies. I argue that the previous government policies aiming at maintaining low and stable inflation was successful in enhancing Chinese people's SWB as people's concerns about inflation decreased over the period 2011-2018. Second, I argue that people's inflation concerns went in the opposite direction of CPI inflation rates during the COVID-19 pandemic in 2020 and 2021 due to people's excessive concerns about surges of inflation. Therefore, relying on the traditional negative association between inflation rates and SWB in this case may derive misleading policy suggestions. Third, my results provide insights for future *ad hoc* inflation policies focusing on specific cohorts and commodities. Maintaining low and stable inflation and especially medicine price is of great importance to benefit the well-being of the growing non-working elderly population with low family income.

My work also has limitations of the data and is possible to be extended as follows. First, the BSVI does not provide search volume data of hybrid keywords. For example, people may search short sentences that includes "price" and "grocery store" at the same

time. Therefore, I cannot identify people's concerns about inflation subject to specific incentives. The Google Trends Index does allow us to look into different combinations of keywords. Future studies are recommended to explore the link between SWB and people's concerns about inflation with different information-search incentives (e.g., checking price tags at grocery stores, looking for discounts or economic news). Second, SWB data is collected on an annual basis which does not support the timely monitor of inflation-SWB association. This is very important when extensive concerns about inflation are frequently observed within a short time period. Future studies that investigate the association between search-volume-based inflation concerns and SWB using high frequency data are recommended. Third, search volume data has the potential to reflect people's concerns about wider factors that are difficult to be measured. For example, people's concerns about social stability contain various concepts which do not have feasible quantitative measures, such as social trust, social justice, and job satisfaction. Therefore, future studies can collect search volume indices of a set of carefully selected keywords to investigate the association between SWB and complex economic and social factors.

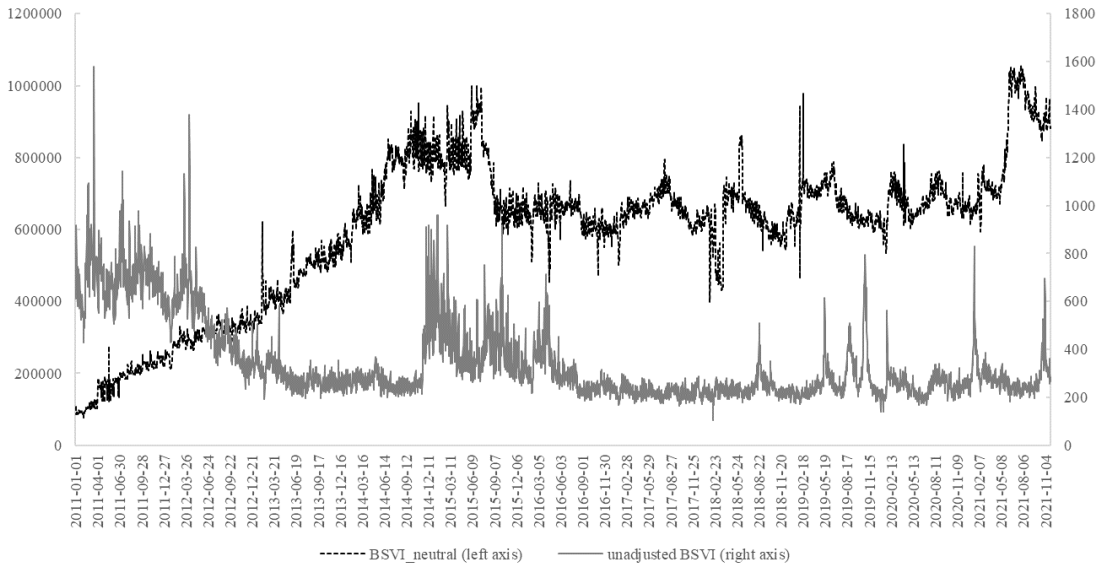
Figures and Tables in Chapter 4

Figure 4.1 Market shares of search engine websites in China



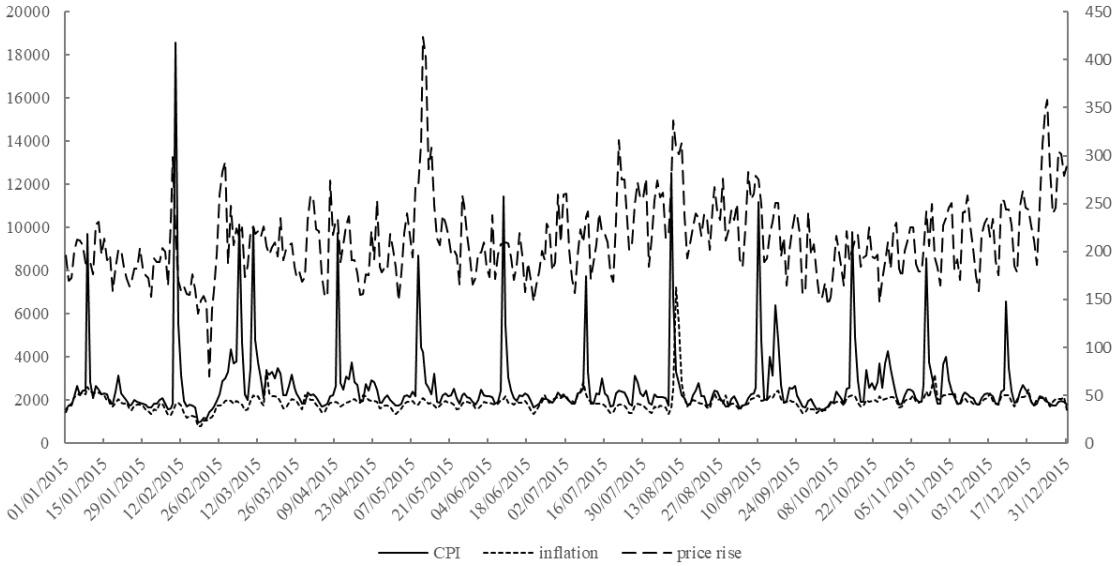
Note: Data source is StatCounter.com. This figure shows monthly market shares (in percentages) of the four most-used search engine websites in China since 2010.

Figure 4.2 Neutral-keyword BSVI and unadjusted BSVI



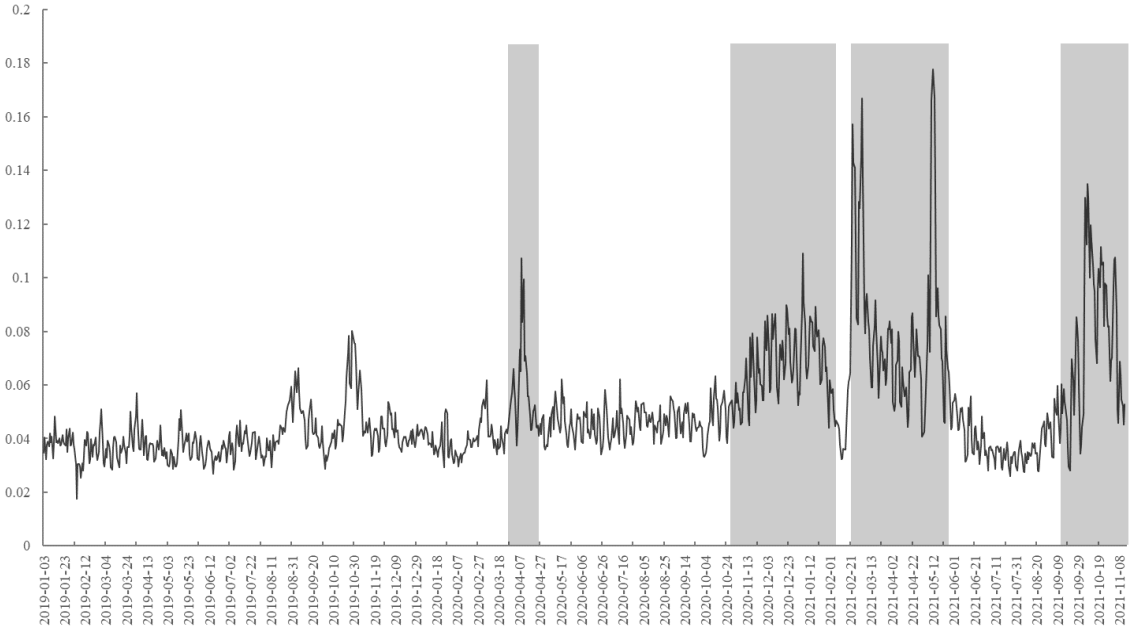
Note: Data source: daily BSVI collected from Baidu Index. Neutral keyword is '百度(Baidu)'. Unadjusted BSVI's keyword is '(commodity) price'.

Figure 4.3 Adjusted daily BSVI of 'CPI', 'inflation', and 'price rise'



Note: Data source: adjusted daily BSVI at national level from 1st January 2015 to 31st December 2015 according to authors' calculation.
The solid line shows the daily BSVI of 'CPI' (left axis). The dotted line shows the daily BSVI of 'inflation' (left axis). The dashed line shows the daily BSVI of 'price rise' (right axis).

Figure 4.4 Adjusted daily BSVI of 'price rise' from 2019 to 2021



Note: Data source: adjusted daily BSVI of 'price rise' at national level according to authors' calculation. The shaded areas indicate the periods with people's excessive concerns about inflation since the outbreak of COVID-19.

Table 4.1 Keyword base for Baidu Search Volume Index

Type of keywords	keyword code	Chinese keywords	Chinese alphabetic	English definitions
General price-related keyword	Ky_1	价格	jiage	price
Topic-specific keywords	Ky_2	物价	wujia	commodity price
	Ky_3	CPI	CPI	CPI
Negative-sentiment-related keywords	Ky_4	通货膨胀	tonghuo pengzhang	inflation
	Ky_5	涨价	zhangjia	price rise

Table 4.2 Summary statistics.

Variable names	Definitions	Mean (SD)	Observations	min	max
SWB measure	*Response code*				
Life satisfaction	1-5 scale from not at all satisfied to completely satisfied	3.20 (0.76)	56,595	1	5
CES-D-10	10 questions about depressive symptoms with total a total score ranges from 0-30	9.20 (6.65)	58,254	0	30
Adjusted BSVI	*Definitions of search keywords*				
$\overline{aBSVI\_1}$	price	2.07 (1.26)	56,595	0	6.82
$\overline{aBSVI\_2}$	commodity price	1.00 (1.47)	56,595	0	9.09
$\overline{aBSVI\_3}$	CPI	6.37 (6.28)	56,595	0	29.09
$\overline{aBSVI\_4}$	inflation	4.66 (4.18)	56,595	0	22.73
$\overline{aBSVI\_5}$	price rise	0.49 (0.76)	56,595	0	4.17

Notes: Life satisfaction and happiness data are from the 2011, 2013, 2015, and 2018 waves of the CHARLS. All adjusted BSVI are transformed to annual data by calculating the mean of adjusted daily BSVI. Standard deviations are in parentheses.

Table 4.3 Adjusted BSVI vs. unexpected adjusted BSVI

keywords	commodity price	price rise	commodity price	price rise
	(1)	(2)	(3)	(4)
$\overline{aBSVI}_{ct}$	0.0011	0.0105		
	(0.0046)	(0.0078)		
$gap(\overline{aBSVI}_{ct})$			-0.0174***	-0.0302***
			(0.0042)	(0.0065)
Control variables	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes
Obs.	56,595	56,595	56,595	56,595
R-squared	0.0736	0.0736	0.0740	0.0741

Note: *Column (1) and (2) reports the estimates of baseline equation (4-2) using adjusted BSVI. Column (3) and (4) report the estimates of equation (4-3) using the unexpected adjusted BSVI. All models were estimated using a fixed-effects linear estimator. The dependent variable in all models is life satisfaction. Data from the 2011 to 2018 waves of the CHARLS were used in estimation. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Table 4.4 Comparisons between various inflation-related keywords

keywords	price	commodity price	CPI	inflation	price rise
	(1)	(2)	(3)	(4)	(5)
$gap(\overline{aBSVI_{ct}})$	-0.0044	-0.0174***	0.0006	-0.0037**	-0.0302***
	(0.0041)	(0.0042)	(0.0012)	(0.0019)	(0.0065)
lffassets	0.0084***	0.0086***	0.0084***	0.0084***	0.0084***
	(0.0016)	(0.0016)	(0.0016)	(0.0016)	(0.0016)
Eq. ffasset changes	N/A	0.85%	N/A	0.08%	2.34%
Control variables	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes
Obs.	56,595	56,595	56,595	56,595	56,595
R-squared	0.0736	0.0740	0.0736	0.0737	0.0741

Note: *This table reports the estimates of equation (4-3) using five keywords. All models were estimated using a fixed-effects linear estimator. The dependent variable in all models is life satisfaction. Data from the 2011 to 2018 waves of the CHARLS were used in estimation. 'Eq. ffasset changes' refers to the equivalent per capita family financial asset loss of a one-standard-deviation increase in* $gap(\overline{aBSVI_{ct}})$*. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Table 4.5 Descriptive statistics of households' internet access

year	2011	2013	2015	2018	Full sample
	(1)	(2)	(3)	(4)	(5)
broadband	0.1681	0.2342	0.2757	0.4829	0.2912
	(0.3739)	(0.4235)	(0.4469)	(0.4997)	(0.4543)
Obs.	13,751	15,425	12,799	14,439	56,414
pc_mphone	0.8000	0.8825	0.9093	0.9369	0.8824
	(0.4001)	(0.3221)	(0.2872)	(0.2431)	(0.3221)
Obs.	13,739	15,502	12,854	14,438	56,533
r_internet	0.0279	0.0461	0.0550	0.1533	0.0711
	(0.1648)	(0.2098)	(0.2280)	(0.3603)	(0.2570)
Obs.	13,776	15,502	12,854	14,463	56,595

Note: This table reports the mean and standard deviations (in parentheses) of three dummy variables indicating household internet access, individual internet access, and individual recent internet use by year. 'broadband' equals 1 if the respondent's family has access to broadband, 0 otherwise. 'pc_mphone' equals 1 if the respondent (and/or his/her spouse) own personal computers or mobile phones, 0 otherwise. 'r_internet' equals 1 if the respondent used the internet in the past month, 0 otherwise.

Table 4.6 Representativeness of inflation-related BSVI

keywords	commodity price	commodity price	commodity price	price rise	price rise	price rise
	(1)	(2)	(3)	(4)	(5)	(6)
$gap(\overline{aBSVI_{ct}})$	-0.0177*	-0.0181***	-0.0182***	-0.0491***	-0.0268***	-0.0294***
	(0.0098)	(0.0047)	(0.0043)	(0.0169)	(0.0073)	(0.0066)
broadband	0.0303***			0.0255**		
	(0.0109)			(0.0111)		
pc_mphone		0.0134			0.0242	
		(0.0145)			(0.0155)	
r_internet			0.0055			-0.0023
			(0.0181)			(0.0184)
$gap(\overline{aBSVI_{ct}})$* pc_mphone	0.0004			0.0289		
	(0.0100)			(0.0178)		
$gap(\overline{aBSVI_{ct}})$* broadband		0.0033			-0.0130	
		(0.0063)			(0.0117)	
$gap(\overline{aBSVI_{ct}})$* r_internet			0.0117			0.0191
			(0.0102)			(0.0216)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	56,533	56,414	56,595	56,533	56,414	56,595
R-squared	0.0741	0.0742	0.0740	0.0741	0.0743	0.0741

Note: *This table reports the estimates of equation (4-3) using the unexpected adjusted BSVI of two keywords. All models were estimated using a fixed-effects linear estimator. The dependent variable in all models is life satisfaction. Data from the 2011 to 2018 waves of the CHARLS were used in estimation. I include three interaction terms between* $gap(\overline{aBSVI_{ct}})$ *and three dummy variables indicating household internet access, individual internet access, and individual recent internet use. 'broadband' equals 1 if the respondent's family has access to broadband, 0 otherwise. 'pc_mphone' equals 1 if the respondent (and/or his/her spouse) own personal computers or mobile phones, 0 otherwise. 'r_internet' equals 1 if the respondent used the internet in the past month, 0 otherwise. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Table 4.7 Inflation aversion of the aging population

	(1)	(2)	(3)
$gap(\overline{aBSVI}_{ct})$	-0.0245**	-0.0118*	-0.0237***
	(0.0112)	(0.0065)	(0.0072)
$gap(\overline{aBSVI}_{ct})$* relative_fincome (reference group: highest quartile)			
# lowest quartile	-0.0312**		
	(0.0157)		
# lower-middle quartile	-0.0019		
	(0.0159)		
# upper -middle quartile	0.0062		
	(0.0153)		
$gap(\overline{aBSVI}_{ct})$* employment (reference group: employed)			
# out of labour market		-0.0191**	
		(0.0079)	
# retired		-0.0390**	
		(0.0154)	
$gap(\overline{aBSVI}_{ct})$* elderly			-0.0259**
			(0.0128)
Control variables	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes
Obs.	56,595	56,595	56,595
R-squared	0.0743	0.0743	0.0742

Note: Note: *This table reports the estimates of equation (4-3) using the unexpected adjusted BSVI of 'price rise'. All models were estimated using a fixed-effects linear estimator. The dependent variable in all models is life satisfaction. Data from the 2011 to 2018 waves of the CHARLS were used in estimation. I include three interaction terms between* $gap(\overline{aBSVI}_{ct})$ *and age, employment status, and relative family income per capita. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Table 4.8 Inflation-related keywords of specific commodities

Keyword code	Chinese keywords	Chinese alphabetic	English definitions
Ky_E1	食品价格	shipin jiage	Food price
Ky_E2	水电价格	shuidian jiage	Utilities price
Ky_E3	药品价格	yaopin jiage	Medicine price

Table 4.9 SWB and the BSVI of commodity-specific keywords

Keywords	food price	utilities price	medicine price
	(1)	(2)	(3)
$gap(\overline{aBSVI}_{ct})$	-0.0255*	-0.0221**	-0.0538***
	(0.0148)	(0.0104)	(0.0088)
lffassets	0.0084***	0.0084***	0.0084***
	(0.0016)	(0.0016)	(0.0016)
Eq. ffasset changes	4.5%	2.7%	5.6%
Control variables	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes
Obs.	56,595	56,595	56,595
R-squared	0.0736	0.0737	0.0746

Note: *This table reports the estimates of equation (4-3) using the unexpected adjusted BSVI of three keywords related to specific categories of commodities. All models were estimated using a fixed-effects linear estimator. The dependent variable in all models is life satisfaction. Data from the 2011 to 2018 waves of the CHARLS were used in estimation. 'Eq. ffasset changes' refers to the equivalent per capita family financial asset loss of a one-standard-deviation increase in* $gap(\overline{aBSVI}_{ct})$*. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Appendix A4

A4.1 The acquisition of raw BSVI data

The Baidu Index does not provide a download function that aggregate your selected data to an csv file. Figure A4.1 shows a screenshot of Baidu Index of requiring the line chart of daily BSVI of 'price rise' in Shanghai from 1st January 2021 to 31st December 2021. The type of the data I choose is 'PC+Mobile' which equals the sum of BSVI from personal computers and mobile devices. Figure A4.1 shows that Baidu Index only provides an average daily BSVI at the bottom of the chart. To obtain daily BSVI of 'price rise', I need to repeat the above-mentioned requests but change the time period to a specific date (e.g., 01/01/2021 – 01/01/2021). Therefore, Figure A4.2 shows that the BSVI of 'price rise' in Shanghai on 1st January 2021 equals 61. This is very time consuming if multiple keywords and years of daily data in different cities are involved. So, I develop a web crawling programme using Python with BeautifulSoup package which exactly mimics and repeats the above-mentioned steps for each keyword, city, and date.

A4.2 The wording of life satisfaction and CES-D-10 questions in the CHARLS

A4.2.1 Life satisfaction

The original wording of life satisfaction question in the CHARLS uses a 1-5 Likert scale from "completely satisfied" to "not at all satisfied". I reversed the scale as follows.

> *Please think about your life-as-a-whole. How satisfied are you with it?*
>
> *(Original wording in Chinese: 总体来看，您对自己的生活是否感到满意？)*

1-5 Likert scale:

1. *Not at all satisfied (一点也不满意)*
2. *Not very satisfied (不太满意)*
3. *Somewhat satisfied (比较满意)*
4. *Very satisfied (非常满意)*
5. *Completely satisfied (极其满意)*

A4.2.2 CES-D-10

CHARLS uses the Chinese translation provided at the Center for Epidemiologic Studies website. The answers for CES-D are on a 1-4 scale, from rarely, to some days (1-2 days), to occasionally (3-4 days) to most of the time (5-7 days). I score these answers using a 0-3 scale suggested by Radloff (1977). Numbers from 0 for rarely to 3 for most of the time are used for negative questions such as "I felt depressed". For positive questions such as "I was happy", the scoring is reversed from 0 for most of the time to 3 for rarely. The original questions with Chinese wordings are as follows. Question Q5 and Q8 are the only two positive questions.

The 10 items below refer to how you have felt and behaved during the last week. Choose the appropriate response.

(Original wording in Chinese: 下面 10 道问题是有关您上周的感觉及行为，每道题目的答案都是一样的。)

Frequency of how you have felt and behaved:

1. *Rarely or none of the time (< 1 day) 很少或者根本没有（< 1 天）*
2. *Some or a little of the time (1 - 2 days) 不太多（1 – 2 天）*
3. *Occasionally or a moderate amount of the time (3 - 4 days) 有时或者说有一半的时间（3 – 4 天）*
4. *Most or all of the time (5 - 7 days) 大多数的时间（5 – 7 天）*

Q1. I was bothered by things that don't usually bother me. (我因一些小事而烦恼。)

Q2. I had trouble keeping my mind on what I was doing. (我在做事时很难集中精力。)

Q3. I felt depressed. (我感到情绪低落。)

Q4. I felt everything I did was an effort. (我觉得做任何事都很费劲。)

Q5. I felt hopeful about the future. (我对未来充满希望。)

Q6. I felt fearful. (我感到害怕。)

Q7. My sleep was restless. (我的睡眠不好。)

Q8. I was happy. (我很愉快。)

Q9. I felt lonely. (我感到孤独。)

Q10. I could not get "going". (我觉得我无法继续我的生活。

A4.3 Control variables

A4.3.1 Details about the selection of control variables

Table A4.1 presents the definition of control variables I use in this study. Following Dolan *et al*. (2008), I include a consistent set of individual- and household-level control variables which take into account the major determinants of SWB from four dimensions. First, to control for basic personal and family characteristics, gender, age, age squared, and household size are included. According to Blanchflower and Oswald (2004), Ferrer-i-Carbonell, and Gowdy, (2007), and Chen *et al*. (2020), SWB is U-shaped in age with lowest life satisfaction occurring in middle age (between about 32 and 50). Therefore, age squared is considered to capture the nonlinear association between age and SWB. However, my sample only includes respondents aged 45 and above.

Therefore, the nonlinear association between age and SWB may not be significant in my study. As for gender, males usually tend to report lower SWB (see, e.g., Alesina, Di Tella, and MacCulloch, 2004; Welsh, 2007; Chen *et al.,* 2020). According to Wunder (2012), individuals living in larger families are more likely to report high SWB. Second, to control for individual socially developed characteristics, I include several categorical variables related to personal highest education degree attained, employment status, and self-rated health status. According to Dolan *et al*. (2008), individuals with bad health status, low education level and without jobs consistently report low SWB. Third, to control for individual relationships, I include marital status. Generally speaking, individuals who are part of a partnership (married or cohabitating) are likely to report higher SWB than individual who are alone. Fourth, to control for income and household finance, I include several variables related to income, assets, and debts. Following Blanchflower and Oswald (2004), and Wang and Tapia Granados (2019), I include household income quartiles calculated within communities to measure household relative income. As for household assets and debts, I include the log of per capita household financial assets and the log of per capita household total debts. I originally planned to control for the log of per capita household total assets. However, the 2018 wave of CHARLS does not provide complete information to identify the ownership of house properties of a family. According to Turunen and Hiilamo (2014) and Chen *et al*. (2020), individuals with high household assets and low debts report higher SWB.

In addition to the above-mentioned four dimensions of the determinants of SWB, I additionally introduce a categorical variable to reflect individuals' residency status.

Hukou is China's residence administrative registration system. A Chinese citizen holds either an "agricultural" or "non-agricultural" hukou. Hukou determines the accessibility to various local public services and welfare benefits (Chan, 2013; Song, 2014). For example, purchasing houses in many urban cities (especially big cities) is restricted if the resident does not hold a local non-agricultural hukou. The social insurance programs are attached to the resident's hukou location. Therefore, I expect that respondents with non-agricultural hukou report higher SWB than respondents with agricultural hukou.

A4.3.2 Results and discussions of control variables

Table A4.3 reports the full table of the regression results included in Table 4.3. The signs, significance and magnitudes or al control variables are very similar across all columns. This may explain a very low correlation between BSVI and any other control variables. Consistent with my expectation, I do not find a U-shaped association between SWB because my sample only include middle-aged and elderly respondents. I do not find significant difference of SWB between male and female. According to Dolan *et al*. (2008), gender effect often disappears when many other demographic control variables are included such as health status. Consistent with Dolan *et al*. (2008) and Wunder (2012), SWB is higher among respondents who are married, do not work, healthier, richer, have more family members. I also do not find significant difference of SWB between agricultural and non-agricultural hukou holders. This may result from the low variation of hukou status over time as my sample include respondents aged 45 and above. These respondents are not likely to move their place of residence and change their hukou status. Therefore, I observe that only 10% of the respondents changed

hukou status and less than 2% of the respondents moved between urban and rural areas over the period 2011-2018. Consistent with Turunen and Hiilamo (2014), SWB is found to be lower if the respondent's family has higher debts. I do not find clear evidence showing a significantly positive association between education and SWB. According to Dolan *et al*. (2008), the association between education and SWB is often found to be insignificant in panel models due to the following two reasons. First, fully controlling for health and income may silence the contribution of education to SWB. Second, fixed effects models usually show insignificant education-SWB associations because most adult respondents are unlikely to improve their education level over the survey years. Additionally, I originally include 5 dummies indicating the 6 geographical regions in China (North, Northeast, East, South-Central, Southwest, Northwest). However, they are all omitted after including the fixed effects. This may result from a very low population mobility among the middle-aged and elderly Chinese.

A4.4 Descriptive statistics

As I mentioned in section 4.5, 73,398 individual-year respondents (respondents henceforth) aged 45 and over were retained after excluding 614 respondents who did not properly report his/her city of residence. I then exclude 7,623 respondents who did not report life satisfaction scores, and 65,775 respondents were retained. In the next step, I exclude 4,365 respondents with missing values in control variables including gender, age, hukou, household size, education, marital status, employment status, self-rated health status, relative household income per capita and per capita household total debts. I also exclude 4,815 respondents from with missing values in family financial

assets, or reported zero cash and deposit. Finally, the number of observations with complete information of all variables is 56,595.

Table A4.2 reports the descriptive statistics of the control variables based on the sample used for the estimation of equation (4-2) and (4-3) in section 4.6. The sample includes 56,595 observations. The mean, standard deviation, minimum and maximum values are reported for each control variable. For individual-level control variables, I observe that the average age of the respondents is 60 years old and about 49% of them are male. The total sample covers about 22% non-agricultural hukou respondents and 78% agricultural hukou respondents. The average educational degree is generally low. About 35% of the respondents hold an educational degree above middle or high school. I also observe that 88% of the respondents are married or cohabitating with partners, 26% do not have a job and 5% are retired. As for family-level control variables, I observe that the average household size is less than three. The mean of the log of per capita household total debts is low because less than 10% of the respondents' families hold debts.

A4.5 The calculation of economic significance

Equation (4-3) can be rewritten as follows, taking the log of per capita household financial assets out of the vector *Z*:

$$SWB_{ijt} = \beta * g\left(\overline{adJ\_BSVI}_{ct}\right) + \alpha\, ln(ffassets_{it}) + \theta' Z_{it} + \varepsilon_{ijt} \qquad \text{(A4-1)}$$

To calculate the marginal rate of substitution between unexpected adjusted BSVI and the log of per capita family financial assets, I differentiate $ffassets_{it}$ with respect

to $g\left(\overline{adJ\_BSVI}_{ct}\right)$. Suppose that the SWB is fixed at a constant level, the following equation calculates the equivalent monetary evaluation of a one-standard-deviation increase in $g\left(\overline{adJ\_BSVI}_{ct}\right)$.

$$\frac{d(ffassets_{it})}{d[g(\overline{adJ\_BSVI}_{ct})]} = -\frac{\beta}{\alpha} ffassets_{it}, \text{ where } d\left(SWB_{ijt}\right) = 0 \qquad \text{(A4-2)}$$

Keeping the SWB level unchanged, $\frac{\beta}{\alpha}$ indicates the proportional change of per capita household financial assets that counteracts the impact of a one-standard-deviation increase of $g\left(\overline{adJ\_BSVI}_{ct}\right)$. When $\frac{\beta}{\alpha} < 0$ and $g\left(\overline{adJ_BSVI}_{ct}\right)$increases by one standard deviation, the equivalent monetary loss to respondent i is approximately equal to $\frac{-\beta * STD[g(\overline{adJ\_BSVI}_{ct})] * 100}{\alpha}$% of his family's per capita financial assets.

A4.6 Robustness checks

A4.6.1 Robustness to different estimation methods

Responses to SWB questions are usually treated as cardinal or ordinal, and SWB equations are usually estimated using ordinary least squares (OLS) or ordinal regression models such as ordered logit or probit (Ferrer-i-Carbonell and Frijters, 2004). The cardinal assumption of SWB data assumes that SWB scores reflect the absolute magnitude of well-being judgement and SWB scores are interpersonally comparable. The Ordinal assumption of SWB data posits that SWB scores show the rank order of different states (OECD, 2013). Focusing on the determinants of well-being, there is no virtual qualitative difference between the regression results from microeconomic equations under cardinal and ordinal assumptions (Frey and Stutzer, 2000, 2002; Ferrer-i-Carbonell and Fritjers, 2004; Layard *et al*., 2008; Dolan *et al.,* 2008; Dickerson *et al*.,

2014).

In this study, my baseline results are based on fixed-effects OLS regressions. To assess the robustness to ordinal assumption of SWB data, I estimate equation (4-3) based on fixed-effects ordered logit regressions. The Stata command I use is "feologit", which applies the 'Blow-up and Cluster'(BUC) estimator proposed by Baetschmann *et al*. (2020). All columns of Table A4.4 report marginal effects (at means) of the fixed effects ordered logit estimates. Respondents who are observed only once or have always the same life satisfaction scores over time are excluded by the program (because their log likelihood contribution is zero). As a result, 9,940 respondents are drooped. Consistent with my main results reported in Table 4.4, column (2), (4) and (5) of Table A4.4 suggest that the likelihood of reporting high life satisfaction significantly increases with the unexpected people's concerns about 'commodity price', 'inflation' and 'price rise'.

A4.6.2 Robustness to the alternative measure of SWB

As I mentioned in Section 4.6.3 and Appendix A4.2, I use the CES-D-10 as an alternative measure of SWB which on mental well-being. Table A4.5 reports the fixed-effects estimates of equation (4-3) using the unexpected people's concerns about five keywords. Firs, consistent with my main result in Table 4.4, column (2), (4) and (5) of Table A4.5 suggest that the higher the unexpected people's concerns about 'commodity price', 'inflation' and 'price rise' the worse the mental well-being (higher CES-D-10 scores). Following the calculation of economic significance introduced in Appendix A4.5, I discover that when the unexpected adjusted BSVI of 'commodity price', 'inflation', and 'price rise' increase by one standard deviation, the equivalent monetary

loss to a respondent is approximately equal to 1.1%, 0.09%, and 2.46% of his/her household's per capita financial assets. These results are very close to those presented in Table 4.4. I again find that the impact of unexpected inflation concerns about 'commodity price' and 'inflation' on SWB is much smaller than that of 'price rise'. Therefore, my main results in section 4.6 are robust to the use of CES-D-10.

Figures and Tables in Appendix A4

Figure A 4.1 Screenshot of daily BSVI from 1st January 2021 to 31st December 2021

Note: This screenshot is obtained at 'https://index.baidu.com' by sending the following requests:
Keyword name: '涨价 (price rise)'
Time period: 01/01/2021-31/12/2021
Device type: PC and mobile search volume
City name: Shanghai
DA: Average of daily BSVI from 01/01/2021 to 31/12/2021 equals 128.

Figure A 4.2 Screenshot of daily BSVI on 1st January 2021

Note: This screenshot is obtained at 'https://index.baidu.com' by sending the same requests as Figure A4.1 except the change in time period to 01/01/2021-01/01/2021. Therefore, this screenshot shows that the BSVI of 'price rise' on 1st January 2021 equals 61.

Table A 4.1 Definitions of control variables

Control variable	Abbreviation	Description
Individual-level		
Age	age	Middle-aged and elderly respondents aged 45 and above
gender	gender	1=male; 0=female
hukou	hukou	1=non-agricultural hukou; 0=agricultural hukou
Marital status	married	1=Married or cohabiting 0=Never married, divorced, or widowed
Educational degree	education	5 categories of education level: illiterate below primary school home/elementary school middle/high school vocational school/college
Employment status	employment	3 categories of employment status: Employed Out of labour market Retired
Self-rated health status	sr_health	5-point scale of self-rated health status: 1=very poor; 2=poor; 3=fair; 4=good; 5=very good
Household-level		
Household size	householdsize	Number of household members
Relative household income per capita	relative_fincome	Household income per capita quartile by community.
Log of per capita household financial assets	lffassets	Log of per capita household total assets
Log of per capita household total debts	lfdebts	Log of per capita household total debts
Other control		
Survey wave dummies	waves	4 waves from 2011 to 2018

Table A 4.2 Descriptive statistics of control variables

Variables	Mean	Std. Dev.	Min	Max
Individual-level controls				
Age	60.2427	(9.4692)	45	108
Gender	0.4852	(0.4998)	0	1
Hukou	0.2216	(0.4153)	0	1
married	0.8811	(0.3237)	0	0
Educational degree (*reference category: Illiterate*)				
below primary school	0.1878	(0.3905)	0	1
home/elementary school	0.2250	(0.4175)	0	1
middle/high school	0.3036	(0.4598)	0	1
vocational school/college	0.0493	(0.2166)	0	1
Employment status (*reference category: employed*)				
Out of labour market	0.2636	(0.4406)	0	1
Retired	0.0549	(0.2279)	0	1
Self-rated health status (*reference category: very poor*)				
Poor	0.1949	(0.3961)	0	1
Fair	0.5162	(0.4997)	0	1
Good	0.1426	(0.3497)	0	1
Very good	0.0983	(0.2978)	0	1
Household- level controls				
Household size	2.6941	(1.4356)	1	16
Relative household income per capita (*reference category: lowest quartile*)				
Lower-middle quartile	0.2490	(0.4324)	0	1
Higher-middle quartile	0.2622	(0.4399)	0	1
Highest quartile	0.2339	(0.4234)	0	1
Log of per capita household financial assets	6.6180	(2.9473)	0	17.5060
Log of per capita household total debts	0.877	(2.7789)	0	14.2855
Other controls				
Survey waves (*reference category: 2011*)				
2013	0.2739	(0.4460)	0	1
2015	0.2271	(0.4190)	0	1
2018	0.2556	(0.4362)	0	1

Note: The descriptive statistics of all variables are based on the sample used for the estimation of equation (4-2) and (4-3) for main results. The number of observations is 56,595.

Table A 4.3 Adjusted BSVI vs. unexpected adjusted BSVI (full table)

Names of keywords	commodity price	price rise	commodity price	price rise
	(1)	(2)	(3)	(4)
$\overline{adj\_BSVI_{ct}}$	0.0011	0.0105		
	(0.0046)	(0.0078)		
$g(\overline{adj\_BSVI_{ct}})$			-0.0174***	-0.0302***
			(0.0042)	(0.0065)
age	-0.0121	-0.0121	-0.0118	-0.0125
	(0.0096)	(0.0096)	(0.0096)	(0.0096)
age^2	0.0001	0.0001	0.0001	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
gender	-0.0433	-0.0434	-0.0433	-0.0425
	(0.0695)	(0.0695)	(0.0693)	(0.0694)
hukou	0.0070	0.0060	0.0052	0.0061
	(0.0281)	(0.0281)	(0.0281)	(0.0280)
householdsize	0.0066**	0.0068**	0.0069**	0.0067**
	(0.0032)	(0.0032)	(0.0032)	(0.0032)
education (reference group: illiterate)				
# below primary school	0.0153	0.0153	0.0147	0.0147
	(0.0240)	(0.0240)	(0.0240)	(0.0240)
# home/elementary school	0.0133	0.0133	0.0138	0.0136
	(0.0277)	(0.0277)	(0.0277)	(0.0277)
# middle/high school	0.0262	0.0262	0.0265	0.0269
	(0.0329)	(0.0329)	(0.0329)	(0.0329)
# vocational school/college	-0.0742	-0.0746	-0.0736	-0.0730
	(0.0526)	(0.0526)	(0.0525)	(0.0526)
married	0.0545**	0.0546**	0.0548**	0.0551**
	(0.0263)	(0.0263)	(0.0263)	(0.0263)
employment (reference group: employed)				
# out of labour market	-0.0322***	-0.0320***	-0.0320***	-0.0321***
	(0.0112)	(0.0112)	(0.0112)	(0.0112)
# retired	-0.0212	-0.0215	-0.0200	-0.0196
	(0.0173)	(0.0173)	(0.01174)	(0.0174)
sr_health (reference group: very poor)				
# poor	0.0963***	0.0967***	0.0963***	0.0964***
	(0.0221)	(0.0221)	(0.0221)	(0.0221)
# fair	0.1887***	0.1892***	0.1890***	0.1887***
	(0.0219)	(0.0219)	(0.0219)	(0.0219)
# good	0.2966***	0.2967***	0.2965***	0.2965***
	(0.0240)	(0.0240)	(0.0240)	(0.0240)
# very good	0.4260***	0.4266***	0.4260***	0.4256***
	(0.0255)	(0.0255)	(0.0255)	(0.0255)
relative_fincome (reference group: lowest quartile)				
# lower-middle quartile	0.0227**	0.0227**	0.0225**	0.0225**
	(0.0099)	(0.0099)	(0.0099)	(0.0099)
# upper-middle quartile	0.0339***	0.0339***	0.0336***	0.0335***

	(0.0100)	(0.0100)	(0.0100)	(0.0100)
# highest quartile	0.0328***	0.0329***	0.0327***	0.0327***
	(0.0114)	(0.0114)	(0.0114)	(0.0114)
lffassets	0.0084***	0.0084***	0.0086***	0.0084***
	(0.0016)	(0.0016)	(0.0016)	(0.00161)
lfdebts	-0.0041***	-0.0041***	-0.0041***	-0.0042***
	(0.0015)	(0.0015)	(0.0015)	(0.0015)
Fixed effects	Yes	Yes	Yes	Yes
Obs.	56,595	56,595	56,595	56,595
R-squared	0.0736	0.0736	0.0740	0.0741

Note: *Column (1) and (2) reports the estimates of equation (4-2). Column (3) (4) reports the estimates of equation (4-3). All models were estimated using a fixed-effects linear estimator. The dependent variable in all models is life satisfaction. Data from the 2011 to 2018 waves of the CHARLS were used in estimation. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Table A 4.4 Robustness to fixed effects ordered logit estimation: Comparisons between various inflation-related keywords

keywords	price	commodity price	CPI	inflation	price rise
	(1)	(2)	(3)	(4)	(5)
Life Satisfaction score from 1 to 5					
1-Very Unsatisfied	0.0001	0.0016***	0.0001	0.0002*	0.0026***
	(0.0004)	(0.0005)	(0.0002)	(0.0001)	(0.0007)
2-Unsatisfied	0.0003	0.0058***	0.0004	0.0006*	0.0092***
	(0.0015)	(0.0017)	(0.0007)	(0.0003)	(0.0025)
3-Fair	0.0003	0.0059***	0.0004	0.0006*	0.0094***
	(0.0016)	(0.0017)	(0.0007)	(0.0003)	(0.0026)
4-Satisfied	-0.0004	-0.0101**	-0.0007	-0.0010*	-0.0162***
	(0.0027)	(0.0029)	(0.0012)	(0.0006)	(0.0044)
5-Very Satisfied	-0.0001	-0.0032***	-0.0002	-0.0003*	-0.0052***
	(0.0009)	(0.0009)	(0.0004)	(0.0002)	(0.0014)
Control variables	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes
Obs.	46,655	46,655	46,655	46,655	46,655
R-squared	0.1036	0.1041	0.1036	0.1036	0.1041

*Note: This table reports the marginal effects of $gap(\overline{aBSVI}_{ct})$ based on the estimates of equation (4-3) using the $gap(\overline{aBSVI}_{ct})$ of five keywords. All columns report marginal effects evaluated at sample means. All models were estimated using the 'Blow-up and Cluster' (BUC) estimator for fixed effects ordered logit model. The dependent variable in all models is life satisfaction. Data from the 2011 to 2018 waves of the CHARLS were used in estimation. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Table A 4.5 Robustness to the use of CES-D-10: Comparisons between various inflation-related keywords

keywords	price	commodity price	CPI	inflation	price rise
	(1)	(2)	(3)	(4)	(5)
$gap(\overline{aBSVI}_{ct})$	-0.0171	0.1674***	-0.0014	0.0333**	0.1601***
	(0.0302)	(0.0032)	(0.0090)	(0.0014)	(0.0062)
lffassets	-0.0426***	-0.0478***	-0.0438***	-0.0472***	0.0404***
	(0.0122)	(0.0122)	(0.0122)	(0.0122)	(0.0016)
Eq. ffasset changes	N/A	1.1%	N/A	0.09%	2.46%
Control variables	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes
Obs.	58,254	58,254	58,254	58,254	58,254
R-squared	0.1416	0.1405	0.1419	0.1413	0.0741

Note: *This table reports the estimates of equation (4-3) using five keywords. All models were estimated using a fixed-effects linear estimator. The dependent variable in all models is CES-D-10. Data from the 2011 to 2018 waves of the CHARLS were used in estimation. 'Eq. ffasset changes' refers to the equivalent per capita family financial asset loss of a one-standard-deviation increase in* $gap(\overline{aBSVI}_{ct})$*. Standard errors clustered at the individual level are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.*

Chapter 5. Conclusion

5.1. Summary

Understanding the impact of inflation on subjective well-being is important. Building on previous studies that investigate the association between national aggregate inflation rates and SWB in developed economies (e.g., Di Tella *et al*., 2001, 2003; Alesina *et al*., 2004; Ruprah and Luengas, 2011; Blanchflower *et al*., 2014; Welsch and Kühling, 2016), I advance the understandings of inflation-SWB association by accounting for people's inflation perceptions (e.g., Ranyard *et al*., 2008).

Three studies are presented using individual SWB data taken from the 2010, 2012, 2014, 2016, and 2018 waves of the CFPS in Chapter 2 and 3, and the 2011, 2013, 2015, and 2018 waves of the CHARLS in Chapter 4. Chapter 2 finds that the effects of inflation on people's SWB are heterogeneous and depend on a reference inflation level as well as on the economic growth context. Chapter 3 suggests that the inflation of different commodities impacts SWB differently. Specifically, considering that advanced-need commodities are more likely to upgrade in quality than basic-need commodities, their inflation actually leads to better SWB, as it reflects quality improvements. Chapter 4 finds that people's unexpected concerns about inflation are negatively associated with SWB and that the non-working older population with low income is the most vulnerable cohort when facing high inflation.

My findings in Chapter 2 and 4 are consistent. Using official inflation statistics and SWB data from the CFPS in Chapter 2, and inflation-related BSVI and SWB data from

the CHARLS in Chapter 4, both chapters suggest that the low and stable inflation environment benefited Chinese citizens' SWB in the past decade.

Chapter 2, 3 and 4 can also be easily extended to other countries for the following three reasons. First, similar to Chapter 2 and 3, official inflation statistics can also be easily obtained and merged with individual SWB data in other countries. Second, similar to Chapter 4, the search-volume-based inflation data can be accessed using Google Trends Index in Europe and the United States. Third, the concepts of inflation evaluations I applied in Chapter 2, 3 and 4 are universal. They were widely adopted by studies about inflation perceptions in Europe and the United States (e.g., Ranyard *et al*., 2008; Brachinger 2008; Malmendier and Nagel, 2016; Cavallo et al., 2017; D'Acunto, Malmendier and Weber, 2021). Therefore, the analyses in Chapter 2, 3 and 4 can be easily replicated using individual SWB data and appropriate inflation data in other countries. The results may be nuanced across countries depending on the trajectory of inflation rates and specific economic situations. For example, the "cost of living crisis" in the UK has become an ingrained concern since 2021. In this case, investigating the association between commodity-specific inflation and SWB is necessary for policymakers to monitor which commodities' prices are particularly concerned by consumers. Another example could focus on the extensive concerns about both recession and high inflation in the US in 2020. The framework presented in Figure 2.7 could be tailored to discuss the well-being cost of inflation under a unique recession circumstance.

5.2. Policy implications

5.2.1. Government policies related to inflation in China

There are two main sets of government policies highlighted by the central government of China focusing on maintaining low and stable inflation and protective subsidies if maintaining low and stable inflation fails. The main features of the two main sets of government policies are explained in the following subsections.

General policy guidance: the implicit inflation targeting

According to the annual Reports of the Work of the Government of China, an implicit inflation targeting policy focuses on maintaining low annual inflation rates around 3% since 2012.[100] The top-down policy scheme in China determines that the implicit inflation targeting is a general guidance provided by the central government. Governments at the provincial or city-level will then have to amend the policy to fit the local economic situations.

The ad hoc government policies: ex ante and ex post measures

'Bao Gong Wen Jia'

The fist *ad hoc* government policy, namely the '*Bao Gong Wen Jia*', includes a set of *ex ante* measures focused on ensuring stable inflation rates of basic-need commodities from the supply side. '*Bao Gong Wen Jia*' was firstly introduced by the central government of China in 2021.[101] This policy relies on an early warning mechanism

[100] The annual Reports of the Work of the Government can be accessed at the site: http://www.gov.cn/guowuyuan/zfgzbg.htm

[101] Details about the '*Bao Gong Wen Jia*' policy and its measures can be accessed at the following sites: http://www.mofcom.gov.cn/article/syxwfb/202111/20211103213485.shtml

which monitors the supply and consumer price indices of specific commodities (e.g., food and utilities). Several specific measures were implemented when there was an early sign of supply shortage or high inflation rates of basic-need commodities. Government subsidies were given to wholesale retailers if they experienced high producers' prices (e.g., prices of vegetables given by agriculture production enterprises). Similarly, the central government helped local authorities sign low-price long term contracts with energy producers. Finally, to meet increasing domestic pork demand and prevent high inflation of pork, local authorities (e.g., the local Department of Commerce, the local Food and Strategic Reserves Administration) released national pork reserves at a price lower than the market average pork price.

Social Assistance and Security Subsidy

The second *ad hoc* government policy, namely the Social Assistance and Security Subsidy (SASS), includes an important *ex post* measure aiming at providing protective subsidies for vulnerable population if maintaining the low and stable inflation fails. The SASS policy was firstly announced by the Chinese National Development and Reform Commission (CNDRC) in 2010. To buffer the risk of high commodity prices during the COVID-19 pandemic, the 2021 updated SASS indicates that the protective subsidies could be activated if the local monthly aggregate CPI inflation rates exceeded 3.5% or the monthly food inflation rates exceeded 6%. The CNDRC also suggested that the local authorities should carefully identify the eligible recipients of the temporary

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http://www.gov.cn/zhengce/2021-11/10/content_5650167.htm

https://www.ndrc.gov.cn/xxgk/zcfb/tz/202106/P020210609372056229138.pdf

subsidy, such as minimum living allowance and unemployment insurance recipients.[102]

5.2.2. Implications for the implicit inflation targeting

General SWB evaluations of the low and stable inflation performance

Chapter 2 and 4 suggest that the low and stable inflation did improve Chinese residents' well-being over the period 2012-2018. Specifically, Chapter 2 finds that people's SWB benefited from the smooth trajectory of inflation rates. Chapter 4 recaptures a similar finding using the BSVI to measure people's concerns about inflation. Specially, Chapter 4 finds that Chinese people were generally becoming less concerned about inflation over the period 2011-2018.

Implicit inflation targeting accounting for local economic contexts.

The provincial annual Reports of the Work of the Government show that more than 90% of the provincial governments simply followed the central government's guidance without adjustments (setting a 3% implicit inflation target).[103] According to Chapter 2, this could be costly for a few provinces with unfavourable economic growth, which were struggling to meet the target inflation rate. For example, according to the 2017 annual Report of the Work of the Government of Liaoning Province, the inflation rate in 2016 was 1.6% and the GDP growth rate was -2.5%.[104] In this case, meeting the

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[102] Details about the SASS in 2010 can be accessed at the site:
http://www.gov.cn/zwgk/2010-11/20/content_1749484.htm
Details about the 2021 updated SASS policy can be accessed at the site:
https://www.ndrc.gov.cn/xwdt/tzgg/202111/t20211116_1304081.html?code=&state=123

[103] The provincial annual Reports of the Work of the Government can be accessed at the official website of provincial governments.

[104] The 2017 annual Report of the Work of the Government of Liaoning Province can be accessed at:
http://www.ln.gov.cn/zwgkx/zfgzbg/szfgzbg/201701/t20170123_2732001.html

target inflation rate at 3% was costly as people's well-being loss associated with a 1% increase in inflation rate in Liaoning Province was about 10 times larger than that in Hebei Province which showed a 6.8% GDP growth rate in 2016. Therefore, adjustments of the inflation target after careful assessments of local economic contexts are strongly recommended.

Concerns about future inflation policies

Chapter 4 finds that, in accordance with the low and stable inflation rates over the period 2012-2018, people's inflation concerns measured by the BSVI was also decreasing over the same period. However, the BSVI went in the opposite direction of inflation rates during the COVID-19 pandemic in 2020 and 2021 due to people's excessive concerns about surges of inflation. This diverging trend was likely due to people's excessive concerns about surges in short-term inflation. Therefore, relying on the traditional negative association between official aggregate inflation rates and SWB in this case may lead to misleading policy suggestions. New measures of people's concerns about inflation are recommended as a supportive policy evaluation tool. These can take the form of internet search volume data and/or online surveys about consumers' attitudes towards the current inflation environment.

5.2.3. Implications for the *ad hoc* government policies

The inflation rates of basic-need commodities

As I mentioned in section 5.2.1, *'Bao Gong Wen Jia'* focuses on stabilising the inflation rates of basic-need commodities. Chapter 3 suggests that food also contains advanced-need commodities, and its inflation may have a positive impact on SWB due to food

quality improvements. To better monitor the price changes of basic-need commodities, Chapter 3 strongly suggests a well-designed household-level survey by local governments which carefully identifies the basic-need commodities in Chinese households' consumption baskets (e.g., raw food ingredients). Additionally, it is important for the NBSC to make use of quality-adjusted inflation rates as China has been experiencing rapid consumption upgrades in recent years.

The threshold to activate SASS policy

The SASS aims at helping the vulnerable population buffer the risk of high inflation when this increases the costs of living. According to Chapter 3, a 6% food inflation threshold may fail to reflect a high level of cost of living because food inflation may be a result of food quality improvements. Therefore, similar to my suggestions in section 5.3.1, Chapter 3 strongly suggests that the threshold of the SASS should follow the price increase of a set of basic-need commodities. Also, Chapter 4 suggests that an alternative threshold on the inflation rate of medicines may be beneficial for the middle-aged and elderly people in China because they are more concerned about medicine prices than food prices.

Tailored SASS policy accounting for local economic contexts.

The 3.5% aggregate monthly inflation rate or the 6% monthly food inflation rates thresholds do not fit all Chinese regions. According to Chapter 2, inflation harmed people's SWB more severely if the GDP growth rate was low. Therefore, lowering the SASS inflation rate thresholds is suggested if the local GDP growth rate is low. If not, a high SASS inflation threshold may fail to provide monetary support for the vulnerable

population in time.

The recipients of the SASS policy

Unemployment insurance recipients are eligible to be supported by the SASS. Chapter 4 argues that the current recipients of the SASS policy fail to cover the majority of the low-income non-working elderly population who are very vulnerable to high commodity prices. Considering the rapid aging of Chinese population, an expansion of the eligible recipients of the SASS policy in the future towards all low-income, non-working elderly people is strongly recommended.

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