The impact of internet use on Chinese residents' subjective well-being

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Abstract: As internet technology plays an increasingly important role in modern life, the impact of internet use on residents has also attracted more attention. Based on the 2017 China General Social Survey data (CGSS2017), we established an Ologit model to test the relationship between internet use and residents' subjective well-being (SWB). We found that using the internet can significantly improve the subjective well-being of residents. Compared with never surfing the internet, a lower frequency of internet surfing does not improve happiness, but a higher frequency will significantly improve residents' happiness. It positively impacts their SWB through two channels: increasing residents' participation in leisure and entertainment and improving residents' sense of social justice. Increasing active hedonic leisure time, can improve the happiness of Chinese urban residents. Furthermore, social justice is also one of the factors that affect happiness.

Keywords: internet use; internet usage frequency; leisure and entertainment; social justice; subjective well-being.

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1 Introduction

Subjective well-being (SWB) is an individual's subjective experience and evaluation of life. It contains two components, namely, positive and negative emotional components and cognitive components. The latter component is known as life satisfaction. Subjective well-being can usually be defined as the overall experience and evaluation of social members' quality of life according to their own standards (Diener, 2009).

The increase in people's attention to subjective well-being stems from changes in the quality of life. Over the past 40 years, China's economy and society have developed rapidly and steadily. According to statistics from the World Bank, China's GDP per capita has reached 12,556 US dollars in 2021, which is surpassing the world's average

GDP per capita.[1] Chinese people improve their quality of life through tourism, education and other ways to realise the value of life they recognise, enhancing their sense of happiness. However, in recent years, the happiness level of Chinese residents has not been significantly improved. According to the World Happiness Report 2022 released by the United Nations, China's average happiness index from 2019 to 2021 ranked 72nd among 146 countries[2], only in the middle. As an integral part of a better life, subjective well-being is more and more valued in the lives of residents. How to improve the happiness of the whole people has become an urgent social issue.

In recent years, a large amount of literature has studied the differences in the level of happiness among individuals. They have focused on the reasons for the differences and the factors that affect subjective well-being. At the individual level, gender, age, absolute and relative income, education level, identity, health level and living environment have shown significant correlations with subjective well-being. At the social level, social culture, social system and economic development level will also affect residents' subjective well-being. For example, in social culture, groups with more religious participation will have a higher sense of happiness (Deaton and Stone, 2013), and cultural factors have good explanatory power for differences in transnational happiness (Ye et al., 2015). The characteristics of a country's social system environment, such as government governance, trust, crime and social capital, profoundly affect the subject well-being of its citizens (Tokuda et al., 2017; MacKerron, 2012; Kislev, 2020). The economic field is one of the most concerned fields in related research. Economic freedom will positively affect average happiness, and the anxiety caused by unemployment will greatly reduce national happiness (Jackson, 2017). Economic growth has a positive effect on life satisfaction (Fotourehchi, 2021). High GDP per capita is a necessary factor for improving well-being, but non-economic factors are also essential (Nadimi et al., 2021).

In the information age, innovation drive and integration leadership of internet technology has become increasingly prominent under the role of basic support, continuously promoting the development and progress of the national economy and culture. In the '50th Statistical Report on China's internet Development Status' released by the China internet Network Information Centre (CNNIC), Chinese internet users reached 1.051 billion, and the internet penetration rate reached 74.4% as of June 2022.[3] The huge scale of netizens shows that the shaping role of the internet has penetrated all aspects of economic and social life: the in-depth use of the internet in work information, social communication, medical education, shopping and financial management and life entertainment. It has become crucial in residents' lives and has greatly affected their lives. In 2019, President of the People's Republic of China, Xi Jinping, repeatedly emphasised in the summary of important discussions on network security and informatisation that improving people's well-being should be the starting point and goal of informatisation development. Thus, people will have more sense of gain, happiness and security in the development of informatisation. This sign demonstrates the close connection between the internet and happiness.

In recent years, the topic of the influence of the internet on happiness has received more attention and discussion in the academic community. In terms of research fields, the existing literature mainly involves several major fields, such as economics, management, psychology and computer science. In terms of research methods, most of the research on economics and management is based on publicly available large-scale global survey datasets, such as the European social survey (Ruggeri et al., 2020), Eurobarometer (Castellacci and Schwabe, 2020), Gallup World Poll (Ganju et al., 2016) and World

Values Survey (Lohmann, 2015). In recent years, innovative methods have also appeared; internet search volume using data from Google Trends assesses the well-being of the people (Algan et al., 2019). However, research in psychology and computer science is more limited to the context of a certain country or specific target group, such as the relationship between the Internet use behaviour of college students and their happiness (Yu, 2015), and the impact of Internet use on the well-being of civil servants (Sui et al., 2022). From the psychological point of view, the use of social networks (SNS) has received special attention, and the usual conclusion is that SNS has a negative impact: prolonged or excessive participation in SNS can lead to loneliness and social interaction. Psychological problems such as obstacles, affecting the user's mood and reduce happiness (Arampatzi et al., 2016; Graciyal and Viswam, 2021). For example, prolonged use of short video platforms can lead to short video addiction, and forced withdrawal from short video can bring about anxiety or depression (Peng et al., 2022). However, Lu and Ma (2022) have also shown that mobile social media sharing behaviours better promote subjective well-being and psychological health among Internet users. Furthermore, more studies have verified the positive correlation between Internet use and subjective well-being (Çikrıkci, 2016). Smartphones, mobile applications and new media use positively affect subjective well-being (Guo et al., 2019; Linnhoff and Smith, 2017). Other scholars have turned their research subjects to different subjects, such as young people, the elderly, farmers and people in developing regions. The main conclusions still support the promotion of subjective well-being by the Internet (Greyling, 2018). For instance, The use of the Internet can increase the social participation of Chinese older adults, thereby enhancing their well-being (Yang et al., 2022). Based on the above viewpoints, we propose the first hypothesis (H1), which consists of two hypotheses H1a and H1b:

H1a   Internet use will enhance residents' SWB in China.

H1b   The frequency of Internet use positively impacts residents' SWB in China.

Given the unbalanced economic development in China and the dual urban-rural development structure, urban and rural residents present different characteristics in various aspects (Song et al., 2019). The living standard of residents in different regions also has specific differences (Warmenhoven et al., 2019). Thus, the information gap caused by the difference in the holding and application of network information technology has gradually occurred. The further development of the internet has shown a polarisation trend, leading to differences in the internet usage of residents in different regions, which in turn has different effects on their subjective well-being. On this basis, residents with different levels of education have different subjective definitions of happiness and access to the internet. Therefore, different incentive effects of happiness are generated for internet use. Furthermore, members of the communist party of China (CPC) who are affected by their political status have a greater sense of identity with their own organisational identity. Thus, they will more likely reap happiness than the non-CPC members and have different effects on happiness after Internet use. Therefore, we propose the second research hypothesis (H2), which consists of the following three hypotheses:

H2a   Residents of different household registration types have different effects on their SWB when they use the internet.

H2b   Residents with different political statuses have different effects on their SWB when they use the internet.

H2c   Residents with different education levels have different effects on their SWB when they use the internet.

Thus, how does internet use affect SWB? Castellacci and Tveito (2018) proposed four different channels through which the Internet affects happiness: changing the use of time, creating new activities, facilitating the acquisition of information and acting as a powerful communication tool. The mediating role of income is also a mainstream view. For example, internet use promotes the increase in the probability of residents' happiness but reduces the positive effect of income on happiness because people who often use the Internet as a source of information achieve less satisfaction from their income. Internet use exacerbates the perceived gap between rich and poor Chinese residents (Zuo and Hong, 2022). For different groups, the mechanisms by which internet use affects happiness are not the same. For example, the influence of internet use on the happiness of the elderly may be adjusted by network skills (Hofer et al., 2019) or may be achieved through less loneliness and more voluntary services (Xu and Huang, 2020). As for effect on rural residents' happiness, four influence mechanisms are proposed: enhance social identity, enrich daily life, and promote political participation on the internet. With the improvement of production efficiency, the increase of leisure time and the enhancement of people's leisure consciousness, the ways of leisure activities are gradually enriched and diversified, and the impact of leisure on the meaning and happiness of personal life is also increasing. For example, increasing leisure time can significantly improve subjective health and thus life satisfaction (Kuo and Huang, 2020). Viklund and Forsman (2022) found that internet-based leisure and entertainment-related activities were significantly associated with perceived happiness. Therefore, we propose the third hypothesis (H3):

H3   The internet enhances residents' SWB by influencing residents' leisure and entertainment and social justice.

Based on the above analysis, we will explore whether residents using the internet can affect their subjective well-being judgments to examine whether the Internet can improve residents' well-being. We will then analyse how and to what extent the internet affects residents' subjective well-being and explore how internet use affects it.

2   Data, variables and model

2.1   Data

The data in this article uses the 2017 Chinese General Social Survey (CGSS2017) survey data. This project started in 2003 and systematically and comprehensively collects social, family and personal data at multiple levels. CGSS2017 surveyed 12,582 individuals, covering 31 provinces, municipalities and autonomous regions in Mainland China. The survey contained 783 variables. The questionnaire was composed of three modules: A core module, C social network and network society (including ISSP2017) module and D family questionnaire (including ESAS2016) module. The data used in this article mainly came from modules A and C.

2.2 Variables

2.2.1 Explained variable

The explanatory variable in this study is 'subjective well-being (SWB)', from question A36 of CGSS2017. The title is 'In general, do you think your life is happy?' The respondent's response includes the following options: 'very unhappy', 'relatively unhappy', 'not happy or unhappy', 'relatively happy, and 'very happy.' The above five options are assigned 1, 2, 3, 4 and 5 in sequence. The average level of subjective well-being of the interviewed residents was 3.856, which is close to the level of 'relatively happy'. Among all the interviewed residents, only 216 people chose 'very unhappy', accounting for 1.72%. The residents who chose 'relatively happy' were the most with 7,502 people, accounting for 59.72%.

2.2.2 Key explanatory variable

The key explanatory variable used in this article is 'internet use,' which is from question A30e of CGSS2017: 'Have you been online in the past six months, including using computers, mobile phones, smart wearables and other devices to use the internet?' Respondents can choose 'have been' and 'have not been.' Among them, 7,156 residents had access to the internet within half a year, accounting for 56.92%, and 5,415 residents had no internet access, accounting for 43.08%.

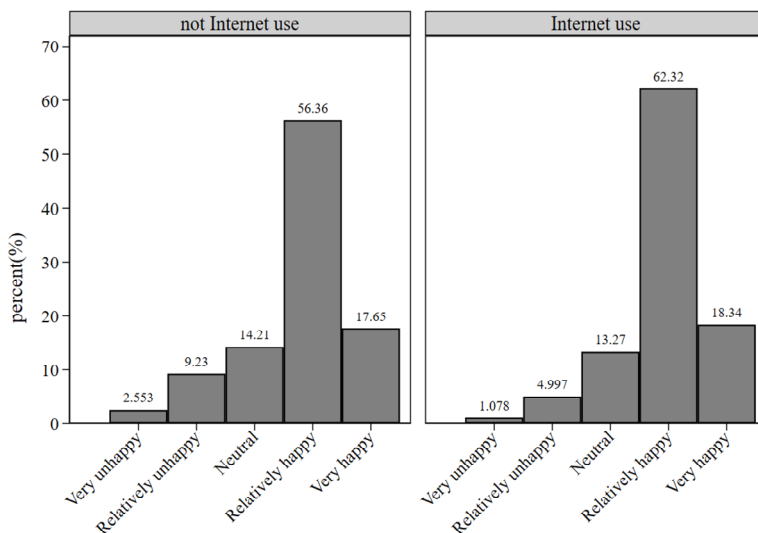**Figure 1** Histogram for SWB distribution

Figure 1 shows that, among the residents who think that they are relatively happy and very happy, the proportion of residents who use the internet is higher than that of residents who do not use the internet. The proportion of residents who use the Internet and think they are happy reaches 62.32%. Among residents who think that they are unhappy, the proportion of residents who do not use the Internet is higher than residents who use it. At the same time, according to CGSS2017 data, the average happiness of

residents who use the internet is 3.918, which is significantly higher than the average happiness of residents who do not use the internet.

2.2.3   Control variables

According to the CGSS2017 questionnaire, we select a series of control variables that may impact residents' happiness. We list the detailed definitions of these variables in Table 1.

Table 1   Variable definitions

Variable	Definition	Obs.
Happiness	Very unhappy = 1, relative unhappy = 2, neutral = 3, relatively happy = 4, very happy = 5	12,550
Internet use	Internet use = 1, not internet use = 0	12,550
Internet usage frequency	Never = 1, rare = 2, sometimes = 3, often = 4, very frequent=5	12,544
Income	Respondents' annual labour income (10000 CNY)	12,536
Sex	Male = 1, Female = 0	12,550
Age	Respondent's age	11,546
Education level	Below elementary school = 1, primary school = 2, junior high school = 3, high school = 4, College and undergraduate = 5, postgraduate = 6	11,668
Religious belief	No religious belief = 1, religious belief = 0	12,054
Political status	CPC member = 1, non-CPC member = 0	6,690
Health status	Very unhealthy = 1, relative unhealthy = 2, normal = 3, relative healthy = 4, very healthy = 5	12,132
Household registration	Urban = 1, rural = 0	12,550

2.3   Model

Given that this article assigns the residents' subjective well-being responses as '1, 2, 3, 4 and 5', it belongs to discrete sort data. We use an ordered regression model (order logit, referred to as 'ologit') to explore the impact of using the internet on residents' SWB. Thus, we estimate the following model as follows:

$$Happiness_i = \alpha + \beta Inter_i + \gamma Control_i + \varepsilon_i \tag{1}$$

$Happiness_i$ represents the SWB of the ith resident, $Inter_i$ represents whether the ith resident uses the internet, $Control_i$ is a series of control variables (including income, age, gender, education level, political status, health status and household registration), ε_i is a random disturbance term, β is a coefficient to be estimated and γ is a vector of coefficients to be estimated. $Happiness_i^*$ represents the latent variable of the subjective well-being of the ith resident. When $Happiness_i^*$ is lower than the critical value C1, the residents feel very unhappy ($Happiness_i = 1$). When $Happiness_i^*$ is higher than C1 but lower than C2, they feel unhappy ($Happiness_i = 2$). When $Happiness_i^*$ is higher than C4, residents feel very happy ($Happiness_i = 5$).

$$Happiness_i = \begin{cases} 1, & Happiness_i^* \leq C1 \\ 2, & C1 < Happiness_i^* \leq C2 \\ & \cdots\cdots \\ 5, & Happiness_i^* > C4 \end{cases} \quad (2)$$

Assuming that ε_i follows the logistic distribution, X represents all explanatory variables, and $\Lambda(\bullet)$ represents the cumulative distribution function, $Happiness_i$ can be expressed as follows:

$$P(Happiness_i = 1) = \Lambda(C1 - X\beta)$$
$$P(Happiness_i = 2) = \Lambda(C2 - X\beta) - \Lambda(C1 - X\beta)$$
$$\cdots\cdots \quad (3)$$
$$P(Happiness_i = 5) = 1 - \Lambda(C4 - X\beta)$$

3 Empirical results

First, we use the Internet as a key explanatory variable and utilise the Ologit model to estimate. Then, we select the frequency of Internet use to replace internet use for scalability analysis. Given that internet use may be caused by residents' self-selection, selection bias may occur. Thus, we will choose the propensity score matching method to correct the model, simultaneously time change the regression model and adjust the variables for robustness testing to improve the credibility of the empirical results. Furthermore, the use of the Internet is likely to cause endogenous problems because of omitted variables and measurement errors. We use household transportation and communication expenditures and Internet penetration rate as instrumental variables to deal with the endogenous problem. We also discuss the heterogeneous effects of Internet usage on residents' happiness from the perspective of household registration, political status and education level and finally go into the mechanism of internet usage on residents' happiness.

3.1 Internet use and SWB

First, we discuss the impact of internet use on residents' subjective well-being. Table 2 shows the estimated results of the Ologit model. In Column (1), the explanatory variables only include internet use. The results show that Internet use has a significant positive effect on residents' SWB at the 1% level, which means that residents who use the internet have a higher sense of well-being. After adding the regional effect in Column (2), the results also show that using the internet at a level of 1% significantly improves residents' subjective well-being. Column (3) of Table 2 adds the income factor of residents on the basis of Column (2). Column (4) adds other control variables, including age, age square, education level, religious beliefs, political appearance, health status and household registration. The results in Columns (3) and (4) show that the coefficient of internet use is still significantly positive at the 5% level, indicating that residents who use the Internet can obtain a higher level of subjective well-being. Therefore, the above four models can

significantly support the positive effect of using the internet on residents' well-being, verifying hypothesis H1a.

Table 2   The impact of Internet use on residents' SWB

	(1)	*(2)*	*(3)*	*(4)*
Internet use	0.261*** (7.55)	0.188*** (5.15)	0.161*** (3.79)	0.143**(2.50)
Income			0.000** (2.56)	0.009(1.62)
Income square			–0.000** (–2.33)	–0.000 (–0.22)
Sex				–0.310*** (–8.79)
Age				–0.031*** (–4.89)
Age square				0.001*** (9.48)
Education level ('below elementary school' is the base group)				
Primary school				0.263*** (3.72)
Junior high school				0.418*** (5.82)
High school				0.495*** (5.17)
College and undergraduate				0.635*** (6.29)
Postgraduate				0.462** (2.33)
Religious belief				–0.077 (–1.38)
Political status				0.300*** (4.89)
Health status ('very unhealthy' as the base group)				
Relatively unhealthy				0.603*** (5.21)
Normal				0.997*** (8.85)
Relative healthy				1.473*** (13.70)
Very healthy				2.083*** (18.33)
Household registration				–0.127** (–2.18)
Regional effect	No	Yes	Yes	Yes
Obs.	12,550	12,550	11,668	11,647
Pseudo R^2	0.002	0.015	0.015	0.052

Notes: The t statistics calculated based on the robust standard error are shown in
       parentheses; *, **, and *** respectively indicate statistical significance at the
       levels of 10%, 5%, and 1%.

The controls generally selected in this article have a significant positive impact on residents' subjective well-being. The results are consistent with previous studies. From the results in Table 2, the effect of age on residents' subjective well-being is significant at the level of 1%, and the overall distribution is in a 'U' shape. In terms of education level, compared with residents without education, the subjective well-being of the elementary school group, junior high school group, high school group, college and undergraduate group and postgraduate group are significantly higher than those of the Below elementary school group, indicating that residents who receive an education will significantly

improve one's subjective well-being. Education at all levels has a significant positive impact on the residents' subjective well-being (Cuñado and de Gracia, 2012). In terms of gender, women's subjective well-being is significantly higher than men's at the 1% level, which may be different because of varying gender expectations for happiness. In terms of political status, the subjective well-being of CPC members is significantly higher than that of non-CPC members at the 1% level. Therefore, the membership of the CPC has a positive impact on the happiness of residents. CPC members may have a stronger sense of happiness from their own identity. This result is consistent with existing research. In terms of household registration, the subjective well-being of rural residents is significantly higher than that of urban residents at the 1% level. To a certain extent, this higher well-being is caused by differences in social life between urban and rural areas, which lead to different expectations of residents' well-being brought about by social development. In terms of health status, the subjective well-being of the groups other than the base group was significantly higher than that of the base group, that is, the 'very unhealthy' group (health status = 1), indicating that physical health has a significant impact on well-being. The better the physical health, the higher the happiness (Sabatini, 2014). This result is in line with our common sense.

3.2 Internet use frequency and subjective well-being

The above analysis can only show the impact of internet use on residents' subjective well-being, but the frequency of internet use in residents' daily lives varies from person to person. Thus, how well do residents who use the internet often and those who rarely use the internet get through the Internet? Can residents who use less Internet also improve their subjective well-being? These questions cannot be answered effectively only through the above analysis. At the same time, the impact of Internet use on residents' well-being cannot be effectively explained by the above analysis results. Therefore, further exploring the impact of internet use on residents' subjective well-being is necessary. Thus, we replace the core explanatory variable 'internet use' with the 'internet use frequency' in question A28-5 from CGSS2017. We use the 'never' group as the base group when we analyse.

The specific regression results are shown in Table 3. Column (1) only controls the key explanatory variables. Column (2) adds regional effects. Column (3) further adds income and income square as control variables. The results show that, regardless of whether the regional effect and income variables are added, the subjective well-being of the 'frequent' group and the 'very frequent' group of Internet use are significantly higher than that of the 'never' group. However, the subjective well-being of the 'rarely' group and the 'sometimes' group was not significantly different from that of the base group. Therefore, compared with those who have never surfed the internet, residents using the Internet less frequently do not improve their happiness. However, surfing the internet more frequently will significantly improve their happiness. The above analysis shows that increasing the frequency of internet use can improve the subjective well-being of residents, which partially validates H1b.

3.3 Endogeneity discussions

Internet use as a key explanatory variable may cause endogenous problems because of omitted variables and measurement errors. It is very hard to quantify the living habits,

cognitive ability, psychological states and other variables of the interviewees. This difficulty will affect the condition of residents using the internet and their subjective well-being. Furthermore, the subjective well-being of the explained variable is biased towards the subjective identification of the interviewees. Different residents define happiness in different dimensions, which will cause measurement errors. The 'subjective well-being' and 'internet use' used in this article are discrete variables. We refer to Roodman (2011) and use the bivariate ordered Probit model (Bioprobit model) and conditional mixed process method (CMP) to estimate the model.

Table 3   The influence of Internet usage frequency on residents' subjective well-being

	(1)	*(2)*	*(3)*
Internet usage frequency ('never' is the base group)			
Rare	–0.034 (–0.44)	–0.036 (–0.45)	–0.069 (–0.71)
Sometimes	0.004 (0.05)	0.012 (0.20)	–0.010 (–0.13)
Often	0.225*** (4.62)	0.152*** (3.36)	0.133** (2.52)
Very frequent	0.348*** (7.45)	0.269*** (5.16)	0.226*** (4.51)
Income			0.009** (2.30)
Income square			–0.000** (–2.03)
Controls	Yes	Yes	Yes
Region effect	No	Yes	Yes
Obs.	12,555	12,555	11,667
Pseudo R^2	0.003	0.016	0.016

Notes: The t statistics calculated based on the robust standard error are shown in
    parentheses; *, **, and *** respectively indicate statistical significance at the
    levels of 10%, 5%, and 1%.

Table 4   Endogenous checks

	IV: communication expenditure		IV: Internet penetration rate	
	(1) Bioprobit	*(2) CMP*	*(3) Bioprobit*	*(4) CMP*
The first stage				
Transportation and communication expenditure	0.158*** (6.61)	0.142*** (5.84)		
Internet penetration rate			0.028*** (18.33)	0.028*** (18.30)
The second stage				
Internet use	0.717*** (5.35)	0.231*** (9.82)	0.384*** (5.19)	0.295*** (5.79)
Controls	Yes	Yes	Yes	Yes

Notes: The t statistics calculated based on the robust standard error are shown in
    parentheses; *, **, and *** respectively indicate statistical significance at the
    levels of 10%, 5%, and 1%.

According to the selection of instrumental variables in the existing literature on this topic, at the regional level, some scholars use variables such as regional broadband usage

(Castellacci and Schwabe, 2020) and Internet coverage (Sabatini and Sarracino, 2017) to replace 'internet use'. At the household level, some scholars also use household transportation and communication expenditure as any instrumental variable. Both variables affect Internet usage and can be tested as instrumental variables. We adopt 'household transportation and communication expenditure' and the province's 'internet penetration rate' as instruments for 'internet use' and use the above two methods to estimate. The data on 'family transportation and communication expenditure' comes from the total annual transportation and communication expenditure (CNY) of the resident's family reported in Question D37-6 of CGSS2017. The data on the 'Internet penetration rate' in each region comes from the CNNIC – 'The 48th Statistical Report on internet development in China'. According to Table 4, in the first stage regression of the Bioprobit model and the CMP method, the effects of 'household transportation and communication expenditure' and 'internet penetration rate' on internet use' are significantly positively correlated at the 1% level. Therefore, these two variables meet the relevance conditions as instrumental variables and can be tested as instruments. In the second stage as an instrumental variable test, the endogeneity test parameter ahrho of the Bioprobit model of transportation expenditure is significant at the 1% level, whereas the endogeneity test parameter ahrho of the Bioprobit model of the Internet penetration rate is significant at the 10% level. Therefore, 'Internet use' is an endogenous explanatory variable, and the results of the Bioprobit model are better than those of the Ologit model. The endogenous test parameter atanhrho_12 of the CMP method of transportation and communication expenditure is significant at the 5% level, whereas the internet penetration rate is significant at the 10% level. Therefore, 'Internet use' is an endogenous explanatory variable. In the second-stage regression results of the Bioprobit model and the CMP model, after correcting possible endogenous errors, internet use still has a significant positive effect on the subjective well-being of residents. The results are both significant at the 1% level. It further proves the positive effect of internet use on residents' subjective well-being.

3.4 Heterogeneity analysis

After discussing the impact of internet use on residents' subjective well-being, we can conclude that Internet use can enhance residents' SWB. However, in the above result, we did not consider the differences among population groups. Thus, we continue to analyse the heterogeneity of the impact of Internet use on residents' SWB from the perspective of household registration, political status and education level. The results are shown in Table 5.

From the perspective of household registration, rural residents' use of the internet has a significant positive impact on their subjective well-being at the 10% level, whereas urban residents' use of the Internet has no significant impact on their subjective well-being. Therefore, rural residents will get a more obvious sense of subjective well-being when using the internet (Zheng and Ma, 2021). For urban residents, this effect is not obvious. The possible reason is that the Internet can transfer information in a timely manner, making social media communication more convenient and thereby bringing satisfaction and happiness to rural residents. Rural residents use the Internet to enhance social identity, enrich their daily lives, improve the quality of social networks and promote Internet political participation, which impacts their happiness, verifying H2a.

Table 5   Heterogeneity analysis of the impact of internet use on residents' SWB

	By household registration		By political status		By education level		
	Urban	*Rural*	*CPC member*	*Non-CPC member*	*Elementary school and below*	*Junior high school and high school*	*Higher education*
Internet use	0.078	0.218**	0.054	0.156***	0.258***	0.154**	0.286
	(1.08)	(2.47)	(0.29)	(2.69)	(2.81)	(2.09)	(1.11)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.054	0.056	0.047	0.050	0.049	0.051	0.046
Obs.	7,387	4,260	1,314	10,333	4,025	5,343	2,296

Notes: The t statistics calculated based on the robust standard error are shown in parentheses; *, **, and *** respectively indicate statistical significance at the levels of 10%, 5%, and 1%.

From a political perspective, internet use by non-CPC members has a statistically significant impact on their subjective well-being at 1%, whereas Internet used by CPC members has no significant impact on their subjective well-being. Therefore, compared with CPC members, non-CPC members use the Internet to obtain a more obvious sense of subjective well-being. CPC members' happier possibly because their sense of identity is higher than that of non-party residents, and the increased happiness of using the Internet is not much improved for CPC members. On the contrary, because of lacking sense of identity, non-party residents using the Internet to increase happiness are more significant and effective, thus verifying H2b.

From the perspective of education level, residents who have not received education and only have a primary school degree use the Internet to have significant subjective well-being at the 1% level. Residents who have received junior high school and high school education use the Internet to have significant subjective well-being at the 5% level. However, the use of the Internet has no significant impact on the subjective well-being of residents receiving higher education.

The possible reasons are as follows. First, given that residents who receive higher education have higher income expectations than their higher education qualifications, they are not satisfied with their current income, which affects their happiness. Second, the more educated, the broader the horizon, the higher the reference standard for comparison and the more likely residents will be dissatisfied with their own situation. Third, the average human capital of higher education is relatively high, and the frequency of daily life and work exposure to the Internet is relatively high, which weakens the happiness effect of using the internet. In this way, we have verified H2c.

3.5 Robustness checks

The endogeneity test above can theoretically reduce the problems of missing variables and errors. However, because the data in this article comes from a questionnaire survey, Internet use may not meet the conditions of random sampling, and self-selection may be encountered. Thus, this study adopts the propensity score matching method to solve the possible selection bias and test whether the positive effect of internet use on residents' subjective well-being is robust. We also adopt the robustness check by replacing the model and adjusting the core explanatory variables and the explained variables.

Table 6 Propensity score matching results

Matching method	Treatment group	Control group	ATT	Standard deviation	t-value
Minimum neighbour matching	3.883	3.725	0.102***	0.018	5.44
Kernel matching	3.915	3.798	0.116	0.074	1.57
Radius match	3.915	3.786	0.128*	0.073	1.74
Spline matching	-	-	0.178***	0.055	3.20

Notes: The minimum neighbour matching adopts no replacement method; the bandwidth of nuclear matching adopts the default value; the radius of radius matching is 0.05; the ATT, standard error, and t value of spline matching use the Bootstrap Method; ***, **, * respectively indicate significant at the level of 1%, 5%, and 10%.

3.5.1 Propensity score matching

Table 6 shows the average disposal effect (ATT) of the two groups of samples using and not using the Internet after matching. The results of minimum neighbour matching, radius matching and spline matching show that, after eliminating the observable systematic differences between samples, internet use improves residents' happiness. However, the ATT of the smallest neighbour matching and spline matching are significant at the 1% statistical level, and the ATT of the radius matching is significant at the 10% statistical level. Only the ATT result with kernel matching is not significant. The significance and value of ATT in different matching methods in Table 6 are different but can prove that the use of the internet has a positive effect on residents' SWB.

3.5.2 Replace models and variables

We use a variety of methods for robustness testing to verify the reliability of the benchmark regression results. We present the results of the robustness test in Table 7. In Column (1) of Table 7, we use the Oprobit model frequently used in the previous related literature for regression. In Column (2), we use the variable 'Whether the Internet can be used' to replace the key explanatory variable 'Internet use' for regression. The variable 'Are you able to use the Internet' comes from the C51 question of CGSS2017: 'Can you access the internet at home (through computers, mobile phones and other electronic devices)'. This variable is also a dummy variable, where 1 means 'can' and 0 means 'cannot'. In Column (3) of Table 7, we use 'whether the Internet can be used' as the key independent variable and replace the dependent variable with 'life satisfaction'. The

meaning of 'life satisfaction' is close to subjective well-being. In previous literature, subjective well-being was divided into life satisfaction, positive emotions, and negative emotions (Diener et al., 1999). Some scholars have also studied the effect of Internet use on residents' life satisfaction to measure its effect on subjective well-being (Pénard et al., 2013). Therefore, to measure subjective well-being, 'life satisfaction' can be used to replace subjective well-being for robust analysis. The 'life satisfaction' in this article uses the D21 question in Part D of CGSS2017: 'In general, are you satisfied with your living conditions?' The value of this variable is from 1 to 5. Among them:

1   represents 'very satisfied'

2   represents 'satisfied'

3   represents 'indifferent or unsatisfied'

4   represents 'unsatisfied'

5 represents 'very dissatisfied'.

We use another variable 'the number of internet devices' as the key independent variable in Column (4). 'The number of internet devices' comes from the C50 question of CGSS2017, 'How many personal internet devices do you currently have'. This variable is a continuous variable. The more internet devices people have, the more likely they are to use the internet.

Table 7   Robustness check results

	(1) Oprobit	(2) Replace independent variables	(3) Replace independent and dependent variables	(4) Replace independent variables
Internet use	0.088***			
	(2.83)			
Whether the internet can be used		0.334***	−0.386***	
		(3.74)	(−4.42)	
Number of internet devices				0.074***
				(3.49)
Controls	Yes	Yes	Yes	Yes
Region EFFECT	Yes	Yes	Yes	Yes
Obs.	11647	3908	3907	10939
Pseudo R^2	0.052	0.059	0.048	0.052

Notes: The t statistics calculated based on the robust standard error are shown in
       parentheses; *, **, and *** respectively indicate statistical significance at the
       levels of 10%, 5%, and 1%.

In the regression results in Table 7, the coefficients of the key explanatory variables in Columns (1), (2) and (4) are all positive and statistically significant at the 1% level, thus verifying the results of the benchmark regression. Furthermore, the regression results in Column (3) of Table 7 show that the coefficient of 'whether you can use the Internet' is significantly negative. The reason here is that the dependent variable of this regression is 'life satisfaction'. The larger the value of this variable, the worse the individual's life satisfaction. This value is the opposite of the value of 'subjective well-being'. The greater

the value of 'subjective well-being', the stronger the personal well-being. Therefore, the regression result in Column (3) means that, compared with those who cannot use the Internet, those who can use the internet have a smaller value of 'life satisfaction', which means that they are more satisfied with their lives. This result is in line with the benchmark. The results are consistent.

3.6   Influence mechanism analysis

Leisure and entertainment is a key factor affecting residents' well-being. The effect of enhancing urban residents' SWB is higher than that of income factors; increasing leisure activities, especially active hedonic leisure time, can improve the happiness of Chinese urban residents (Schmiedeberg and Schroder, 2017). Furthermore, social justice is also one of the factors that affect happiness. A series of factors, such as fairer social environment, more transparent government affairs and more complete laws and regulations, promote the improvement of the residents' sense of social justice. The residents' subjective well-being will increase accordingly. Therefore, social equity can greatly affect the residents' subjective well-being.

However, how the Internet can improve residents' subjective well-being by affecting residents' leisure and entertainment and social justice still needs to be explored. We choose residents' responses to 'how often did you surf the Internet for leisure and entertainment in the past year' to measure their leisure and entertainment conditions, which is from question C42-4 in the CGSS2017 questionnaire. The value range of this variable is 1–5, where 1 stands for 'never', 2 stands for 'rarely', 3 stands for 'sometimes', 4 stands for 'often', and 5 stands for 'always'. We choose whether residents agree with 'Internet can promote social justice' in question C61-6 to measure residents' sense of social justice. The value of this variable is also from 1 to 5, where 1 represents 'strongly disagree', 2 represents 'disagree', 3 represents 'neutral', 4 represents 'agree', and 5 represents 'strongly agree'. We regard the two as the explained variables and use 'Internet use' as the key explanatory variable to explore the mechanism of Internet use affecting happiness.

Table 8   Influence mechanism analysis

Variable	Leisure and entertainment			Social justice		
Model	(1)	(2)	(3)	(4)	(5)	(6)
Internet use	2.402***	2.371***	1.701***	0.126*	0.145*	0.248**
	(8.72)	(8.20)	(4.02)	(1.80)	(1.80)	(2.19)
Controls	No	No	Yes	No	No	Yes
Region effect	No	Yes	Yes	No	Yes	Yes
Obs.	2420	2420	1692	3547	3547	2289
Pseudo R^2	0.014	0.026	0.066	0.000	0.008	0.015

Notes: The t statistics calculated based on the robust standard error are shown in parentheses; *, **, and *** respectively indicate statistical significance at the levels of 10%, 5%, and 1%.

In Table 8, the explained variable in Columns (1)–(3) is 'leisure and entertainment', and the explained variable in Columns (4)–(6) is 'social justice'. The results in Columns (1)–(3) show that the use of the internet can significantly promote residents' leisure and entertainment, which is significant at the 1% level. This may be that internet use can increase the time, type and form of leisure and entertainment activities for residents. With the development of the internet, residents' leisure and entertainment activities have become more colourful. internet use provides residents with more choices for leisure and entertainment, not limited to time and space barriers. As a result, residents have more opportunities for leisure and entertainment, relaxation and rest; relieve fatigue; and regulate their body and mind, thereby enhancing their sense of well-being. Thus, the way of leisure has a direct impact on happiness, and it affects happiness through mental health. Therefore, a mechanism for residents to participate in leisure and entertainment activities through the internet can be obtained to increase their subjective well-being.

In terms of social justice, the results of Columns (4)–(6) show that internet use also has a positive impact on residents' sense of social justice. Residents can obtain social public service resources more easily through the internet. At the same time, the use of internet-based media can also reduce relative deprivation. In turn, the sense of fairness can be improved. With the development of the Internet, the widespread use of online media has promoted more transparency in society, and residents have more convenient access to social information. The sense of social justice has also improved. Therefore, the use of the internet can improve the residents' sense of happiness by improving the influencing mechanism of residents' sense of social justice. H3 was also confirmed.

4   Conclusions

We use the data from the 2017 CGSS2017 to conduct an empirical analysis of the relationship between internet use and residents' SWB and its mechanism through the Ologit model and conduct an extended analysis using internet use frequency instead of internet use. We can draw several conclusions.

Our empirical results show that internet use can significantly improve residents' subjective well-being. This result remains valid after considering regional effects and adding a series of control variables. Using household transportation and communication expenditure and internet penetration rate as instrumental variables for internet use and utilising the Bioprobit model and CMP method for evaluation, after correcting the selection bias and endogenous problems, the positive effect of internet use on residents' subjective well-being remains significant.

A higher frequency of surfing the internet significantly improves residents' happiness. After using the frequency of Internet use instead of the indicators of whether to use the internet, we find that residents who 'used frequently' and 'very frequently' had higher subjective well-being than those who 'never' used the internet. That is, the higher the frequency of Internet use, the stronger the residents' subjective well-being. However, low-frequency surfing does not significantly improve subjective well-being compared with residents who never surf the internet.

The influence of internet use on the subjective well-being of residents with different household registration, political status and education level is heterogeneous. Internet use has a significant positive effect on the subjective well-being of rural residents, residents who are not CPC members and residents with lower education levels. However, the

internet use for urban residents, CPC members and residents with higher education and above does not affect SWB.

Internet use affects residents' subjective well-being through increased participation in leisure and entertainment and improvement of social equity. The use of the internet enriches residents' leisure and entertainment methods, relieves fatigue and increases happiness, thereby enhancing their sense of happiness. Furthermore, internet use facilitates residents' access to information, makes society more transparent and strengthens residents' subjective feelings of fairness, bringing out happiness.

This study provides micro evidence for the effect of internet use on well-being, and further explores the heterogeneity of internet use on residents' subjective well-being. This provides useful enlightenment for future research on further improving residents' subjective well-being and deepening the application of the internet.

The policy implications are as follows. Since the use of the internet and the frequency of internet use play a significant role in promoting residents' subjective well-being, the government should continue to improve the internet infrastructure, accelerate the informatisation construction of urban and rural areas, provide convenient, fast and high-quality internet services, and enable the people to share the development achievements of the internet era, so as to continuously improve people's well-being.

There are still some limitations in this study. Firstly, this paper is based on CGSS secondary research data, and despite obtaining a large sample dataset, it still has the limitations that are common in this type of research. That is, the measurement of each variable is limited by the dimensions and items of the questionnaire, and there are problems such as simplistic measurement of variables and incomplete consideration of influencing factors. Secondly, the variables used in the analysis also have limitations. The two variables involved in this paper, frequency of internet use and subjective well-being, are both subjective judgments of individuals and both arise in social comparisons. And individual variability, differences in reference groups and measures, etc. may lead to biased results. Third, we use cross-sectional data and therefore cannot validate the temporal trend on the causal relationship between internet use and well-being. Future research is yet to explore more appropriate variable measures with a larger time span to make the results more relevant to the real situation.

References

Algan, Y., Murtin, F., Beasley, E., Higa, K. and Senik, C. (2019) 'Well-being through the lens of the internet', *PLoS One*, Vol. 14, No. 1, p.e0209562.

Arampatzi, E., Burger, M.J. and Novik, N. (2016) 'Social network sites, individual social capital and happiness', *Journal of Happiness Studies*, Vol. 19, No. 1, pp.99–122.

Castellacci, F. and Schwabe, H. (2020) 'Internet, unmet aspirations and the U-shape of life', *PLoS One*, Vol. 15, No. 6, p.e0233099.

Castellacci, F. and Tveito, V. (2018) 'Internet use and well-being: A survey and a theoretical framework', *Research Policy*, Vol. 47, No. 1, pp.308–325.

Çikrıkci, Ö. (2016) 'The effect of internet use on well-being: Meta-analysis', *Computers in Human Behavior*, Vol. 65, No. 1, pp.560–566.

Cuñado, J. and de Gracia, F.P. (2012) 'Does education affect happiness? Evidence for Spain', *Social Indicators Research*, Vol. 108, No. 1, pp.185–196.

Deaton, A. and Stone, A. A. (2013) 'Two happiness puzzles', *American Economic Review*, Vol. 103, No. 3, pp.591–597.

Diener, E. (2009) 'Subjective well-being', in Diener, E. (Ed.): *The Science of Well-Being: The Collected Works of Ed Diener*, pp.11–58, Dordrecht: Springer Netherlands.

Diener, E., Suh, E.M., Lucas, R.E. and Smith, H.L. (1999) 'Subjective well-being: three decades of progress', *Psychological Bulletin*, Vol. 125, No. 2, p.276.

Fotourehchi, Z. (2021) 'Sustainable development and happiness', *International Journal of Happiness and Development*, Vol. 6, No. 3, pp.306–324.

Ganju, K.K., Pavlou, P.A. and Banker, R.D. (2016) 'Does information and communication technology lead to the well-being of nations? A country-level empirical investigation', *MIS Quarterly*, Vol. 40, No. 2, pp.417–430.

Graciyal, D.G. and Viswam, D. (2021) 'Social media and emotional well-being: pursuit of happiness or pleasure', *Asia Pacific Media Educator*, Vol. 31, No. 1, pp.99–115.

Greyling, T. (2018) 'Internet access and its relationship to subjective well-being in a developing region', *South African Journal of Economic and Management Sciences*, Vol. 21, No. 1, pp.1–12.

Guo, N.Y., Wang, M.P., Luk, T.T., Ho, S.Y., Fong, D.Y.T., Chan, S.S.C. and Lam, T.H. (2019) 'The association of problematic smartphone use with family well-being mediated by family communication in Chinese adults: a population-based study', *Journal of Behavioral Addictions*, Vol. 8, No. 3, pp.412–419.

Hofer, M., Hargittai, E., Buchi, M. and Seifert, A. (2019) 'Older adults' online information seeking and subjective well-being: the moderating role of internet skills', *International Journal of Communication*, Vol. 13, No. 1, pp.4426–4443.

Jackson, J. (2017) 'Free to be happy: economic freedom and happiness in US States', *Journal of Happiness Studies*, Vol. 18, No. 4, pp.1207–1229.

Kislev, E. (2020) 'Social capital, happiness, and the unmarried: a multilevel analysis of 32 European countries', *Applied Research in Quality of Life*, Vol. 15, No. 5, pp.1475–1492.

Kuo, Y-L. and Huang, T-H. (2020) 'The impacts of increasing leisure time on subjective health and life satisfaction', *International Journal of Happiness and Development*, Vol. 6, No. 1, pp.26–40.

Linnhoff, S. and Smith, K.T. (2017) 'An examination of mobile app usage and the user's life satisfaction', *Journal of Strategic Marketing*, Vol. 25, No. 7, pp.581–617.

Lohmann, S. (2015) 'Information technologies and subjective well-being: does the Internet raise material aspirations?', *Oxford Economic Papers*, Vol. 67, No. 3, pp.740–759.

Lu, M. and Ma, Q. (2022) 'The effect of mobile social media sharing behavior on the subjective well-being and mental health regulation of internet users', *Occupational Therapy International*, Vol. 2022, No. 1, p.7573322.

MacKerron, G. (2012) 'Happiness economics from 35000 feet', *Journal of Economic Surveys*, Vol. 26, No. 4, pp.705–735.

Nadimi, R., Tanaka, S. and Tokimatsu, K. (2021) 'Applying optimisation programming and research generator methods to measure subjective well-being within country', *International Journal of Happiness and Development*, Vol. 6, No. 3, pp.237–262.

Pénard, T., Poussing, N. and Suire, R. (2013) 'Does the Internet make people happier?', *The Journal of Socio-Economics*, Vol. 46, pp.105–116, DOI: https://doi.org/10.1016/j.socec.2013.08.004.

Peng, C., Lee, J-Y. and Liu, S. (2022) 'Psychological phenomenon analysis of short video users' anxiety, addiction and subjective well-being', *International Journal of Contents*, Vol. 18, No. 1, pp.27–39.

Roodman, D. (2011) 'Fitting fully observed recursive mixed-process models with CMP', *The Stata Journal*, Vol. 11, No. 2, pp.159–206.

Ruggeri, K., Garcia-Garzon, E., Maguire, Á., Matz, S. and Huppert, F.A. (2020) 'Well-being is more than happiness and life satisfaction: a multidimensional analysis of 21 countries', *Health and Quality of Life Outcomes*, Vol. 18, No. 1, p.192.

Sabatini, F. (2014) 'The relationship between happiness and health: evidence from Italy', *Social Science and Medicine*, Vol. 114, pp.178–187, DOI: https://doi.org/10.1787/cdb5de9b-en.

Sabatini, F. and Sarracino, F. (2017) 'Online networks and subjective well-being', *Kyklos*, Vol. 70, No. 3, pp.456–480.

Schmiedeberg, C. and Schroder, J. (2017) 'Leisure activities and life satisfaction: an analysis with German panel data', *Applied Research in Quality of Life*, Vol. 12, No. 1, pp.137–151.

Song, Z., Song, T., Yang, Y. and Wang, Z. (2019) 'Spatial–temporal characteristics and determinants of digital divide in China: a multivariate spatial analysis', *Sustainability*, Vol. 11, No. 17, DOI: https://doi.org/10.3390/su11174529.

Sui, M., Ding, H., Xu, B. and Zhou, M. (2022) 'The impact of internet use on the happiness of Chinese civil servants: a mediation analysis based on self-rated health', *International Journal of Environmental Research and Public Health*, Vol. 19, No. 20, DOI: https://doi.org/10.3390/ijerph192013142.

Tokuda, Y., Fujii, S. and Inoguchi, T. (2017) 'Individual and country-level effects of social trust on happiness: the Asia barometer survey', in Inoguchi, T. and Tokuda, Y. (Eds.): *Trust with Asian Characteristics: Interpersonal and Institutional*, pp.123–139, Springer, Singapore.

Viklund, E.W.E. and Forsman, A.K. (2022) 'Exploring the nuanced links between internet use and subjective well-being among older adults: a nordic population-based study', *Frontiers in Psychology*, Vol. 12, DOI: https://doi.org/10.3389/fpsyg.2021.797269.

Warmenhoven, H., Hoebink, P.R.J. and Janssens, J.M.A.M. (2019) 'Subjective wellbeing of the Chinese post-reform generation: influence of family income and urban/rural origin on the happiness of Chinese students', *International Journal of Happiness and Development*, Vol. 5, No. 4, pp.279–297.

Xu, Y. and Huang, Y. (2020) 'Chinese middle-aged and older adults' internet use and happiness: the mediating roles of loneliness and social engagement', *Journal of Applied Gerontology*, Vol. 40, No. 12, pp.1846–1855.

Yang, Y., Zeng, D. and Yang, F. (2022) 'Internet use and subjective well-being of the elderly: an analysis of the mediating effect based on social capital', *International Journal Of Environmental Research And Public Health*, Vol. 19, No. 19, DOI: https://doi.org/10.3390/ijerph191912087.

Ye, D., Ng, Y-K. and Lian, Y. (2015) 'Culture and happiness', *Soc. Indic. Res.*, Vol. 123, No. 2, pp.519–547.

Yu, S.C. (2015) 'Happiness or addiction: an example of taiwanese college students' use of Facebook', *International Journal of Technology and Human Interaction*, Vol. 11, No. 4, pp.26–40.

Zheng, H. and Ma, W. (2021) 'Click it and buy happiness: does online shopping improve subjective well-being of rural residents in China?', *Applied Economics*, Vol. 53, No. 36, pp.4192–4206.

Zuo, X. and Hong, Z. (2022) 'The impact of internet use on perception of the poor-rich gap: empirical evidence from China', *Sustainability*, Vol. 14, No. 6, DOI: https://doi.org/10.3390/su14063488.

Notes

1 See [online] https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=CN (accessed 2 February 2023).

2 See [online] https://happiness-report.s3.amazonaws.com/2022/WHR+22.pdf (accessed 2 February 2023).

3 See [online] http://www.cnnic.net.cn/NMediaFile/2022/0926/MAIN1664183425619U2MS43 3V3V.pdf (accessed 2 February 2023).