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Market participation and subjective well-being of maize farmers

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ABSTRACT

This study explores how maize farmers' market participation influences their subjective well-being, utilizing the 2020 China Rural Revitalization Survey data collected by the Chinese Academy of Social Science. Three variables, including market participation (a binary variable), sales ratio (a continuous variable), and sales frequency (a categorical variable), are utilized to measure maize farmers' market participation patterns comprehensively. By estimating a conditional mixed process model, this study finds that maize farmers' market participation significantly improves their subjective well-being captured by happiness, life satisfaction, and confidence about the future by 0.672, 0.925, and 1.125 points, respectively. Maize income mediates the positive association between farmers' market participation and their subjective well-being. The disaggregated analyses reveal that farmers at the household income tertiles 2 and 3 obtain a higher level of happiness, life satisfaction, and confidence about the future. Meanwhile, market participation significantly improves life satisfaction and confidence about the future of farmers experiencing natural disasters, while it increases the happiness of farmers who do not have such experiences. Farmers' market participation significantly improves their objective well-being regarding pork consumption and milk consumption by 68 g/capita/day and 56 g/capita/day, respectively. Further analysis confirms that market participation intensity, reflected by sales ratio and frequency, significantly increases farmers' subjective well-being. These findings highlight that the government should devote more efforts to inciting maize farmers to participate in market transactions to increase farmers' incomes and subjective well-being.

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1. Introduction

Farmers' market participation underlies the worldwide inexhaustible power for agricultural transformation (Dey and Singh, 2023; Zhang et al., 2021). Participation in input and output market transactions has been widely recognized as an important engine for improving farmers' input use efficiency (Zhang et al., 2021), output supply (Goldberg et al., 2021), food security (Herrmann et al., 2018), nutrition intake (Carletto et al., 2017; Kilimani et al., 2022; Zheng and Ma, 2023), and rural income growth (Dey and Singh, 2023; Ogutu and Qaim, 2019). Farmers' market participation promotes sustainable rural development in the developing world.

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Many studies have investigated whether farmers' market participation can facilitate rural development by improving rural households' economic welfare. In general, they found that farmers' market participation increases household income (Dey and Singh, 2023; Ogutu and Qaim, 2019) and improves food security (Asfaw et al., 2012; Herrmann et al., 2018; Ochieng et al., 2020). For instance, Ogutu and Qaim (2019) found that agricultural commercialization measured by the share of farm output sold contributes to the reduction of income poverty in Kenya. Dey and Singh (2023) found that vegetable farmers' market participation increases their income in Eastern India. The works of Asfaw et al. (2012) for Kenya and Ochieng et al. (2020) for Central Africa reported that farm output market participation is linked to enhanced food security. Besides, the existing studies also confirmed that farmers' market participation contributes to rural human capital accumulation (Gelo et al., 2020; Julius Chegere and Sebastian Kauky, 2022; Kilimani et al., 2022; van Asselt and Useche, 2022). For instance, Gelo et al. (2020) stated that farmers' market participation increases their investments in child schooling in Ethiopia. Julius Chegere and Sebastian Kauky (2022) and van Asselt and Useche (2022) found that market participation can improve farmers' nutrition intake and thus enhance the physical conditions of household members in Tanzania and Guatemala, respectively.

Enhancing farmers' subjective well-being (i.e. how rural people experience and evaluate different aspects of their lives) is also essential in promoting sustainable rural development (Asadullah et al., 2018). A high level of subjective well-being not only improves farmers' life quality but also enhances their productivity and then increases their economic performance (e.g. household income) (Stevenson and Wolfers, 2021) and welfare (e.g. food consumption and health condition) (Dominko and Verbič, 2022; Martín-María et al., 2020). For instance, Stevenson and Wolfers (2021) found that subjective well-being promotes farmers to earn more income. Dominko and Verbič (2022) found that subjective well-being positively affects people's food consumption. Accordingly, improving farmers' subjective well-being is at the core of promoting rural development. Therefore, effective strategies for farmers' subjective well-being improvement are warranted.

Previous studies have proven that economic improvement leads farmers to a higher level of subjective well-being (Charles et al., 2019; Dufhues et al., 2023; Lim et al., 2020; Van den Broeck and Maertens, 2017; Yan and Wen, 2020; Yeo and Lee, 2019). For instance, Van den Broeck and Maertens (2017) found that off-farm income positively influences rural women's subjective well-being in Senegal. The work of Tauseef (2022) for Bangladesh suggested that income increase is a significant driver for farmers' subjective well-being. The logic behind this is that income growth can directly satisfy people's basic needs (e.g. food, medical care, and security) and their higher-level needs (e.g. self-development, social status elevation, and dream realization), making them happier and satisfied with their lives. As aforementioned, market participation could serve as an effective channel to enhance farmers' income earnings, which could further improve farmers' subjective well-being. Nevertheless, although farmers in the developing world gradually rely more on the output market as their primary income generation channel (Ochieng et al., 2020; Ogutu and Qaim, 2019), little is known about how farmers' market participation is linked to their subjective well-being.

The present study aims to conceptually and empirically investigate how farmers' market participation influences their subjective well-being. This study uses a conditional mixed process (CMP) model to address the selection bias and endogeneity issues associated with farmers' market participation and estimate the 2020 China Rural Revitalization Survey (CRRS) data collected by the Chinese Academy of Social Science. The present study focuses on market participation and the subjective well-being of maize farmers because the samples of maize farmers are larger than that of other crops, such as rice and wheat, in the CRRS dataset. The analysis of this study helps identify effective pathways to improve farmers' subjective well-being and market participation, which are beneficial for stakeholders in China and other developing countries with similar conditions to promote agricultural commercialization, rural subjective well-being improvement, and sustainable rural development.

This study contributes to the literature in five aspects. First, in addition to measuring farmers' market participation as a dummy, this study also accounts for the sales ratio (ratio of the quantity of maize sold to the total maize output) and sales frequency. It estimates their impacts on subjective well-being for additional understanding. Compared with measuring market participation as a dummy variable, considering the sales ratio (a continuous variable) and sales frequency (a categorical variable) can help comprehensively reflect the continuity and repeatability attributes of market transactions. This allows us to comprehensively understand how farmers' market participation decisions and participation intensity affect their subjective well-being. However, previous studies consider farmers' market participation a dichotomous decision (e.g. Dey and Singh, 2023; Li et al., 2020; Xu and Du, 2022), neglecting their market participation intensity. Second, this study considers happiness, life satisfaction, and confidence about the future to comprehensively capture farmers' subjective well-being. Although happiness and life satisfaction have been widely used in previous studies to capture individuals' subjective well-being (Nie et al., 2021; Zheng and Ma, 2021), these indicators normally reflect people's past and present subjective status. By contrast, the variable representing confidence about the future captures people's subjective well-being regarding the future dimension. Prior literature (Diener et al., 1999; Veenhoven, 2013) defined subjective well-being as people's subjective enjoyment of life, which temporally includes the past, present, and future dimensions. Thus, the inclusion of confidence about the future enables us to give a comprehensive depiction of farmers' subjective well-being.

Third, two variables (maize income and income from other crops) that capture incomes and one variable named social interaction are considered and explored in how they mediate the relationship between farmers' market participation and their subjective well-being. This can enrich the understanding the mechanisms linking market participation to subjective

well-being. Based on this, policymakers can design precise strategies to improve farmers' subjective well-being and market participation. Fourth, this study looks further at how market participation affects the subjective well-being of farmers regarding different household income levels and natural disaster experiences. This allows us to understand the specific scenarios under which market participation is beneficial for subjective well-being improvement. Fifth, this study explores whether market participation stimulates farmers to consume more pork, milk, and healthcare products to advance people's understanding of this field. In general, the findings of this study would help design practical strategies that improve rural farmers' subjective well-being and promote rural development sustainably.

The remainder of the paper is structured as follows. Section 2 introduces the background information of the case study. Section 3 presents the analytical framework and empirical approach. Section 4 presents the data source, variables, and descriptive statistics. The discussions on the empirical results in Section 5 follow this. Finally, Section 6 presents conclusions, policy implications, and limitations.

2. Background

Rural China provides a compelling case study for exploring the association between farmers' market participation and their subjective well-being. The market is increasingly important in boosting rural development in China. During the past 46 years of economic reform, a significant transformation of the rural economy from administrative dominance to marketization has been observed throughout the country (Xu and Du, 2022; Zhang et al., 2021). It is a common phenomenon in China that farmers' economic performance is growingly determined by their market participation. Consequently, the net business income of rural households in China increased from 4504 yuan/capita (roughly equivalent to 648 USD/capita) in 2015 to 6566 yuan/capita (roughly equivalent to 945 USD/capita) in 2021 (NBSC, 2022). However, the contribution of agricultural commercialization to rural income growth is lessening (Zhang et al., 2021). The low participation rate of the agricultural output market hinders farmers from earning more income and diminishes the importance of market participation in improving their economic performance. For instance, the ratio of agricultural income (mainly derived from market participation) to farmers' total disposable income decreased from 39% in 2015 to 35% in 2021 (NBSC, 2022). This suggests that market participation, an efficient strategy to improve farmers' economic performance and sustainable rural development, stands to be properly exploited. Therefore, it is essential for China to further promote farmers' agricultural output market participation.

China is now heading towards constructing a harmonious countryside and listing farmers' subjective well-being improvement as a primary mission in this process (Li et al., 2023; Zheng and Ma, 2021). The existing studies have proven that the targeted poverty alleviation program (Chang et al., 2022; Tang et al., 2022) and the rural garbage classification program (Li and Ma, 2023; Qi et al., 2022; Shi et al., 2020) implemented by the Chinese government increased farmers' subjective well-being. However, due to the large rural population (more than 510 million), improving rural people's subjective well-being could not be accomplished shortly (Li and Ma, 2023). More importantly, the historical dual urban–rural economic structure has caused a startling subjective well-being gap between urban and rural residents in China (Asadullah et al., 2018; Yang et al., 2019). For instance, Asadullah et al. (2018) reported that the mean happiness score of Chinese urban residents was 3.81, which is statistically significantly higher than that of rural residents (i.e. 3.69). More strikingly, China's suicide rate in rural areas was almost twice as high as in urban areas in 2021 (NHCC, 2022). Undoubtedly, it is essential to find different channels to improve farmers' subjective well-being, and this study explores the role of market participation.

This study puts a particular emphasis on China's maize farmers. In China, maize, the most widely planted crop, embodies the country's central part of crop cultivation (Zheng et al., 2020). Together with wheat and rice, maize is one of the three main grain crops in China, and it is ranked first in both planting area and total output. In 2021, the planting area of maize in China reached 43.32 million hectares, accounting for 26% of the country's total crop planting area (NHCC, 2022). Meanwhile, the maize output reached an astonishing 272.5 million tons in 2021.

To a great extent, maize planting has attracted most of China's rural residents and profoundly determines their livelihood. Given the significant contribution of maize production to China's agricultural performance, improving maize commercialization could stimulate rural China's food security, economic growth, and sustainable development. However, official data from the National Development and Reform Commission (NDRC) of China showed that the commercialization rate of maize was only 75% on average in 2021 (NDRC, 2022). More strikingly, maize commercialization in some regions currently remains in the bud. For instance, in 2021, the commercialization rates of maize in Chongqing and Gansu were only 31% and 46%, respectively (NDRC, 2022), much lower than the statistic (53%) reported by Haile et al. (2022) in Ethiopia. Therefore, China urgently needs further action to boost maize farmers' market participation.

Since maize farmers represent most of China's rural residents, their happiness, life satisfaction, and confidence about the future could reflect the real condition of rural subjective well-being. Maize farmers provide a nationally representative case to investigate market participation and its impact on subjective well-being. This study focuses on how China's maize farmers could play a dual efficacy in rural development by unlocking the pathways to farmers' subjective well-being improvement and rural commercialization.

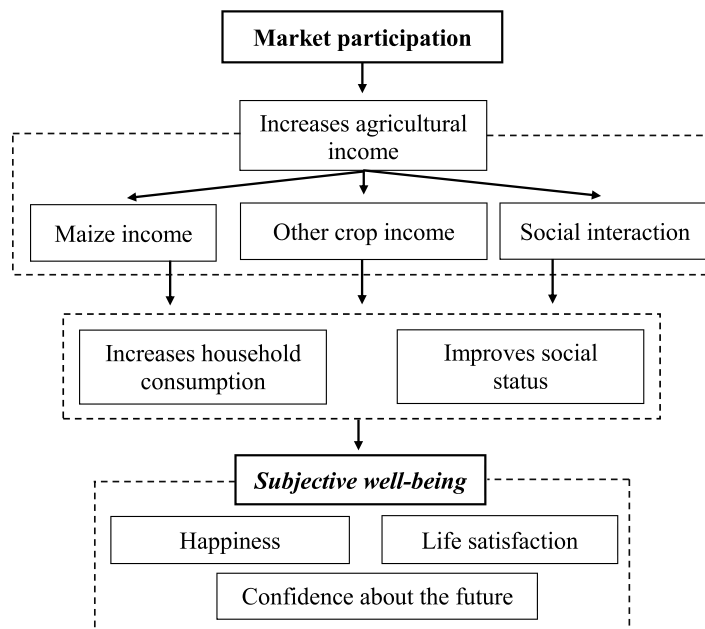


Fig. 1. Potential pathways of the impact of farmers' market participation on their subjective well-being.

3. Analytical framework and empirical approach

3.1. Analytical framework

Maize farmers' market participation can influence their subjective well-being through three potential channels. This is depicted in Fig. 1. The first channel suggests that maize farmers' market participation can influence their subjective well-being by increasing maize income. Market participation effectively links farmers to many competitive buyers who bid for more acquisitions (Ochieng et al., 2020), significantly increasing the volume of maize products sold out and the prices farmers receive. Compared with selling agricultural products in informal markets (sellers need to trade through bilateral bargaining to remain anonymous from the taxing authority), participation in formal markets (sellers can publicly advertise their prices and locations) triggers bulk sales of agricultural products (Abdul-Rahaman and Abdulai, 2020). It decreases transaction costs (Anbarci et al., 2012). As a result, maize farmers' market participation can significantly increase their agricultural income in general and maize income in particular. Higher agricultural income lifts farmers' social status (Riddell et al., 2018) and increases their consumption (Amare et al., 2021), making them happier and more satisfied with their lives.

The second channel suggests that maize farmers' market participation can potentially improve their income from other crops (e.g. rice and wheat), improving their subjective well-being. Farmers' market participation can bring them abundant market information (Asfaw et al., 2012; Ochieng et al., 2020), such as prices, sales timing, and sales channels, on the one hand; on the other hand, it can facilitate farmers to strengthen their negotiation abilities during their maize trades with multiple peddlers (Dey and Singh, 2023). For instance, a veteran maize seller is more likely to be confident and skilled to negotiate with peddlers during their other crop transactions and tilt the balance of the transaction in their favour. Subsequently, these benefits induce maize farmers to sell more of their other crops at higher prices and lower transaction costs and thus increasing their other crop income. Via this channel, market participation can lead maize farmers to enjoy more diversified consumption and a higher-level social status, which contributes to the improvement of their subjective well-being.

The third channel is that market participation can promote farmers' social interaction, which benefits their agricultural income generation and subjective well-being (Rao et al., 2016). Market participation, intrinsically, is manifested as the material and information exchange among the participants. Through participating in the agricultural output market, farmers tend to deeply communicate with their neighbours and other villagers apart from the buyers, facilitating them to obtain essential information on price, sales channels, and improved production practices, which thereby promote their crop production and commercialization (Ochieng et al., 2020). As a result, maize farmers can possess higher maize and other crop income. Meanwhile, social interaction derived from market participation can also facilitate farmers to build harmonious interpersonal relationships with others, which is helpful for them to release psychological pressure and anxiety (Rao et al., 2016; Zheng et al., 2023). Regarding the effects above, market participation can influence maize farmers' subjective well-being through social interaction.

In sum, the discussions in this section conceptually reveal that maize farmers' market participation is positively associated with their subjective well-being. In what follows, an appropriate econometric approach will be utilized to investigate this association and verify the influential channels empirically.

3.2. Empirical approach

3.2.1. Empirical specifications

It is assumed that farmers are making a dichotomous decision on whether to sell their products to the markets or not to maximize their expected benefits. Taking maize farmers as an example, they can choose to sell part or all their produced maize to the market and earn income from maize sales directly. Alternatively, they can, for example, choose to consume the produced maize for food or use it to feed livestock and earn income from maize production indirectly (livestock sales directly). To facilitate the analysis, it is assumed that the benefits a farmer can receive from selling and not selling his maize to the markets are P_s^* and P_n^* , respectively. The farmer will choose to sell their maize to the markets (i.e. participating in markets) directly if and only if the benefits received from market participation are higher than the same received from not participating (i.e. storing produced maize at home, consuming it directly, or using it as a supplementary feed for livestock rather than directly for market sales). Let us further assume that MP_i^* is the expected net benefit difference between market participation and non-participation, one can have $MP_i^* = P_s^* - P_n^* > 0$ if a farmer chooses to participate in the market to sell their maize. Although MP_i^* cannot be observed in reality, it can be modelled by a latent variable function as specified below:

$$MP_i^* = \alpha X_i + \varepsilon_i, MP_i = \begin{cases} 1, & \text{if } MP_i^* > 0 \\ 0, & \text{if } MP_i^* \leq 0 \end{cases} \quad (1)$$

where MP_i^* is a latent variable denoting the propensity that individual i participates in the market. Although MP_i^* cannot be observed directly, it can be proxied by MP_i . Specifically, MP_i equals one if household i chooses to participate in the market for selling maize and zero otherwise. X_i indicates the vector of selected control variables, such as age, education, and asset ownership. α is the parameter to be estimated. ε_i is an error term.

The variables representing farmers' subjective well-being (i.e. happiness, life satisfaction, and confidence about the future) are captured using a 5-point Likert scale in the 2020 CRRS data. For instance, happiness = 1 and happiness = 5 would suggest the lowest and highest happiness levels reported by a farmer. This is consistent with previous studies (e.g. Li and Ma, 2023; Tsurumi et al., 2021). Therefore, following Charles et al. (2019) and Zheng and Ma (2023), the association between farmers' market participation and their subjective well-being can be expressed using the ordered probit model as follows:

$$SWB_i^{J*} = \beta MP_i + \gamma X_i + \mu_i, \text{ with } SWB_i^J = \begin{cases} 1 & \text{if } SWB_i^{J*} \leq C_1 \\ 2 & \text{if } C_1 < SWB_i^{J*} \leq C_2 \\ \dots & \\ K & \text{if } C_{K-1} < SWB_i^{J*} \end{cases} \quad (2)$$

where SWB_i^{J*} refers to the latent variable indicating the level of farmer i 's subjective well-being, representing happiness ($J = 1$), life satisfaction ($J = 2$), and confidence about the future ($J = 3$). SWB_i^{J*} is unobserved and determined by a categorical variable, SWB_i^J are unknown cut-offs (i.e. C_1, \dots, C_{K-1}). $SWB_i^J = 1$ represents the lowest level of subjective well-being indicators, while $SWB_i^J = K$ represents the highest level.

3.2.2. Model selection

Addressing the endogeneity issues in estimating the impact of farmers' market participation on their subjective well-being is the primary task of our empirical design. Generally, the endogeneity issues come from three causes. The first cause of endogeneity is an omitted variable. In addition to observed factors (e.g. age, gender and education), some unobserved factors (e.g. farmers' motivations and managerial skills) would also affect farmers' market participation and subjective well-being. However, we could not include those unobserved factors in the empirical analysis. The second cause of endogeneity is reverse causality or simultaneity. Although we assume that farmers' market participation would determine their subjective well-being, it might also be a case that those with a high level of subjective well-being like to commercialize their products through market participation. The third cause of endogeneity is measurement error. This issue arises because we cannot precisely measure all variables included in the model all the time.

In sum, the market participation variable tends to be endogenous. Without addressing such issues properly, the estimates of the association between market participation and subjective well-being could be biased. The ordered probit model specified by Eq. (2) treats all explanatory variables as exogenous. Therefore, a more rigorous econometric strategy is required to address endogeneity issues when estimating the association between farmers' market participation and subjective well-being.

When estimating the impact of a binary endogenous treatment variable (i.e. market participation) on a categorical dependent variable like happiness, life satisfaction, and confidence about the future, the endogenous ordered probit (EOP) model (e.g. Zheng and Ma, 2023; Zhu et al., 2020) and the CMP model (e.g. Mallapragada et al., 2016; Roy Chowdhury et al., 2018) could be applied. Among them, the EOP model requires the key explanatory variable to be dichotomously distributed (Zheng et al., 2023), while the CMP model relaxes this restriction and allows for multiple variable distribution forms (Mallapragada et al., 2016; Roodman, 2011). As indicated earlier, market participation (dummy variable), sales ratio (continuous variable), and sales frequency (categorical variable) are simultaneously considered key explanatory variables. Therefore, the CMP model is used as the main econometric strategy.

3.2.3. Conditional mixed process model

The CMP model jointly regresses Equations (1) and (2) and estimates the unbiased impact of market participation on subjective well-being using a maximum likelihood (ML) estimator (Roodman, 2011). Meanwhile, the ML estimator generates a correlation coefficient (i.e. $\rho_{\mu\epsilon}$) between the error terms in the two equations. A significant $\rho_{\mu\epsilon}$ would indicate the presence of the unobserved endogeneity associated with the market participation variable, evidencing the efficiency of estimating the CMP model (Mallapragada et al., 2016).

To realize the CMP model's significance in addressing endogeneity issues, a valid instrumental variable (IV) should be identified and included in Eq. (1) but not in Eq. (2). An IV is certified as valid only if it is correlated with the endogenous variable (the correlation assumption) and uncorrelated with the dependent variable (the exogeneity assumption) (Hanushek et al., 1996; Rivkin, 2001). In this regard, we exercise caution and employ a variable representing the proximity to plots as an IV. Specifically, the IV represents the proximity degree of respondents' residences to their farm plots. The selected IV is valid for two main reasons. First, farmers are more likely to rely on maize for income if they grow the crop in farmland far away from home. Therefore, the proximity to the plot variable is expected to correlate with farmers' market participation positively. Put another way, the IV can meet the correlation assumption. Second, the proximity of respondents' residences to their farm plots cannot directly influence their subjective well-being, such as happiness, life satisfaction, and confidence about the future. Therefore, the selected IV meets the exogeneity assumption.

This study follows Adhvaryu and Nyshadham (2017) and Li and Ma (2023) and conducts a falsification test and regression analyses to confirm the IV's validity statistically. The statistics in Tables A.1 and A.2 in the Appendix suggest that the IV is significantly correlated with farmers' market participation and uncorrelated with their subjective well-being (i.e. happiness, life satisfaction, and confidence about the future). In sum, proximity to plots is valid and efficient in addressing endogeneity issues associated with the market participation variable.

3.2.4. Generalized structural equation model

This study also attempts to unlock the mechanisms through which farmers' market participation influences their subjective well-being. Therefore, the present study further conducts a mediation analysis concerning the influencing channels discussed in Section 3.1. Several econometric strategies can perform the mediation analysis, including the seemingly unrelated regression (SURE) model (Lee et al., 2018), the structural equation (SE) model (Cheng et al., 2018), and the generalized structural equation (GSE) model (Perez et al., 2018). The SURE and SE models are suitable only for normally distributed dependent variables (Perez et al., 2018; Preacher and Hayes, 2008), while the GSE model is excluded from this restriction (Preacher and Hayes, 2008). Thus, the GSE model is more efficient and robust for mediation analysis than the SURE and SE models (Preacher and Hayes, 2008).

In the present study, the dependent variables, happiness, life satisfaction, and confidence about the future, are categorical variables. Given this, the GSE model is regressed to explore the pathways by which farmers' market participation influences their subjective well-being. Here, let us consider the scenarios of two mediators, i.e., $Media_1$ and $Media_2$ and specify the GSE model as follows:

$$SWB_i^j = \theta_1 MP_i + \vartheta Media_{1i} + \tau Media_{2i} + \varphi_1 X_i + \zeta_{1i} \quad (3)$$

$$Media_{1i} = \theta_2 MP_i + \varphi_2 X_i + \zeta_{2i} \quad (4)$$

$$Media_{2i} = \theta_3 MP_i + \varphi_3 X_i + \zeta_{3i} \quad (5)$$

where $Media_1$ and $Media_2$ indicate the chosen mediators. SWB_i^j , MP_i , and X_i are defined above. θ_1 , θ_2 , θ_3 , ϑ , τ , φ_1 , φ_2 , and φ_3 are parameters to be estimated. ζ_{1i} , ζ_{2i} , and ζ_{3i} are error terms. Utilizing the estimates from Eqs. (3)–(5), the indirect effects (i.e. the mediation effects) of market participation on subjective well-being through two mediators, $Media_1$ and $Media_2$, can be calculated as follows:

The indirect effect through $Media_1$:

$$IE_{Media_1} = \theta_2 * \vartheta \quad (6)$$

The indirect effect through $Media_2$:

$$IE_{Media_2} = \theta_3 * \tau \quad (7)$$

The total indirect effect:

$$IE_{Total} = \theta_2 * \vartheta + \theta_3 * \tau \quad (8)$$

It should be noted that the GSE model cannot be directly used to do the mediation analysis as it accounts nothing for the endogeneity issues associated with market participation. To cope with this, the present study follows prior literature (e.g. [Ma et al., 2022](#); [Ying et al., 2019](#)) and estimates a two-step predictor substitution (2SPS) model. A probit model, including the IV, is estimated to predict the market participation variable's value in the first stage. In the second stage, this study replaces the original market participation variable with the predicted one and then estimates the GSE model. By doing so, the GSE model can generate unbiased mediation effects.

4. Data, variables, and descriptive analysis

4.1. Data

The data from the 2020 CRRS was analysed in the present study. The Rural Development Institute, Chinese Academy of Social Science organized the survey and collected data from mainland China's eastern, central, and western regions. They collected multiple pieces of information to comprehensively understand the current situation of rural China, such as rural household demographic characteristics, rural industry development, and rural social governance. More importantly, the dataset of the 2020 CRRS pertains to abundant information on farmers' market participation and subjective well-being, fulfilling the empirical task of the present study.

The sample of the 2020 CRRS was generated in five steps. The first step randomly selected ten provinces from eastern, central, and western China. These include Zhejiang, Shandong, and Guangdong provinces from eastern China, Heilongjiang, Anhui, and Henan provinces from central China, and Sichuan, Guizhou, Shaanxi, and Ningxia provinces from western China. In the second step, according to the county-level per capita GDP (gross domestic product), five counties within each sampled province were randomly chosen using the equidistant random sampling method. In the following two steps, 156 towns and 300 villages were randomly and sequentially selected using the same sampling technique. Finally, 10–15 households from each chosen village were randomly selected using the roster provided by village committees and then face-to-face interviews. As a result, a nationally representative survey sample of 3738 rural households can be obtained from the 2020 CRRS.

This study carefully cleaned the 2020 CRRS data before formal estimations. First, 2673 samples without maize cultivation were purposively dropped as this study mainly focuses on maize cultivators. Second, 72 samples with missing and abnormal values in subjective well-being indicators (i.e. happiness, life satisfaction, and confidence about the future) were deleted. Finally, this study also excluded 26 samples reporting missing and abnormal values in the variables used as controls. As a result, a sample of 967 rural households was analysed in this study.

4.2. Variables

4.2.1. Subjective well-being indicators

Subjective well-being was captured using three variables: happiness, life satisfaction, and confidence about the future. Specifically, the happiness indicator captures farmers' daily emotional quality and thus reflects their short-run hedonic well-being, while the life satisfaction indicator reflects farmers' evaluation of their past and ongoing life and measures their long-run subjective well-being ([Li and Ma, 2023](#); [Pénard et al., 2013](#); [Zheng and Ma, 2021](#)). These two indicators only reflect farmers' subjective well-being in the context of past and present, leaving the future perspective neglected. Previous studies ([Diener et al., 1999](#); [Kahneman and Deaton, 2010](#); [Pénard et al., 2013](#); [Veenhoven, 2013](#)) have generalized the definition of subjective well-being, enlarging the scope of the content that can be included in it. For instance, [Kahneman and Deaton \(2010\)](#) and [Pénard et al. \(2013\)](#) suggested that subjective well-being is people's emotional evaluation of their lives. Thus, people's emotional reactions could be integrated into the framework of subjective well-being. More directly, [Diener et al. \(1999\)](#) and [Veenhoven \(2013\)](#) defined subjective well-being as one's subjective enjoyment of life as a whole, which should include the dimensions of past, present, and future. Confidence about the future, reflecting farmers' emotional reaction to tomorrow (e.g. hopeful or hopeless), can measure people's subjective well-being from the future dimension. Meanwhile, from a utilitarian perspective, people's subjective well-being about the future (e.g. confidence about the future) quite matters in their present economic performance and long-term development ([Pleeging et al., 2021](#)). Accordingly, it is necessary to expand the scope of subjective well-being's description by including the dimension of the future. Therefore, this study also includes the indicator of confidence about the future as an extra measure of farmers' subjective well-being.

The 2020 CRRS questionnaire measures the three subjective well-being variables on a 5-point Likert scale. In particular, the happiness variable ranges from 1 = very unhappy to 5 = very happy; the life satisfaction variable ranges from 1 = very unsatisfied to 5 = very satisfied; and the variable representing confidence about the future ranges from 1 = very unconfident about the future to 5 = very confident about the future.

4.2.2. Market participation

Market participation is considered the treatment variable. Following [Zou and Deng \(2019\)](#) and [Burke et al. \(2020\)](#), this study primarily defines it using a dummy variable to capture maize farmers' market participation decisions. The dummy

takes the value of one if a household sold out maize in 2019 and zero otherwise. Because the market participation dummy can only capture particular effects on subjective well-being, this study also considers sales ratio (i.e. the ratio of the quantity of maize sold to the total maize output) and sales frequency (i.e. sales frequency of maize in 2019) to capture maize farmers' market participation intensity and improve people's understanding of the association between market participation and subjective well-being.

4.2.3. Selection of control variables

The present study relies on the existing literature on market access (e.g. [Burke et al., 2020](#); [Kilimani et al., 2022](#); [Ogutu and Qaim, 2019](#)) and subjective well-being (e.g. [Dufhues et al., 2023](#); [Li and Ma, 2023](#); [Nie et al., 2021](#); [Zheng and Ma, 2021](#)) to select control variables. This study uses the household head's age, gender, education, marital status, ethnic minority, communist party membership, health, and household size to reflect rural households' demographic characteristics. It should be noted that China has issued multiple preferential policies (e.g. bonus policy for education and employment subsidies) for ethnic minorities, which helps them enjoy a high level of subjective well-being ([Ma and Chen, 2020](#)). Meanwhile, the reality is that the vast majority of China's ethnic minorities reside in less developed areas (e.g. Yunnan, Guizhou, and Qinghai provinces) where rural markets remain immature. Thus, ethnic minorities' market participation could be low. Collectively, the ethnic minority variable tends to pose a positive impact on subjective well-being but a negative impact on market participation. Following [Blanchflower \(2021\)](#), this study also controls the impact of farmers' age in a squared form to capture the nonlinear relationship between farmers' age and subjective well-being.

Following [Vatsa et al. \(2022\)](#) and [Li and Ma \(2023\)](#), this study selects household income, asset ownership, and farm size indicators to proxy rural households' financial conditions. As documented by previous studies ([Vatsa et al., 2022](#); [Zheng and Ma, 2021](#)), good financial condition frees people to purchase and enjoy multiple goods and services and increases their subjective well-being. Therefore, the three financial variables are expected to affect farmers' subjective well-being positively.

People's negative shock experience negatively affects their subjective well-being ([Li and Ma, 2023](#); [López-Feldman and Porro, 2021](#)). Given this, the empirical settings of this study include the dummy of natural disasters to reproduce this inverse association. Farmers' relationship with other villagers determines their psychological condition ([Ding et al., 2021](#)). This study uses a binary variable representing neighbourhood conflicts to reflect farmers' interpersonal relationships. Previous studies (e.g. [Li and Ma, 2023](#); [Qi et al., 2022](#)) have documented that pro-environmental practices, such as garbage classification and toilet upgrades, are supposed to be significant drivers of farmers' subjective well-being improvement. Thus, this study uses two dummies representing farmers' sanitary toilet use and garbage classification as controls. Besides, to capture the influences of prefecture-level disparities on farmers' market participation and subjective well-being, following prior literature (e.g. [Li and Ma, 2023](#); [Vatsa et al., 2022](#); [Zhu et al., 2020](#)), a vector of county dummies are included in the empirical settings.

4.3. Descriptive analysis

[Table 1](#) illustrates the definitions and descriptive statistics of the selected variables. In the sample, all the average levels of farmers' happiness, life satisfaction, and confidence about the future exceed the category of 4 out of 5. This finding is consistent with [Nie et al. \(2021\)](#) and [Li and Ma \(2023\)](#), who concluded that China's rural residents enjoy a relatively high level of subjective well-being. Moreover, a simple mean comparison illustrated in [Fig. 2](#) suggests that market participants enjoy a higher level of happiness, life satisfaction, and confidence about the future relative to non-participants. For instance, the degree of confidence about the future for market participants is 4.29 out of 5, which is higher than that of non-participants (i.e. 4.12). These findings underlie the precondition of the present study. It is important to call attention to the low prevalence of farmers' market inclusion. The proportion of respondents participating in the market is approximately 0.55, much closer to that of Zambia (0.52) ([Burke et al., 2020](#)) but significantly lower than that of Peru (0.99) ([Fan and Salas Garcia, 2018](#)). Meanwhile, the mean values of the sales ratio and frequency variables are only 0.26 and 0.59, respectively. These statistics suggest a large commercialization potential for farmers' maize products to be further exploited.

Turning to the control variables, the statistics in [Table 1](#) deliver some interesting information about the sampled maize farmers. For instance, [Table 1](#) suggests that the sampled households tend to be headed by aged, male, poorly educated, married, and Han (the largest ethnic group in China) farmers. About 21% of the sampled household heads are characterized as communist party members. The average value of household size is about 3.34, suggesting the sample is dominated by small rural households. Approximately 91% of the sampled households own computers or smartphones. Meanwhile, a significant fraction (about 30%) of the maize farmers in the sample experienced natural disasters in 2019. The descriptive statistics in [Table 1](#) also suggest the average size of farmland operated by the sampled households is about 6.83 mu. Moreover, approximately 63% and 36% of the respondents use sanitary toilets and classify their domestic wastes, respectively.

5. Results and discussion

This section presents and discusses the empirical results of this study. As can be seen, the statistics of $\rho_{\mu\epsilon}$ in Models (2) and (3) in the lower panel of [Table 2](#) are all negative and statistically significant at the 1% significance level, implying the

Table 1
Variable definitions and descriptive statistics.

Variables	Definition	Mean	SD.
<i>Subjective well-being variables</i>			
Happiness	Self-reported happiness: from 1 = very unhappy to 5 = very happy	4.18	0.84
Life satisfaction	Self-reported life satisfaction: from 1 = very unsatisfied to 5 = very satisfied	4.13	0.81
Confidence about the future	Self-reported confidence about the future: from 1 = very unconfident to 5 = very confident	4.22	0.91
<i>Objective well-being variables</i>			
Pork consumption	Household pork consumption (kg/capita/day)	0.04	0.06
Milk consumption	Household milk consumption (kg/capita/day)	0.05	0.07
Healthcare product consumption	1 if a household head (HH) has a physical examination and/or consumes health care products (e.g. multivitamin–multimineral supplements), 0 otherwise	0.65	0.48
<i>Key explanatory variables</i>			
Market participation	1 if a household sold out maize in 2020, 0 otherwise	0.55	0.50
Sales ratio	Ratio of the quantity of maize sold to the total maize output	0.26	0.22
Sales frequency	Sales frequency of maize in 2020 from 0 to 2 or more	0.59	0.49
<i>Control variables</i>			
Age	Age of a HH (years)	56.21	9.69
Gender	1 if a HH is male, 0 otherwise	0.95	0.21
Education	Educational level of a HH: 1 = No formal education (illiterate), 2 = Primary school, 3 = Elementary school, and 4 = High school or above	1.71	0.72
Marital status	1 if the HH is married, 0 otherwise	0.94	0.24
Ethnic minority	1 if a HH belongs to an ethnic minority (e.g. Miao, Manchu, and Hui), 0 otherwise	0.18	0.38
Communist party membership	1 if a HH is a communist party member, 0 otherwise	0.21	0.41
Health	Physical condition of HH in 2020: 1 = poor, 2 = fair, 3 = good	1.89	0.63
Household size	Number of people residing in a household	3.34	1.47
Household income	Total household income (10,000 yuan/capita/year)	1.97	1.84
Asset ownership	1 if a household owns a computer and/or smartphone, 0 otherwise	0.91	0.28
Farm size	Total farmland area growing maize (mu) ^a	6.83	5.77
Natural disaster	1 if a household experiences natural disasters (e.g. drought and flood), 0 otherwise	0.30	0.46
Neighbourhood conflicts	1 if a household experiences neighbourhood conflicts, 0 otherwise	0.07	0.25
Sanitary toilet use	1 if a household uses a sanitary toilet (e.g. flush toilet), 0 otherwise	0.63	0.48
Garbage classification	1 if a household classifies its domestic garbage, 0 otherwise	0.36	0.48
Proximity to plots (IV)	Proximity degree of respondents' residences to their farm plots: 1 = close, 2 = medium, 3 = far	1.72	0.81

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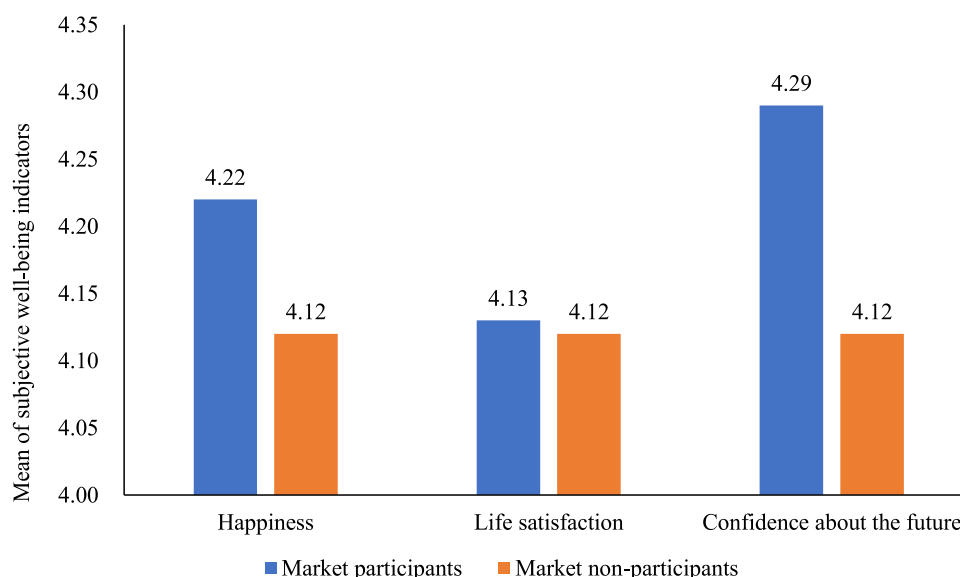
Table 1 (continued).

Variables	Definition	Mean	SD.
<i>Mediators</i>			
Maize income	Net income from maize (1000 yuan) ^b	2.75	10.04
Other crop income	Net income from other crops (e.g. rice and wheat) (1000 yuan)	3.80	10.82
Social-oriented gift expenditure ratio	Ratio of the money spent on social-oriented events (e.g. weddings, birthdays, and funerals) (%)	0.11	0.92
Sample size		967	

Note: SD refers to standard deviation.

^a 1 mu = 1/15 ha.

^b yuan is the Chinese currency.

**Fig. 2.** Subjective well-being of market participants and non-participants.

existence of unobserved endogeneity of market participation. Accordingly, using the CMP model to query the association between maize farmers' market participation and their subjective well-being is sensible.

In the following parts, this study discusses the determinants of farmers' market participation in Section 5.1. Section 5.2 explains the effects of farmers' market participation and a vector of control variables on happiness, life satisfaction, and confidence about the future. Sections 5.3 and 5.4 present and discuss the mediation and disaggregated analysis findings, respectively. We discuss market participation's impact on farmers' objective well-being proxied by pork consumption, milk consumption, and healthcare product consumption in Section 5.5. The final section discusses the results of further analysis, including the effects of sales ratio and sales frequency on happiness, life satisfaction, and confidence about the future.

5.1. Determinants of farmers' market participation

Columns 2, 4, and 6 of Table 2 demonstrate the factors influencing maize farmers' market participation decisions. It is worth noting that the estimates for the determinants of market participation are fairly similar in signs and significant magnitudes in the three columns. This study only focuses on the estimates illustrated in Column 2 to ease the interpretation. The education variable positively and significantly impacts market participation, indicating that better-educated farmers are more likely to participate in the output market. Good knowledge enables farmers to properly collect and use market information and sell their agricultural products at higher prices. Thus, better-educated farmers are prone to participate in the markets.

Interestingly, the coefficient of the ethnic minority variable is negative and significant, suggesting that ethnic minorities in China are less likely to be market participants. This stands to reason, as most of China's ethnic minorities are located

Table 2
Determinants of market participation and subjective well-being: CMP model estimates.

Variables	Model (1)		Model (2)		Model (3)	
	Market participation	Happiness	Market participation	Life satisfaction	Market participation	Confidence about the future
Market participation	0.672 (0.338)**		0.925 (0.254)***		1.123 (0.237)***	
Age	0.019 (0.059)	−0.009 (0.040)	0.026 (0.058)	0.059 (0.040)	0.011 (0.056)	0.024 (0.040)
Age-squared	−0.000 (0.001)	0.000 (0.000)	−0.000 (0.001)	−0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)
Gender	0.260 (0.272)	−0.140 (0.189)	0.347 (0.271)	0.006 (0.187)	0.276 (0.260)	−0.140 (0.190)
Education	0.171 (0.082)**	−0.032 (0.060)	0.175 (0.082)**	−0.039 (0.059)	0.179 (0.081)**	0.013 (0.060)
Marital status	−0.248 (0.215)	0.359 (0.158)**	−0.272 (0.211)	0.101 (0.159)	−0.169 (0.208)	0.246 (0.158)
Ethnic minority	−0.349 (0.201)*	−0.027 (0.160)	−0.393 (0.199)**	−0.166 (0.160)	−0.375 (0.202)*	−0.075 (0.159)
Communist party membership	0.194 (0.138)	0.115 (0.103)	0.169 (0.137)	0.078 (0.101)	0.192 (0.136)	−0.151 (0.100)
Health	−0.069 (0.082)	0.220 (0.060)***	−0.073 (0.082)	0.282 (0.061)***	−0.077 (0.081)	0.262 (0.061)***
Household size	−0.091 (0.039)**	−0.029 (0.030)	−0.099 (0.039)**	−0.028 (0.029)	−0.106 (0.038)***	0.055 (0.029)*
Household income	−0.132 (0.030)***	0.061 (0.025)**	−0.136 (0.029)***	0.037 (0.023)	−0.133 (0.030)***	0.086 (0.023)***
Asset ownership	0.088 (0.209)	0.046 (0.146)	0.114 (0.207)	−0.052 (0.145)	0.083 (0.203)	−0.079 (0.144)
Farm size	0.037 (0.014)***	0.003 (0.011)	0.040 (0.014)***	−0.014 (0.011)	0.034 (0.014)**	0.006 (0.011)
Natural disaster	−0.142 (0.123)	0.107 (0.088)	−0.128 (0.122)	0.039 (0.087)	−0.155 (0.120)	−0.053 (0.088)
Neighbourhood conflicts	0.101 (0.198)	−0.419 (0.146)***	0.121 (0.199)	−0.025 (0.148)	0.102 (0.199)	−0.161 (0.147)
Sanitary toilet use	−0.082 (0.124)	0.085 (0.092)	−0.105 (0.123)	0.175 (0.091)*	−0.090 (0.124)	0.012 (0.092)
Garbage classification	−0.047 (0.114)	0.218 (0.082)***	−0.054 (0.113)	0.265 (0.082)***	−0.086 (0.112)	−0.043 (0.082)
Proximity to plots (IV)	0.231 (0.069)***		0.226 (0.067)***		0.203 (0.066)***	
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.741 (1.704)		0.529 (1.679)		1.018 (1.635)	
<i>Cut points</i>						
Cut 1	−1.347 (1.240)		0.632 (1.181)		−0.125 (1.195)	
Cut 2	−0.691 (1.226)		1.343 (1.171)		0.092 (1.190)	
Cut 3	0.452 (1.214)		2.204 (1.165)*		0.405 (1.185)	
Cut 4	1.598 (1.206)		3.604 (1.160)***		1.088 (1.177)	
$\rho_{\mu\epsilon}$	−0.319 (0.197)		−0.532 (0.144)***		−0.580 (0.136)***	
Log-likelihood	−1443.061		−1413.545		−1406.848	
LR χ^2 (df = 109)	544.76, prob > χ^2 = 0.000		568.53, prob > χ^2 = 0.000		560.66, prob > χ^2 = 0.000	
Observations	967		967		967	

Note: Standard errors in parentheses.

* <0.10.

** <0.05

*** <0.01

in remote and undeveloped areas where agricultural markets are not well developed (Maurer-Fazio and Hasmath, 2015). The negative and significant coefficient of the household size variable suggests that households with larger member sizes are less likely to participate in market sales. The plausible explanation is that large households consume a large fraction of

their maize outputs, decreasing the volume that could be sold out. This is consistent with [Fan and Salas Garcia \(2018\)](#), who found that large household size in Peru hinders farmers from participating in the agricultural output market. Household income exerts a negative and significant impact on market participation. This is understandable as selling out the produced maize is unnecessary for rich farmers to improve their economic condition. Farmers' market participation is also observed to be positively and significantly associated with farm size. Large farmland generates considerable maize products due to the economies of scale, deepening the pool of products for sale. The positive association between farm size and market participation is also observed in Ghana ([Abdul-Rahaman and Abdulai, 2020](#)) and Zambia ([Burke et al., 2020](#)). Additionally, as expected, proximity to plots (the IV) positively and significantly impacts maize farmers' market participation.

5.2. Impacts on subjective well-being

[Table 2](#), Columns 3, 5, and 7, shows the estimates of dependent variables' determinants. At first glance, farmers' market participation exerts a positive and statistically significant impact on happiness, life satisfaction, and confidence about the future, three variables proxying to subjective well-being. That said, market participation can entice farmers to be happier, more satisfied with life, and more confident about their future. The pronounced effects of farmers' market participation on their happiness, life satisfaction, and confidence about the future confirm the inferences from the conceptual framework section. That is, farmers' market participation enhances household economic conditions, which then improves their subjective well-being. Market participation can be a vital factor driving farmers' subjective well-being improvement.

For comparison, this study also estimates the impact of market participation on subjective well-being using a simple ordered probit model expressed as Eq. (2). The corresponding results in [Table A.3](#) suggest that the coefficients of market participation for happiness and life satisfaction are positive but insignificant, while that for confidence about the future is positive and significant at the 10% level. More importantly, the coefficients of market participation in the table are much smaller than those in [Table 2](#). Accordingly, since the simple ordered probit model cannot address the endogeneity of the key explanatory variable, it tends to underestimate the impact of market participation on subjective well-being. This somewhat evidences the CMP model's efficiency in investigating market participation's impact on subjective well-being.

Empirical results in [Table 2](#) also suggest that farmers' subjective well-being measured by happiness, life satisfaction, and confidence about the future are associated with several control variables. Generally, the estimates of these control variables align with classic economic theories and our expectations. Even so, some of them are worth interpretation at length as they entail interesting findings. For brevity, this study discusses these variables' effects on happiness, life satisfaction, and confidence about the future together. The health variable positively and significantly impacts the three dependent variables, suggesting that healthier people tend to obtain greater subjective well-being. Good physical condition isolates farmers from the distress induced by illness and large medical expenditures, making them more satisfied with their lives. This result is consistent with the findings of [Charles et al. \(2019\)](#) in the UK and [Li and Ma \(2023\)](#) in China. Household size is positively and significantly associated with confidence about the future, suggesting farmers residing in larger households are more likely to be confident about their tomorrow. Large households are rich in labour endowment, allowing them considerable expectations and a long-term discount. This result is supported by the observation of [Kulkarni Vani et al. \(2023\)](#), who found that farmers residing in larger households in India tend to have a higher level of subjective well-being than those in smaller ones.

The empirical results also report that farmers' happiness and confidence about the future are positively and significantly associated with their income levels. Farmers with high-income levels are always in good financial condition, allowing them to have more diversified consumptions; therefore, wealthy farmers tend to have a high level of subjective well-being ([Li and Ma, 2023](#); [Qiu et al., 2021](#)). This result aligns with Vietnam's phenomenon that income increases make Vietnamese happy ([Markussen et al., 2018](#)). Neighbourhood conflicts, as expected, exert a significant hindrance to farmers' happiness. Besides, the results in the table also suggest that sanitary toilet use is positively and significantly associated with life satisfaction. At the same time, garbage classification is positively linked to happiness and life satisfaction. Pro-environmental behaviour refreshes farmers' living conditions and enhances their reputation, improving their subjective well-being. These results align with the findings of [Qi et al. \(2022\)](#) and [Li and Ma \(2023\)](#) in China.

5.3. Mediation analyses

This study hypothesizes that the association between maize farmers' market participation and their subjective well-being could be mediated by maize income, other crop income, and social interaction. Thus, the mediation analysis mainly focuses on verifying these three mechanisms. To this end, three variables, maize income, other crop income, and social interaction, are chosen as the mediators. Specifically, maize income refers to the net income from maize sales, and other crop income is the net return from selling other crops (e.g. rice and wheat). Meanwhile, since the 2020 CRRS dataset provides no direct information on farmers' social interaction, this study follows prior literature ([Hu et al., 2021](#); [Li and Ma, 2023](#)) and proxies it utilizing the ratio of social-oriented gift expenditure to household income. The results derived from the GSE model are illustrated in [Table 3](#).

[Table 3](#) shows that maize income's indirect and total indirect effects are positive and statistically significant. In contrast, the indirect effects of other crop income and social-oriented gift expenditure ratios are insignificant. The results in the table suggest that the promotion of market participation in happiness, life satisfaction, and confidence about the future

Table 3
Mediation effects: GSE model estimates.

Subjective well-being	Mediators	Observed		95% confidence intervals		
		Coefficients	Bias	Lower	Upper	
Happiness	Total indirect effect	0.271 (0.103)	−0.098	0.058	0.361	(P)
				0.132	0.361	(BC)
	Maize income	0.319 (0.092)	−0.093	0.117	0.356	(P)
				0.203	0.356	(BC)
	Other crop income	−0.040 (0.083)	−0.021	−0.163	0.028	(P)
				−0.163	0.028	(BC)
Life satisfaction	Social-oriented gift expenditure ratio	−0.008 (0.014)	0.016	−0.012	0.025	(P)
				−0.012	0.018	(BC)
	Direct effect	0.619 (1.367)	0.031	−0.894	2.334	(P)
				−0.894	2.334	(BC)
	Total indirect effect	0.643 (0.280)	−0.113	0.162	0.846	(P)
				0.162	0.846	(BC)
Confidence about the future	Maize income	0.699 (0.314)	−0.153	0.140	0.916	(P)
				0.140	0.916	(BC)
	Other crop income	−0.063 (0.051)	0.018	−0.116	0.021	(P)
				−0.116	0.021	(BC)
	Social-oriented gift expenditure ratio	0.007 (1.116)	0.023	−0.058	0.132	(P)
				−0.058	0.132	(BC)
	Direct effect	0.996 (1.116)	0.056	−0.355	2.660	(P)
				−0.355	2.660	(BC)
	Total indirect effect	0.443 (1.357)	0.839	0.127	3.115	(BC)
				0.127	3.115	(BC)
	Maize income	0.478 (1.495)	0.925	0.030	3.443	(P)
				0.030	1.538	(BC)
	Other crop income	−0.029 (0.054)	−0.009	−0.090	0.024	(P)
				−0.090	0.024	(BC)
	Social-oriented gift expenditure ratio	−0.005 (0.136)	−0.076	−0.251	0.073	(P)
				−0.114	0.073	(BC)
	Direct effect	0.125 (0.634)	−0.319	−0.875	0.543	(P)
				−0.537	0.543	(BC)

Note: The maize income and other crop income variables are measured at 1000 yuan. Bootstrap standard errors in parentheses. (P) refers to percentile confidence interval and (BC) refers to bias-corrected confidence interval.

are positively mediated by maize income. Market participation links farmers to higher maize income and increases their consumption and social status (Ochieng et al., 2020; Riddell et al., 2018), making them happier, more satisfied with life, and more confident about the future. The results verify the mechanisms connecting maize farmers' market participation to subjective well-being improvement.

5.4. Disaggregated analyses

One could also be interested in scrutinizing the effect of maize farmers' market participation on subjective well-being under some specific circumstances. Thus, this study disaggregates market participation's impact on subjective well-being by household income tertiles and natural disaster experiences. The disaggregated estimates based on the CMP model are illustrated in Figs. 3 and 4.

Regarding the household income categories, the results depicted in Fig. 3 suggest the positive effects of market participation on happiness and life satisfaction are statistically significant only for medium-income farmers. In contrast, its positive impact on confidence about the future is significant for medium- and high-income farmers. The effects of market participation on maize farmers' subjective well-being are heterogeneous across household income tertiles. That

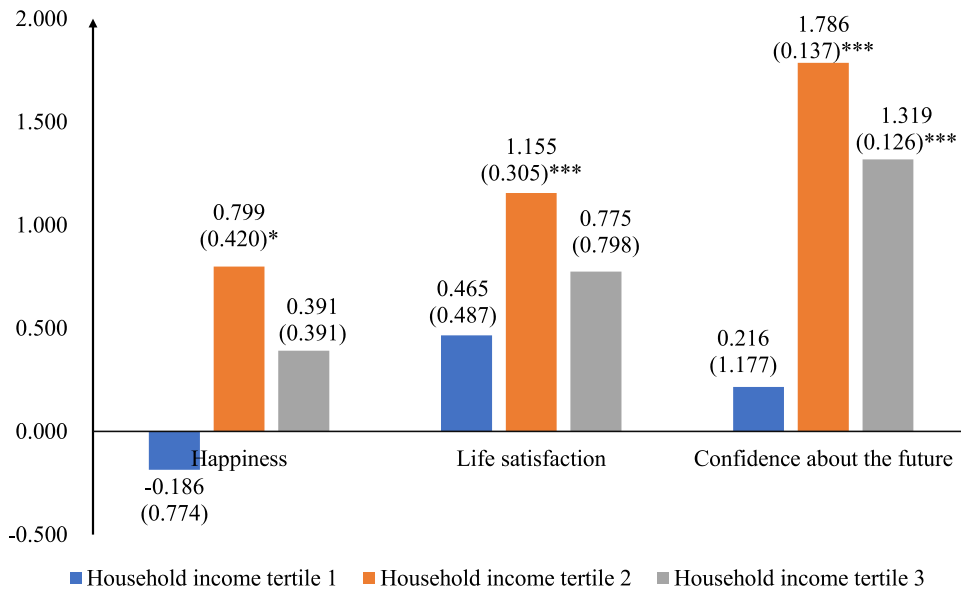


Fig. 3. Disaggregated analyses of market participation's impacts on subjective well-being by household income tertiles: CMP model estimates.

is, market participation benefits more to medium- and high-income farmers' subjective well-being regarding happiness, life satisfaction, and confidence about the future. This finding provides important evidence that special attention should be paid to crushing the roadblocks between market participation and low-income farmers' subjective well-being.

Meanwhile, the results in Fig. 4 suggest market participation has heterogeneous effects on happiness, life satisfaction, and confidence about the future in natural disaster experiences. In particular, market participation positively and significantly impacts happiness only for farmers without natural disaster experiences. The impacts of market participation on life satisfaction and confidence about the future are positive and significant for farmers with and without natural disaster experiences. At the same time, the coefficient of the former category is dramatically larger than the latter. The effects of market participation on life satisfaction and confidence about the future regarding natural disaster experiences suggest participating in the market can effectively help farmers hedge against the adverse influence of natural disasters on subjective well-being. However, the results also reveal market participation is powerless to light up the happiness of natural disaster bearers. Accordingly, this finding contains important values as it highlights the significance of instant support in facilitating market participation to light up natural disaster bearers' happiness.

5.5. Impact of market participation on objective well-being

In rural China, residents' diets are historically vegetable-dominated, and their protein consumption needs to be improved for balanced nutrition intake (Huang et al., 2020). Meanwhile, China's rural residents' physical condition intertwines with rural transformation and awaits further improvement (Liu et al., 2020). Farmers' market participation would also increase households' consumption and diet, improving their well-being. Therefore, the present study further estimates the impact of market participation on household objective well-being regarding nutrition intake. In particular, maize farmers' healthcare products and protein consumption (proxied by pork consumption and milk consumption measured at kg/capita/day) are selected as objective well-being indicators of interest. Since the 2020 CRRS data provides no quantitative and monetary information on maize farmers' healthcare product consumption, this study uses a dummy to measure this indicator. In particular, the dummy takes the value of one if maize farmers took a physical examination and/or consumed healthcare products (e.g. multivitamin–multimineral supplements) in 2019 and zero otherwise.

The results are presented in Table 4. They show that maize farmers' market participation positively impacts their pork consumption and milk consumption at the 1% significance level. Compared with non-participants, market participants tend to enjoy 68 g/capita/day and 56 g/capita/day more pork and milk, respectively. These findings provide suggestive evidence to Kilimani et al. (2022), who found that crop commercialization increases farmers' protein intake. Accordingly, maize farmers' market participation possesses the potential to improve their objective well-being in the case of nutrition intake. However, market participation does not significantly impact the odds of maize farmers consuming healthcare products. This is plausible as healthcare products, such as multivitamin–multimineral supplements, are non-essential goods to farmers in China. When farmers achieve more income earnings from participating in markets, they are more likely to consume necessities, such as protein-rich food, instead of goods that are not urgently necessary. Meanwhile, protein-rich food consumption improves farmers' physical condition and thus reduces their consumption of healthcare products.

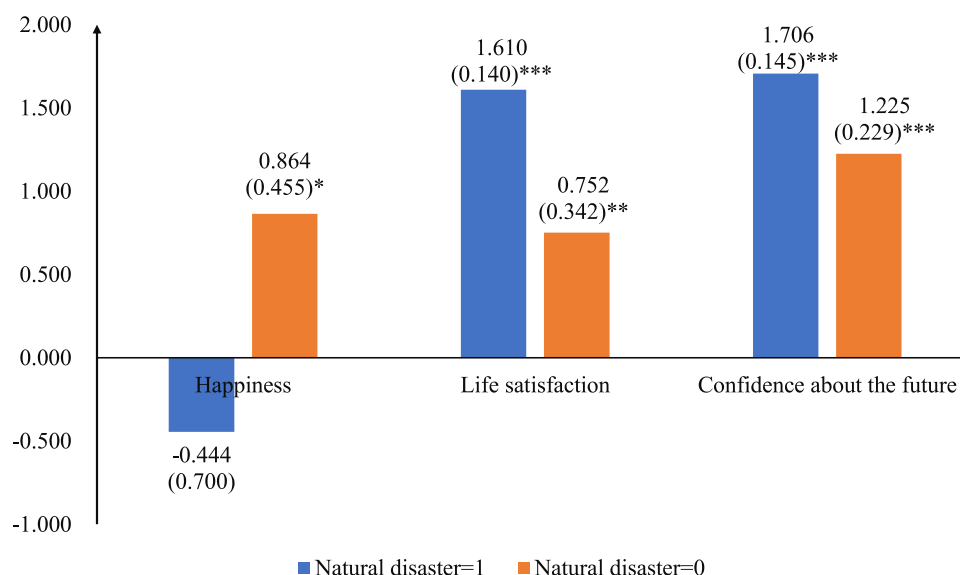


Fig. 4. Disaggregated analyses of market participation's impacts on subjective well-being by natural disaster experience: CMP model estimates.

Table 4

Effects of market participation on pork consumption, milk consumption, and healthcare product consumption: CMP model estimates.

Variables	Pork consumption	Milk consumption	Healthcare product consumption
Market participation	0.068 (0.010)***	0.056 (0.014)***	−0.155 (1.190)
Control variables	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes
Constant	−0.103 (0.067)	0.116 (0.070)*	3.335 (2.127)
Observations	967	967	967

Note: Standard errors in parentheses;

The first stage of the CMP model estimates Eq. (1), and the results are not presented for the sake of simplicity. The second stage of the CMP model uses a Tobit model to estimate the pork and milk consumption equations because the two consumption variables contain zero observations. The second stage of the CMP model for healthcare product consumption is estimated using a Probit model as we measure this consumption as a dummy.

* <0.10.

*** <0.01.

5.6. Further analyses

5.6.1. Impact of sales ratio on subjective well-being

In the analysis above, market participation is measured as a dummy variable. To improve understanding, this study uses the CMP model to estimate further the impact of the sales ratio on happiness, life satisfaction, and confidence about the future. For the sake of simplicity, Table 5 only presents the results of the key explanatory variable estimated from the second stage of the CMP model. The results show that maize farmers' sales ratio exerts a positive and statistically significant impact on their happiness, life satisfaction, and confidence about the future, suggesting higher market participation intensity leads to a higher level of subjective well-being. Since the sales ratio is a continuous measure of maize farmers' market participation, compared to Table 2, the results in Table 5 confirm the positive association between market participation and subjective well-being. These findings remind us that increasing maize farmers' intensity in market transactions could be a feasible strategy for subjective well-being improvement.

5.6.2. Impact of sales frequency on subjective well-being

Table 6 illustrates the impact of sales frequency on farmers' happiness, life satisfaction, and confidence about the future. The table only presents the results of the key explanatory variable estimated in the second stage of the CMP model for brevity. The results suggest that sales frequency exerts a positive and significant impact on happiness, life satisfaction, and confidence about the future, suggesting that a sales frequency increase is beneficial for elevating farmers' subjective well-being. This finding verifies the positive association between market transactions and farmers' subjective well-being from

Table 5
Effects of sales ratio on subjective well-being: CMP model estimates.

Variables	Happiness	Life satisfaction	Confidence about the future
Sales ratio	2.373 (0.883) ^{***}	0.883 (0.423) ^{**}	1.512 (0.384) ^{***}
Control variables	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes
Constant	0.584 (0.396)	0.687 (0.603)	−0.294 (0.540)
Observations	967	967	967

Note: Standard errors in parentheses.

The first stage of the CMP model uses the Tobit model to estimate the sales ratio equation. We use the Tobit model because 45% of farmers in the sample did not sell their products to the market. The second stage of the CMP model uses an ordered probit model to estimate Eq. (2).

^{**} <0.10.

^{***} <0.05.

Table 6
Effects of sales frequency on subjective well-being: CMP model estimates.

Variables	Happiness	Life satisfaction	Confidence about the future
Sales frequency	0.727 (0.337) ^{**}	0.825 (0.269) ^{***}	0.934 (0.359) ^{***}
Control variables	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes
Constant	0.332 (0.364)	0.609 (0.351) [*]	0.128 (0.379)
Observations	967	967	967

Note: Standard errors in parentheses;

The first stage of the CMP model uses the ordered probit model to estimate the sales frequency equation. The second stage of the CMP model uses an ordered probit model to estimate Eq. (2).

^{*} <0.10.

^{**} <0.05.

^{***} <0.01.

a new perspective—farmers can receive subjective well-being improvement from their dichotomous behaviour of market participation and from repeating this action. Accordingly, it highlights that promoting farmers' market participation is not a one-time task but rather a continuous process. Farmers' market participation is always disturbed by high transaction costs and unexpected risks, terminating market participation's benefits on subjective well-being. Therefore, rather than enticing farmers to participate in market transactions, it could be more important to maintain participants' enthusiasm for doing it.

6. Conclusions, policy implications, and limitations

Market participation is becoming an effective strategy for farmers to possess improved economic welfare, even though it remains quite reticent in the developing world's rural areas. Meanwhile, rural residents' subjective well-being improvement, the eternal theme of human development, is primarily subject to their economic welfare. Logically, one can believe that farmers' market participation could serve as a promising pathway to their subjective well-being improvement. Motivated by the urgent need to improve farmers' market participation and subjective well-being, this study empirically investigated the relationship of maize farmers' market participation with their subjective well-being using the rural China case.

This study's conclusions, supported by the empirical results estimated by the CMP model, are that farmers' market participation can significantly improve their subjective well-being regarding happiness, life satisfaction, and confidence about the future. Meanwhile, the empirical results from the GSE model confirmed that the association between market participation and subjective well-being is positively mediated by maize income. More importantly, according to the results of disaggregated analysis based on the CMP model, one can conclude that market participation benefits medium- and high-income farmers more in their happiness, life satisfaction, and confidence about the future. Meanwhile, market participation helps mitigate the subjective well-being gap in life satisfaction and confidence about the future induced by natural disaster experiences. However, it cannot do the same to farmers' happiness. Further analysis suggested that maize farmers' market participation significantly promotes pork consumption and milk consumption, while it does not significantly impact healthcare product consumption. Meanwhile, the results of further analysis also suggested that an increase in maize farmers' market participation intensity (measured by sales ratio and sales frequency) significantly promotes happiness, life satisfaction, and confidence about the future.

This study contains significant policy implications for achieving sustainable rural development regarding farmers' subjective well-being improvement and rural commercialization. The pronounced promotions of farmers' market participation on their happiness, life satisfaction, and confidence about the future suggest that market participation opens a practical avenue to increase subjective well-being. Therefore, the government in developing countries facing a low agricultural market participation ratio, such as China, Zambia, and India, should devote more public resources to improving the output market and enticing more farmers to participate in market transactions. Moreover, the positive association of subjective well-being with sales ratio and sales frequency highlights that the government should further increase farmers' market participation by deepening their participation intensity. More importantly, farmers' market participation in countries like China and Zambia is always challenged by high transaction costs and risks of contract breaches. Therefore, the government must promulgate relevant laws and reinforce its supervision over agricultural product transactions to make market participation more accessible, profitable, and attractive. Moreover, regarding education's positive impact on market participation, practices to increase farmers' knowledge, such as free evening courses and training, should be considered fully. Also, the empirical results suggest that ethnic minorities are vulnerable to a low market participation probability. The government must provide market participation-targeted subsidies to incite their market participation. Meanwhile, as most of them are located in remote and less developed parts of China, the government should allocate massive investments in transportation infrastructure construction in such areas. Additionally, market participation is powerless to improve low-income and natural disaster-disturbed farmers' happiness, so special attention, such as free and periodic psychological counselling, should be laid on such farmers. This could be especially useful for nations like China, India, and sub-Saharan countries, as natural disasters continuously harass their rural residents.

This study is not immune from limitations. Panel data can properly control the spatial and temporal variants and appropriately reflect the association between farmers' market participation and their subjective well-being. However, panel data jointly containing information on farmers' market transactions and subjective well-being is quite rare, limiting our ability to conduct perfect empirical analysis. Meanwhile, due to data limitations, the regressions of this study cannot control variables like farmers' contact frequency with others and religions. Collectively, future studies should devote efforts to collecting proper panel data and improving the specification of empirical settings.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that support the findings of this study are available from Junpeng Li upon request.

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Appendix

See [Tables A.1–A.3](#).

Table A.1
Falsification test.

Variables	χ^2	p-value
<i>Dependent variables</i>		
Happiness	0.03	0.874
Life satisfaction	1.90	0.170
Confidence about the future	0.44	0.506
<i>Key explanatory variables</i>		
Market participation	$\chi^2(1) = 11.02^{***}; p = 0.001$	
Sales ratio	$\chi^2(1) = 8.97^{***}; p = 0.003$	
Sales frequency	$\chi^2(1) = 8.50^{***}; p = 0.004$	

Note:
*** <0.01.

Table A.2
Effectiveness tests of the IV.

Variables	Market participation	Sales ratio	Sales frequency
Proximity to plots (IV)	0.232 (0.070)***	0.036 (0.012)***	0.204 (0.070)***
Control variables	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes
Constant	1.200 (1.689)	0.459 (0.284)	
Observations	967	967	967
Variables	Happiness	Life satisfaction	Confidence about the future
Proximity to plots (IV)	0.006 (0.041)	0.051 (0.037)	0.028 (0.042)
Control variables	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes
Constant	3.831 (0.810)	2.437 (0.846)	4.010 (0.874)
Observations	967	967	967

Note: Standard errors in parentheses;

*** <0.01.

Table A.3
Effects of market participation on subjective well-being: ordered probit model estimates.

Variables	Happiness	Life satisfaction	Confidence about the future
Market participation	0.143 (0.096)	0.043 (0.096)	0.166 (0.097)*
Control variables	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes
Observations	967	967	967

Note: Standard errors in parentheses.

* <0.10.

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