
Market Participation and Subjective Well-being of Maize Farmers in China

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1. Introduction

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), and rural income growth (Dey and Singh, 2023; Ogutu and Qaim, 2019). Undoubtedly, farmers' market participation enables to promote rural development sustainably in the developing world.

Market participation can directly benefit people's economic welfare (Dey and Singh, 2023; Kilimani et al., 2022). Meanwhile, economic welfare is directly associated with people's subjective well-being. Therefore, market participation could be linked to people's subjective well-being. However, the literature on this topic remains very thin.

1. Introduction

The market is playing an increasingly important role in boosting rural development in China. However, the commercialization of maize, the primary cereal crop in China in production and planting areas, currently remains in the bud.

Meanwhile, China is heading towards constructing a harmonious countryside and listing farmers' subjective well-being improvement as a primary mission in this process. As a matter of fact, farmers' subjective well-being still lags behind that of urban residents. **Therefore, this study investigates the impact of market participation on subjective well-being using the case of maize farmer in China.**

1. Introduction

Our study contributes the literature in multiple ways:

- (1) In addition to measuring farmers' market participation as a dummy, we account for the sales ratio (ratio of the quantity of maize sold to the total maize output) and sales frequency and estimate their impacts on subjective well-being for additional understanding.
- (2) We consider confidence for the future as a new dimension of subjective well-being measurement.
- (3) We consider two income variables (maize income and income from other crops) and explore how they mediate the relationship between farmers' market participation and their subjective well-being.
- (4) We go further and look at how market participation affects the subjective well-being of farmers regarding different household income levels and natural disaster experiences.
- (5) We explore whether market participation stimulates farmers to consume more milk, meat, and healthcare products to advance our understanding in this field.

2. Empirical strategy

Compared with PSM, IPWRA, and ESR approaches, **conditional mixed process (CMP) model** can not only account for observed and unobserved endogeneities, but also determine the direct impact of market participation on categorical variables, such as happiness, life satisfaction, and confidence for the future.

We use the **CMP** model to query the impact of SCPs adoption on farmers' subjective well-being.

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

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

A maximum likelihood estimator is employed to estimate those equations above simultaneously.

The correlation between the two error terms, $\rho_{\varepsilon\mu}(\varepsilon_i, \mu_i)$, points to the presence of unobserved endogeneity.

IV

This study synthesizes the public online marketing willingness (POMW) variable representing the ratio of farmers who is willing to sell their agricultural products online in the sampled county excluding the respondent to be the IV.

The literature shows that **people's actions can be largely predicted by their behavioural willingness** (e.g., Chowdhury and Ceder, 2016; Wang et al., 2020). Meanwhile, the theory of peer effect suggests people's willingness and behaviour tend to be influenced by their friends, relatives, and other villagers (Di Falco et al., 2020)

| Variables | χ^2 | p-value |
|----------------------------------|-----------------------------------|---------|
| <i>Dependent variables</i> | | |
| Happiness | 0.99 | 0.320 |
| Life satisfaction | 1.97 | 0.160 |
| Confidence for the future | 1.68 | 0.195 |
| <i>Key explanatory variables</i> | | |
| Market participation | $\chi^2(1)=11.19^{***}$; p=0.001 | |
| Sales ratio | $\chi^2(1)=31.77^{***}$; p=0.000 | |
| Sales frequency | $\chi^2(1)=14.78^{***}$; p=0.000 | |

Note: *** < 0.01.

3. Data and descriptive statistics

- The data from the 2020 China Rural Revitalization Survey (CRRS) was analyzed in our study. The Rural Development Institute, Chinese Academy of Social Science organized the survey and collected data from the eastern, central, and western regions of mainland China. They collected multiple pieces of information to comprehensively understand the current situation of rural China .
- After data cleaning, a dataset comprising 980 observations on rural households analyzed in our study.

3. Data and descriptive statistics

| Table 1-1 Variable definitions and descriptive statistics | | | |
|---|---|------|------|
| Variables | Definition | Mean | S.D. |
| <i>Subjective well-being variables</i> | | | |
| Happiness | Self-reported happiness: from 1=very unhappy to 5=very happy | 4.18 | 0.85 |
| Life satisfaction | Self-reported life satisfaction: from 1=very unsatisfied to 5=very satisfied | 4.14 | 0.81 |
| Confidence for the future | Self-reported confidence for the future: from 1=very unconfident to 5=very confident | 4.26 | 0.79 |
| <i>Objective well-being variables</i> | | | |
| Milk consumption | Household milk consumption (kg/capita/day) | 0.03 | 0.07 |
| Meat consumption | Household meat (e.g., beef and mutton) consumption (kg/capita/day) | 0.01 | 0.04 |
| 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 | 0.59 | 0.49 |
| Sales ratio | Ratio of the quantity of maize sold to the total maize output | 0.51 | 0.46 |
| Sales frequency | Sales frequency of maize in 2020 from 0 to 2 or more | 0.62 | 0.66 |

3. Data and descriptive statistics

Table 1-2 Variable definitions and descriptive statistics

| Variables | Definition | Mean | S.D. |
|--------------------------|---|-------|-------|
| <i>Control variables</i> | | | |
| Age | Age of a HH (years) | 56.51 | 10.12 |
| Gender | 1 if a HH is male, 0 otherwise | 0.95 | 0.22 |
| Education | Educational level of a HH: 1=No formal education (illiterate), 2=Primary school, 3=Elementary school, and 4=High school or above | 1.70 | 0.72 |
| Ethnic minority | 1 if a HH belongs to an ethnic minority (e.g., Miao, Manchu, and Hui), 0 otherwise | 0.18 | 0.38 |
| Village cadre | 1 if a HH serves as a village cadre, 0 otherwise | 0.17 | 0.39 |
| Health | Physical condition of HH in 2020: 1=poor, 2=fair, 3=good | 1.89 | 0.62 |
| Household size | Number of people residing in a household | 3.31 | 1.56 |
| Asset ownership | 1 if a household owns a computer, 0 otherwise | 0.20 | 0.40 |
| Farm size | Total farmland area growing maize (mu) ^a | 18.25 | 54.10 |
| Natural disaster | 1 if a household experiences natural disasters (e.g., drought and flood), 0 otherwise | 0.30 | 0.46 |
| Eastern region | 1 if a household is located in eastern China, 0 otherwise | 0.12 | 0.33 |
| Central region | 1 if a household is located in central China, 0 otherwise | 0.32 | 0.47 |
| Western region | 1 if a household is located in western China, 0 otherwise | 0.56 | 0.50 |
| POMW (IV) | Ratio of farmers who are willing to sell agricultural products online in the sampled county excluding the respondent, 0 otherwise | 0.25 | 0.10 |
| <i>Mediators</i> | | | |
| Maize income | Net income from maize (1,000 yuan) ^b | 2.79 | 10.01 |
| Other crop income | Net income from other crops (e.g., rice and wheat) (1,000 yuan) | 3.92 | 11.12 |
| Sample size | | 980 | |

Note: S.D. refers to standard deviation. ^a 1 mu=1/15 hectare. ^b yuan is the Chinese currency.

4. Results and discussion

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 for the future |
| Market participation | | 0.809 (0.319)** | | 0.883 (0.238)*** | | 0.883 (0.340)*** |
| Age | 0.013 (0.005)*** | 0.005 (0.004) | 0.013 (0.005)*** | 0.004 (0.004) | 0.011 (0.005)** | -0.005 (0.004) |
| Gender | 0.186 (0.215) | -0.084 (0.167) | 0.181 (0.217) | 0.095 (0.166) | 0.233 (0.213) | -0.079 (0.169) |
| Education | 0.175 (0.069)** | -0.033 (0.057) | 0.178 (0.069)** | -0.027 (0.055) | 0.187 (0.070)*** | 0.052 (0.060) |
| Ethnic minority | -0.291 (0.124)** | 0.193 (0.104)* | -0.302 (0.125)** | 0.143 (0.102) | -0.291 (0.125)** | 0.217 (0.106)** |
| Village cadre | 0.010 (0.117) | 0.193 (0.096)** | 0.029 (0.117) | 0.226 (0.095)** | -0.007 (0.119) | 0.044 (0.096) |
| Health | -0.051 (0.073) | 0.213 (0.057)*** | -0.039 (0.074) | 0.304 (0.058)*** | -0.055 (0.074) | 0.251 (0.059)*** |
| Household size | -0.092 (0.030)*** | -0.018 (0.026) | -0.100 (0.030)*** | -0.012 (0.024) | -0.096 (0.030)*** | 0.018 (0.026) |
| Asset ownership | 0.017 (0.122) | 0.105 (0.094) | -0.011 (0.121) | 0.201 (0.094)** | -0.005 (0.124) | 0.319 (0.100)*** |
| Farm size (ln) | 0.314 (0.038)*** | -0.064 (0.042) | 0.320 (0.038)*** | -0.135 (0.034)*** | 0.312 (0.039)*** | -0.056 (0.044) |
| Natural disaster | -0.037 (0.104) | -0.086 (0.081) | -0.033 (0.104) | -0.121 (0.080) | -0.038 (0.104) | -0.129 (0.083) |
| Eastern region | 1.466 (0.175)*** | -0.087 (0.179) | 1.459 (0.173)*** | -0.089 (0.157) | 1.451 (0.175)*** | 0.134 (0.199) |
| Central region | 0.751 (0.118)*** | -0.011 (0.129) | 0.750 (0.117)*** | -0.185 (0.111)* | 0.738 (0.118)*** | -0.023 (0.136) |
| POMW (IV) | 1.627 (0.534)*** | | 1.681 (0.508)*** | | 1.731 (0.526)*** | |
| Constant | -1.813 (0.448)*** | | -1.825 (0.447)*** | | -1.779 (0.440)*** | |
| Cut points | | | | | | |
| Cut 1 | | -1.418 (0.361)*** | | -1.299 (0.358)*** | | -1.593 (0.368)*** |
| Cut 2 | | -0.893 (0.342)*** | | -0.636 (0.337)* | | -1.113 (0.350)*** |
| Cut 3 | | 0.105 (0.334) | | 0.167 (0.333) | | -0.343 (0.341) |
| Cut 4 | | 1.128 (0.339)*** | | 1.480 (0.340)*** | | 0.959 (0.343)*** |
| $\rho_{\mu\epsilon}$ | -0.500 (0.187)** | | -0.531 (0.137)** | | -0.473 (0.204)* | |
| Log-likelihood | -1,615.528 | | -1,569.592 | | -1,518.165 | |
| LR χ^2 (df=26) | 364.23, prob> $\chi^2=0.000$ | | 399.48, prob> $\chi^2=0.000$ | | 388.99, prob> $\chi^2=0.000$ | |
| VIF test | | Mean VIF=1.21 | | Mean VIF=1.21 | | Mean VIF=1.21 |
| Observations | 980 | | 980 | | 980 | |

Table 3 Mediation effects: Generalized structural equation (GSE) model estimates

| Subjective well-being | Mediators | Observed | | 95% Confidence intervals | | |
|---------------------------|-----------------------|------------------------|--------|--------------------------|-------|------|
| | | Coefficients | Bias | Lower | Upper | |
| Happiness | Total indirect effect | 0.106 (0.045)** | 0.008 | 0.051 | 0.231 | (P) |
| | | | | 0.033 | 0.185 | (BC) |
| | Maize income | 0.107 (0.045)** | 0.007 | 0.053 | 0.233 | (P) |
| | | | | 0.030 | 0.185 | (BC) |
| | Other crop income | -0.001 (0.003) | 0.000 | -0.008 | 0.006 | (P) |
| | | | | -0.008 | 0.002 | (BC) |
| Direct effect | -0.033 (0.082) | 0.007 | -0.165 | 0.122 | (P) | |
| | | | -0.201 | 0.122 | (BC) | |
| Life satisfaction | Total indirect effect | 0.060 (0.030)** | -0.002 | 0.001 | 0.125 | (P) |
| | | | | 0.001 | 0.130 | (BC) |
| | Maize income | 0.060 (0.030)** | -0.002 | 0.001 | 0.129 | (P) |
| | | | | 0.012 | 0.130 | (BC) |
| | Other crop income | -0.000 (0.003) | 0.000 | -0.004 | 0.010 | (P) |
| | | | | -0.005 | 0.010 | (BC) |
| Direct effect | 0.004 (0.088) | -0.004 | -0.190 | 0.209 | (P) | |
| | | | -0.190 | 0.250 | (BC) | |
| Confidence for the future | Total indirect effect | 0.043 (0.037)* | 0.006 | 0.003 | 0.136 | (BC) |
| | | | | 0.003 | 0.161 | (BC) |
| | Maize income | 0.045 (0.037)* | 0.006 | 0.007 | 0.138 | (P) |
| | | | | 0.004 | 0.138 | (BC) |
| | Other crop income | -0.002 (0.004) | -0.001 | -0.014 | 0.001 | (P) |
| | | | | -0.016 | 0.001 | (BC) |
| Direct effect | 0.103 (0.075) | 0.006 | -0.054 | 0.253 | (P) | |
| | | | -0.054 | 0.253 | (BC) | |

Note: The maize income and other crop income variables are measured at 1,000 yuan. (P) refers to percentile confidence interval and (BC) refers to bias-corrected confidence interval. Controls include age, gender, education, ethnic minority, village cadre, health, household size, asset ownership, farm size, natural disaster, and region variables. The reference region is the western region. ** < 0.05 and * < 0.10. For details of the GSE model, please refer to the study of Preacher and Hayes (2008).

Table 4 Disaggregated analysis of market participation's impacts on subjective well-being by household income tertiles and natural disaster experience: CMP model estimates

| Categories | Happiness | Life satisfaction | Confidence for the future |
|-----------------------------|------------------|-------------------|---------------------------|
| Household income tertiles | | | |
| Tertile 1 | -0.251 (0.433) | 0.015 (0.405) | 1.075 (0.459)** |
| Tertile 2 | 1.078 (0.354)*** | 0.930 (0.382)** | 0.917 (0.599) |
| Tertile 3 | 1.497 (0.174)*** | 1.524 (0.106)*** | -0.118 (0.933) |
| Natural disaster experience | | | |
| Natural disaster=1 | -0.511 (0.677) | 1.135 (0.351)*** | 1.328 (0.350)*** |
| Natural disaster=0 | 0.996 (0.268)*** | 0.735 (0.322)** | 0.761 (0.481) |

Note: Standard errors in parentheses. *** < 0.01 and ** < 0.05.

Table 5 Effects of market participation on milk consumption, meat consumption, and healthcare product consumption: CMP model estimates

| Variables | Milk consumption | Meat consumption | Healthcare product consumption |
|----------------------|------------------|------------------|--------------------------------|
| Market participation | 0.226 (0.049)*** | 0.129 (0.016)*** | 0.930 (0.333)*** |
| Control variables | Yes | Yes | Yes |
| Observations | 980 | 980 | 980 |

Note: Standard errors in parentheses; *** < 0.01.

The first-stage of the CMP model estimates Equation (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 milk and meat 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.

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

| Variables | Happiness | Life satisfaction | Confidence for the future |
|-------------------|----------------|-------------------|---------------------------|
| Sales ratio | 0.720 (0.379)* | 0.771 (0.349)** | 0.728 (0.396)* |
| Control variables | Yes | Yes | Yes |
| Observations | 980 | 980 | 980 |

Note: Standard errors in parentheses. ** < 0.05 and * < 0.10.

The first-stage of the CMP model uses the Tobit model to estimate the sales ratio equation. We use the Tobit model because 41% of farmers in our sample did not sell their products to the market. The second-stage of the CMP model uses an ordered probit model to estimate Equation (2).

Table 7 Effects of sales frequency on subjective well-being: CMP model estimates

| Variables | Happiness | Life satisfaction | Confidence for the future |
|-------------------|------------------|-------------------|---------------------------|
| Sales frequency | 1.299 (0.153)*** | 1.154 (0.216)*** | 1.177 (0.231)*** |
| Control variables | Yes | Yes | Yes |
| Observations | 980 | 980 | 980 |

Note: Standard errors in parentheses; *** < 0.01, ** < 0.05, and * < 0.10.

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 Equation (2).

5. Conclusion and policy implications

5.1 Conclusion

- Farmers' market participation can significantly improve their happiness, life satisfaction, and confidence for the future.
- The association between market participation and subjective well-being is positively mediated by maize income.
- Market participation benefits medium- and high-income farmers more in their happiness and life satisfaction, while it helps light the confidence for the future only for the low-income farmers.
- Market participation helps mitigate the subjective well-being gap in life satisfaction and confidence for the future induced by natural disaster experiences. However, it cannot do the same to farmers' happiness.
- Maize farmers' market participation significantly promotes their milk consumption, meat consumption, and healthcare product consumption.
- Market participation intensity (measured by sales ratio and sales frequency) exerts a significant promotion on happiness, life satisfaction, and confidence for the future.

5. Conclusion and policy implications

5.2 Policy implications

- The government should devote more public resources to improving the output market and enticing more farmers to participate in market transactions.
- The government should take further steps to increase farmers' market participation by deepening their participation intensity.
- The government needs to promulgate relevant laws and reinforce its supervision over agricultural product transactions to make market participation more accessible, profitable, and attractive.
- The provision of free evening courses and training should be given full consideration.
- The government needs to provide ethnic minorities with market participation-targeted subsidies and improved transportation infrastructure construction.
- Free and periodic psychological counseling should be given to farmers experiencing natural disasters.

Thanks for your time!