Can Citrus Farmers Earn More from Selling Online?

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Outline

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2. Background
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1. Introduction

- Connecting farmers and markets are important for improving rural income.

  However, there are many barriers:

  - inadequate distribution channels (Liu et al., 2019)
  - high transaction costs (Liu et al., 2021)
  - information asymmetries (Ullah et al., 2020)

1. Introduction

- Online sales can provide faster, more in-depth, and interactive information, which helps to:
  - expand sales scope
  - reduce information asymmetries
  - lower transaction costs
- Some studies showed that online sales improve farmers' lives, including:
  - farming returns (Liu et al., 2021)
  - off-farm employment (Leong et al., 2016)
  - entrepreneurial skills (Mei et al., 2020)
  - subjective well-being (Jin et al., 2020)

1. Introduction

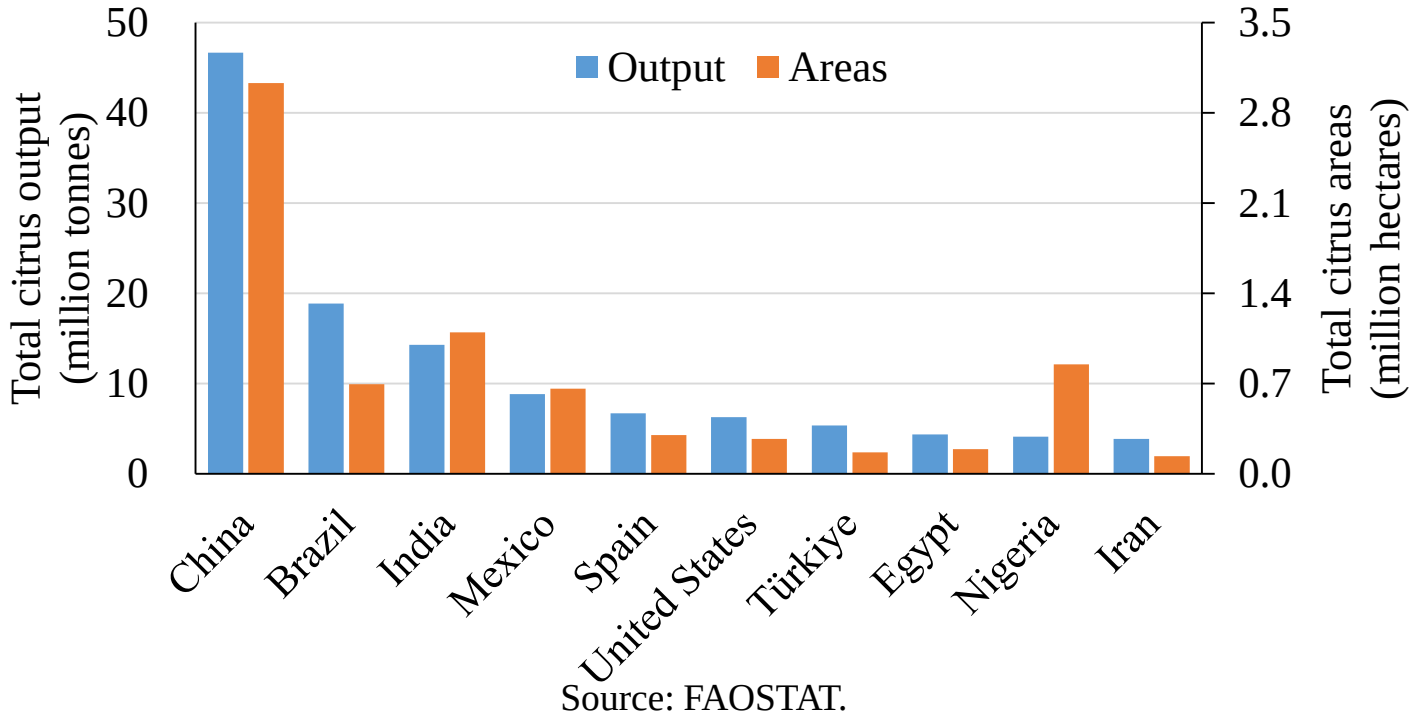
- Especially, some studies have investigated income, but results remain mixed.
  - Taobao Villages increased household income, but this program assigned to less than 1% of China's villages, which is hardly representative (Li and Qin, 2022).
  - Peng et al. (2021) showed that e-commerce improves rural income, but the impact is different in different areas, with an inverted U-shaped effect in poor areas.
  - Couture et al. (2021) showed that e-commerce did not affect rural income.

1. Introduction

- Research objectives
  - Discuss the factors that affect online sales adoption.
  - Explore the impact of online sales on rural income.
- Research contributions
  - In order to capture the spillover effects, consider multiple dimensions of income (i.e. **net returns from citrus production, net farm income, and household income**).
  - Defines online sales in a general sense (Farmers' online sales behaviour) rather than a special case.
  - Adopt the **Endogenous Treatment Regression** to address endogeneity.

2. Background

- Citrus production in China
  - Citrus is one of the most popular fruits globally.
  - China's citrus output and planting area are the highest globally.
  - However, China's citrus price was **90.21 USD/ton** in 2021, lower than India's (**536.83 USD/ton**) and Iran's (**259.75 USD/ton**)

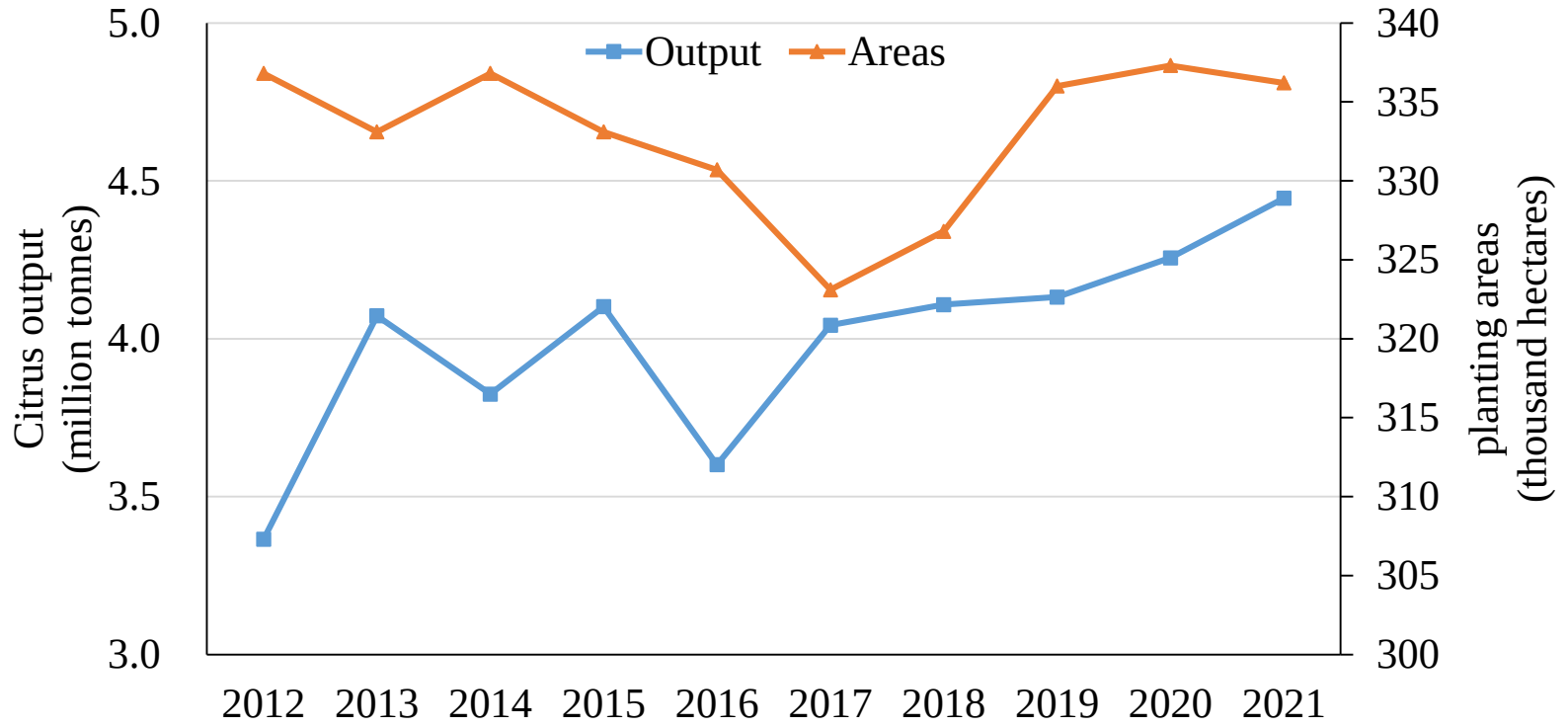


Source: FAOSTAT.

Figure 1 Total ten citrus-producing countries by total output and planting areas in 2021

2. Background

- Citrus production in Jiangxi
  - One of the eight citrus planting areas.
  - Contributing to **8%** and **11%** of output and planting areas in China.
  - China's citrus commercialisation is 88% in 2021, but only **56%** in Jiangxi Province.

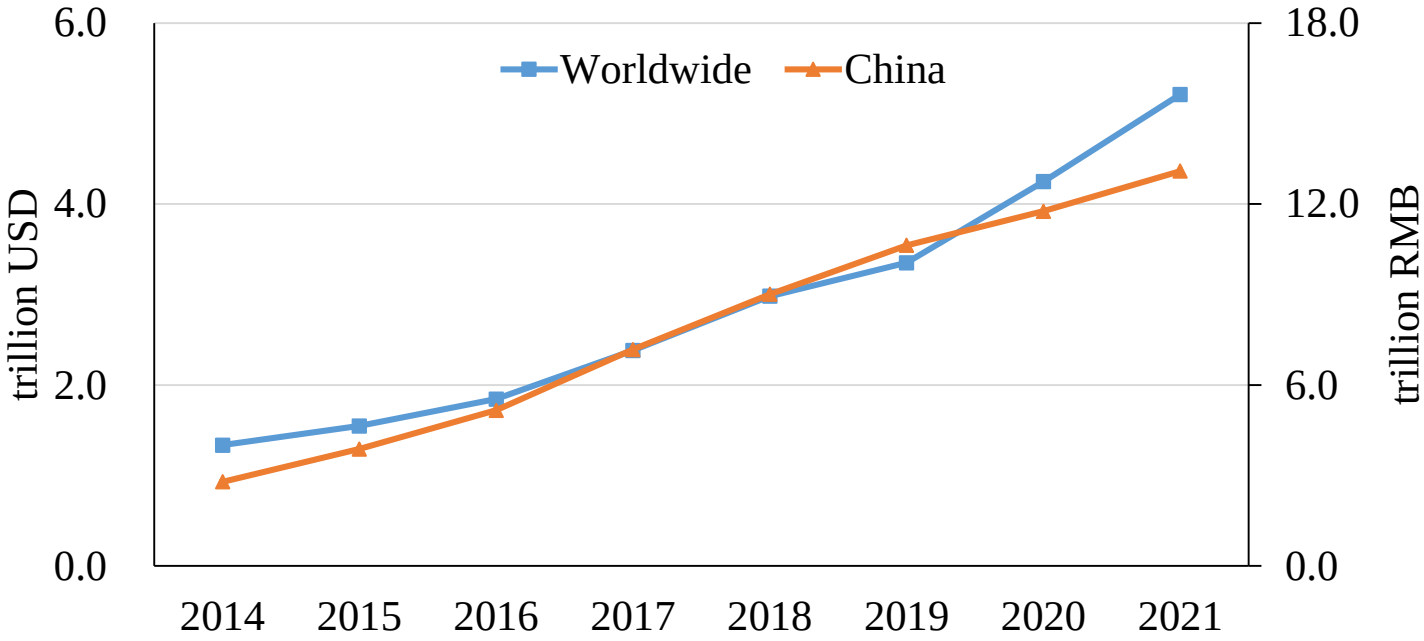


Source: China rural statistical yearbooks (2013-2022)

Figure 2 Total citrus output and planting areas in Jiangxi province (2012-2021)

2. Background

- Development of online sales



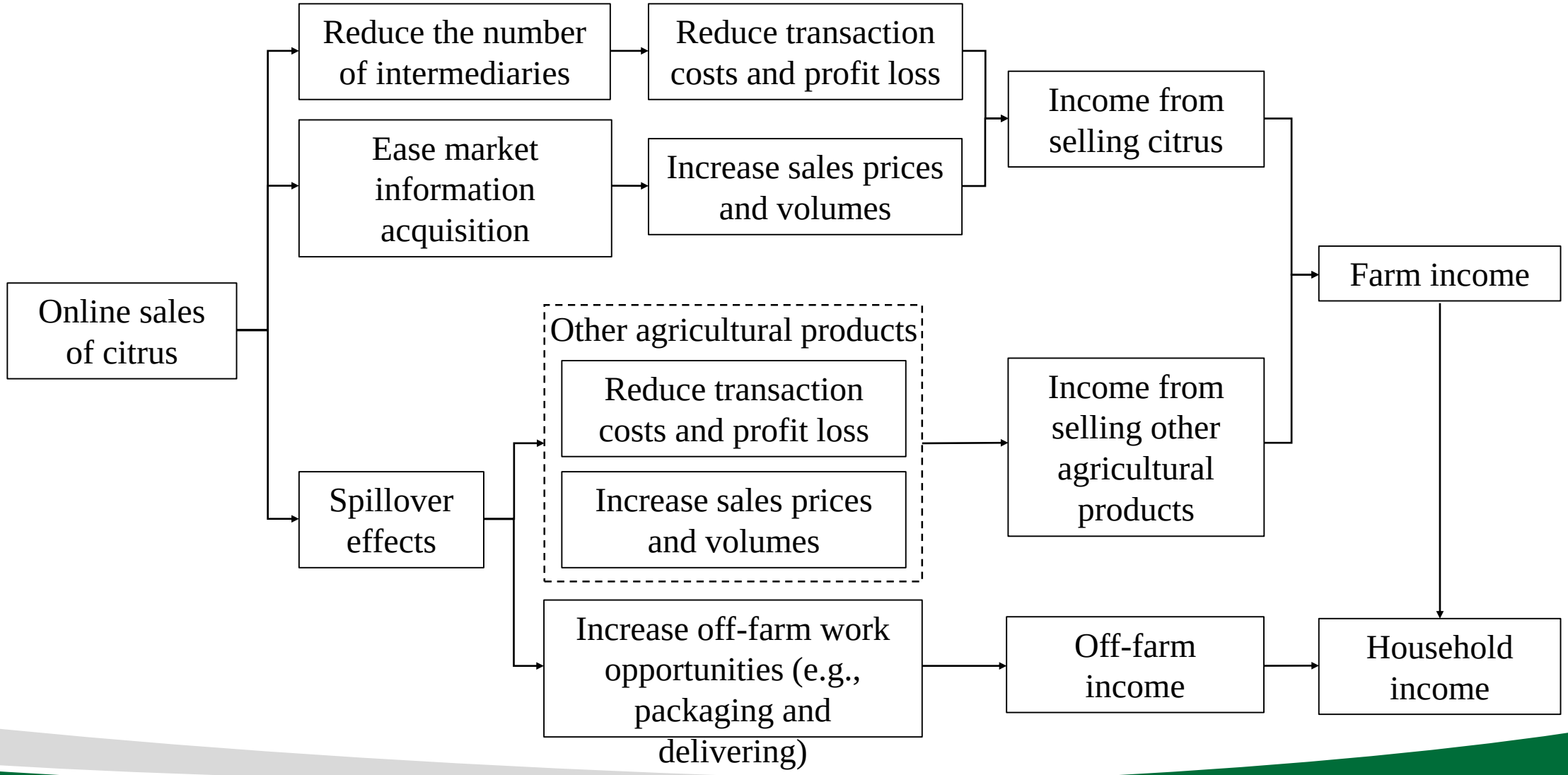
Source: Statista and NBS

Figure 3 Online retail sales worldwide and in China

- In rural China, online retail sales were 2.05 trillion yuan in 2021, of which 422.1 billion yuan was traded in agricultural products, accounting for only **9.8%** of total agricultural products transactions.

3. Analytical framework and estimation strategy

- Analytical framework



3. Analytical framework and estimation strategy

- Estimation strategy
  - Farmers are not randomly contracted for online sales so endogeneity may exist.
  - PSM and IPWRA can address the endogeneity of observed factors but neglect unobserved factors.
  - **Endogenous Treatment Regression (ETR)** can address endogeneity of observed and unobserved factors and helps estimate unbiased

Stage 1:
$$OS_i^* = \alpha_i X_i + \beta_i IV_i + \varepsilon_i, \qquad OS_i = \begin{cases} 1, & if \ \ OS_i^* > 0 \\ 0, & otherwise \end{cases} \tag{1}$$

Stage 2:
$$INC_i^J = \gamma_i OS_i + \delta_i X_i + \mu_i, \ J = 1, 2, 3 \tag{2}$$

4. Data, variables, and descriptive statistics

- Data
  - Survey location: Jiangxi Province, China
  - Survey time: October and November 2022
  - Target: Citrus farmer
  - Sample size: 926 (After data cleaning)

4. Data, variables, and descriptive statistics

Table 1 Variable definitions and summary statistics

Variables	Definitions	Mean (S.D.)
Outcome variables		
Net returns from citrus production	The difference between gross income from citrus production and production costs (10,000 yuan/capita) [a]	0.31 (1.43)
Net farm income	The difference between gross income from all kinds of farming activities and total agricultural production costs (10,000 yuan/capita)	0.54 (1.73)
Household income	(10,000 yuan/capita)	3.43 (4.18)
Treatment variable		
Online sales	1 if household has sold citrus via online platforms (e.g., Taobao, Jingdong, and Pinduoduo), 0 otherwise	0.15 (0.36)
Instrumental variables		
Network fees	Expenditure on phone and Internet bills (100 yuan/month)	2.76 (2.19)
Peer sales	Proportion of people selling online in the village to the village size (excluding the respondent)	0.15 (0.15)

Note: S.D. refers to the standard deviation; [a] Yuan is a Chinese currency (1 USD =6.73 yuan in 2022).

[b] 1=illiterate; 2=Primary school; 3=Junior school; 4=High school/junior college; 5=College and above.

4. Data, variables, and descriptive statistics

Table 1 Variable definitions and summary statistics

Variables	Definitions	Mean (S.D.)
Control variables		
Age	Age of household head (HH) in years	53.23 (9.38)
Sex	1 if HH is male, 0 otherwise	0.77 (0.42)
Education	Education level of HH [b]	2.67 (1.03)
Health status	Self-reported health status: from 1=very unhealthy to 5=very healthy	4.20 (0.88)
Village cadre	1 if HH serves as a village cadre in a village, 0 otherwise	0.18 (0.38)
Risk attitude	1 if HH is a risk-lover, 0 otherwise	0.32 (0.47)
Family size	Number of people residing in a household in persons	5.11 (1.85)
Dependency ratio	Ratio of household members under the age of 15 and over the age of 60 to total household size	0.33 (0.21)
Property ownership	1 if household purchased another property in the county, 0 otherwise	0.22 (0.41)
Farming years	Number of years HH engaged in citrus farming (years)	19.56 (9.27)
Soil conditions	Self-reported soil conditions of farmland: from 1=very poor to 5=very good	3.50 (0.95)
Plot number	Number of cropland plots for citrus production	2.77 (2.64)
Distance	Distance from the village to the county (km)	18.16 (14.44)
Location	1 if HH resides in Ganzhou, 0 otherwise (i.e. Fuzhou)	0.47 (0.50)

Note: S.D. refers to the standard deviation; [a] Yuan is a Chinese currency (1 USD =6.73 yuan in 2022).

[b] 1=illiterate; 2=Primary school; 3=Junior school; 4=High school/junior college; 5=College and above.

5. Empirical results and discussion

- Factors influencing online sales & Impacts on rural incomes

Table 3 Impact of online sales on net returns, net farm income, and household income: ETR model estimations

Variables	Online sales	Net returns from citrus production	Net farm income	Household income
Online sales		0.500 (0.250)**	0.858 (0.302)***	1.783 (0.697)**
Age	-0.010 (0.007)	-0.014 (0.010)	-0.028 (0.013)**	-0.057 (0.025)**
Sex	-0.035 (0.162)	0.241 (0.158)	0.449 (0.178)**	0.299 (0.330)
Education	0.158 (0.064)**	-0.045 (0.077)	-0.133 (0.093)	0.164 (0.172)
Health	0.014 (0.071)	0.019 (0.049)	0.061 (0.061)	0.292 (0.138)**
Village cadre	0.039 (0.148)	0.214 (0.135)	0.304 (0.188)	0.376 (0.464)
Risk attitude	0.684 (0.117)***	0.149 (0.078)*	0.097 (0.094)	0.523 (0.246)**
Family size	-0.005 (0.034)	-0.035 (0.035)	-0.079 (0.040)**	-0.061 (0.084)
Dependency ratio	0.098 (0.336)	-0.403 (0.241)*	-0.333 (0.298)	-2.733 (0.662)***
Property ownership	0.097 (0.144)	0.065 (0.099)	0.197 (0.116)*	1.437 (0.351)***
Farming years	0.011 (0.007)	0.022 (0.006)***	0.019 (0.007)***	0.045 (0.017)***
Soil conditions	0.015 (0.063)	0.079 (0.042)*	0.125 (0.051)**	0.616 (0.135)***
Plots number	-0.002 (0.029)	-0.004 (0.012)	-0.012 (0.016)	0.019 (0.037)
Distance	0.003 (0.004)	0.001 (0.002)	0.000 (0.003)	-0.001 (0.006)
Location	0.744 (0.167)***	0.330 (0.113)***	0.253 (0.141)*	0.363 (0.336)
Network fees	0.067 (0.023)***			
Peer sales	0.749 (0.402)*			
Constant	-2.396 (0.633)***	0.185 (0.523)	1.108 (0.642)*	1.703 (1.383)
$\rho_{\varepsilon u}$	-0.088 (0.035)**			
Wald test ($\rho_{\varepsilon u} = 0$)		Chi2 (1) = 6.27, Prob = 0.012	Chi2 (1) = 4.68, Prob = 0.031	Chi2 (1) = 1.88, Prob = 0.171
Over identification test				
Sargan test		Chi2 (1) = 0.418, Prob = 0.518	Chi2 (1) = 1.073, Prob = 0.300	Chi2 (1) = 0.052, Prob = 0.819
Basmann		Chi2 (1) = 0.410, Prob = 0.521	Chi2 (1) = 1.055, Prob = 0.305	Chi2 (1) = 0.051, Prob = 0.821
Observations	926	926	926	926

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust standard errors in parenthesis. The regional reference is Fuzhou.

5. Empirical results and discussion

- Disaggregated analysis

Table 4 Disaggregated analysis by gender and survey regions: Second-stage estimations of the ETR model estimations

	Net returns from citrus production		Net farm income		Household income	
By gender	Male	Female	Male	Female	Male	Female
Online sales	0.463	0.965	0.895	1.103	1.819	4.595
	(0.286)	(0.567)*	(0.363)**	(0.564)*	(0.809)**	(0.921)***
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	715	211	715	211	715	211
By region	Ganzhou	Fuzhou	Ganzhou	Fuzhou	Ganzhou	Fuzhou
Online sales	0.604	0.409	1.172	1.222	2.015	2.308
	(0.361)*	(0.217)*	(0.614)*	(0.521)**	(1.003)**	(1.150)**
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Observations	435	491	435	491	435	491

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust standard errors in parenthesis.

6. Concluding remarks and implications

- Concluding remarks
  - Online sales increase net returns from citrus production, net farm income, and household income by 5,000 yuan/capita, 8,580 yuan/capita, and 17,830 yuan/capita.
  - Disaggregated analyses show that online sales have a more significant effect on females than males for three types of income. Online sales affect net returns more in Ganzhou than that in Fuzhou. Concerning net farm income and household income, online sales have a greater impact on Fuzhou than Ganzhou.
- Policy implications
  - The government should consider enhancing the relevant infrastructure to support online sales.
  - Policymakers may consider providing online sales-targeted training to farmers with a focus on the techniques and benefits.

Thank you!