

# Information Acquisition Capability and Risk Perception as Dual Mediators in the Relationship between E-commerce Participation and Grape Growers' Behavioral Upgrading

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## Abstract

Using survey data from 386 grape growers in Yingkou City, Liaoning Province, this article examines the dual mechanisms through which e-commerce participation affects farmers' behavioral upgrading. The analysis focuses on three outcome dimensions - standardized production behavior, diversified marketing behavior, and green technology adoption - and treats information acquisition capability and risk perception as two mediating channels. The empirical strategy combines reliability and validity testing, multiple regression, and bootstrap mediation analysis. The results show that e-commerce participation is positively associated with all three behavioral outcomes, but the mechanism is not unidirectional. Information acquisition capability serves as a strong positive mediator, with indirect effects of 0.215, 0.232, and 0.208 for standardized production, diversified marketing, and green technology adoption, respectively, accounting for about one-third of the total effect. By contrast, risk perception constitutes a significant negative mediating pathway, with indirect effects of -0.138, -0.150, and -0.136. These findings indicate that the behavioral value of rural e-commerce lies not only in expanding sales channels, but also in reshaping the information environment and lowering perceived uncertainty in farmers' operational decisions. The article argues that digital-rural policy should move beyond simple platform access and instead emphasize information services, trust-building mechanisms, and differentiated support for behavioral transformation.

## Keywords

Rural e-commerce; grape growers; information acquisition capability; risk perception; mediation effect.

## 1. Introduction

In the digital transformation of agriculture, e-commerce has become more than an alternative sales outlet. For highly commercialized fresh products such as grapes, online transactions alter how producers acquire information, interpret market demand, organize grading and packaging, and evaluate the risks embedded in circulation. In this sense, e-commerce participation should be understood as a behavioral environment that restructures farmers' decision-making rather than merely as a transaction channel.

Most existing studies have already established that participation in rural e-commerce can improve income, market access, or marketing performance. However, less attention has been paid to the process through which e-commerce changes production and operational behavior at the farm level. This gap is particularly important for grape growers in Yingkou City, where product quality stability, post-harvest handling, and rapid market response directly affect both sales and reputation. Growers do not simply need a platform; they need the capability to read information and the confidence to act under uncertainty.

Accordingly, this article isolates two mechanism variables from the dissertation: information acquisition capability and risk perception. The first represents the enabling side of digital participation, because stronger information access can improve timeliness, accuracy, and the breadth of operational judgment. The second represents the constraining side, because quality risk, logistics risk, and platform-rule uncertainty may inhibit behavioral upgrading if they are not effectively managed. The core question addressed here is therefore not only whether e-commerce participation matters, but how these two channels jointly shape behavioral upgrading among grape growers.

Compared with the first article, which emphasized the overall association between e-commerce participation and behavioral transformation, the present article concentrates on mechanism identification. By foregrounding mediation analysis, it aims to clarify the internal chain linking e-commerce participation to standardized production behavior, diversified marketing behavior, and green technology adoption.

## **2. Theoretical logic and research framework**

### **2.1. Information acquisition capability as an enabling mechanism**

E-commerce participation can strengthen farmers' access to price signals, consumer preferences, platform rules, and technical knowledge. Compared with traditional wholesale-oriented marketing, online participation exposes producers to more frequent and more granular feedback. Once such information is internalized, growers are more likely to standardize field management, diversify marketing channels, and experiment with environmentally friendly technologies. Information acquisition capability therefore functions as a resource-empowerment mechanism that converts digital exposure into concrete behavioral change.

### **2.2. Risk perception as a constraining or relieving mechanism**

Risk perception reflects farmers' subjective assessment of uncertainty in prices, quality complaints, product losses, logistics delays, and platform governance. In the context of fresh grapes, these uncertainties are highly salient. A farmer who perceives high operational risk may delay technology adoption, avoid new marketing arrangements, or remain conservative in standardization investment. Yet if e-commerce participation gradually reduces uncertainty by improving information transparency and transaction predictability, lower perceived risk can itself become a channel through which behavior improves. The dissertation data reveal this second pattern: risk perception acts as a significant negative mediator.

### **2.3. Analytical framework**

The analytical structure used in this article links e-commerce participation to three behavioral outcomes through two parallel mediators. A positive indirect path is expected through information acquisition capability, whereas a negative indirect path is expected through risk perception. Figure 1 summarizes this dual-mediation framework.

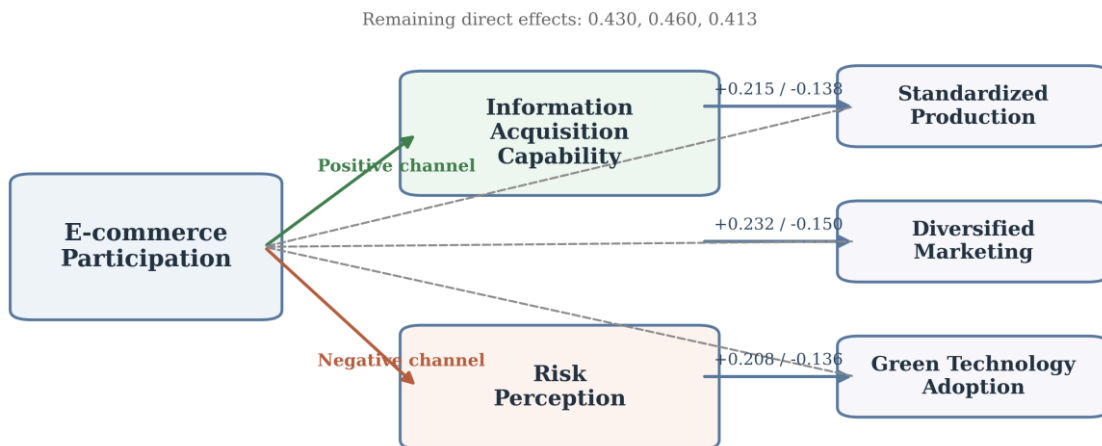


Figure 1. Dual-mediation framework of the dissertation-based empirical analysis.

### 3. Data, variables, and methods

#### 3.1. Study area and sample

The analysis uses the dissertation dataset collected in the major grape-producing areas of Yingkou City, including townships in Gaizhou and Dashiqiao. The survey combined offline field interviews with an online supplementary questionnaire. A total of 415 questionnaires were collected, of which 386 were valid, yielding a valid response rate of 92.99%. The sample covers different age groups, planting scales, educational levels, and degrees of e-commerce participation, making it suitable for identifying variation in behavioral adjustment.

Table 1. Condensed sample profile of the survey.

Dimension	Category	n	%
Survey validity	Valid questionnaires	386	92.99
Household head age	<=50 years	176	45.6
Household head age	>50 years	210	54.4
Planting scale	<=5 mu	142	36.8
Planting scale	5-20 mu	189	49.0
Planting scale	>20 mu	55	14.2
E-commerce participation	Participates in e-commerce	199	52.1
E-commerce participation	Does not participate	187	47.9

Note: 1 mu ≈ 0.067 hectares.

#### 3.2. Variable measurement and empirical strategy

The independent variable is the e-commerce participation index. The dependent variables are standardized production behavior, diversified marketing behavior, and green technology

adoption. Information acquisition capability and risk perception are included as mediators. Scale quality is satisfactory: Cronbach's alpha ranges from 0.824 to 0.883, and the measurement model shows acceptable fit (chi-square/df = 2.365, GFI = 0.902, CFI = 0.923, IFI = 0.925, RMSEA = 0.058). The empirical analysis proceeds in three steps: baseline regressions for direct effects, bootstrap tests for indirect effects, and comparative interpretation of the two mediation channels.

Table 2. Reliability summary for the core constructs.

Core latent variable	Cronbach's alpha	Composite reliability (CR)
E-commerce participation	0.852	0.887
Standardized production behavior	0.883	0.905
Diversified marketing behavior	0.876	0.898
Green technology adoption	0.871	0.895
Information acquisition capability	0.855	0.882
Risk perception	0.824	0.853

## 4. Results

### 4.1. Baseline direct effects

Before turning to mediation, the baseline regressions confirm that e-commerce participation is positively associated with all three behavioral outcomes. The standardized coefficients are 0.428 for standardized production behavior, 0.465 for diversified marketing behavior, and 0.412 for green technology adoption, all significant at the 1% level. This pattern indicates that growers who participate more deeply in e-commerce tend to show stronger behavioral upgrading across production, marketing, and technology dimensions.

### 4.2. Positive mediation through information acquisition capability

The first mediation test demonstrates that information acquisition capability is a strong transmission channel. The total effects of e-commerce participation on standardized production, diversified marketing, and green technology adoption are 0.645, 0.692, and 0.621, respectively. After the mediator is introduced, the direct effects remain positive but are reduced to 0.430, 0.460, and 0.413. The corresponding indirect effects through information acquisition capability are 0.215, 0.232, and 0.208, and the bootstrap confidence intervals do not include zero. The share of mediation is approximately one-third for all three outcomes, which suggests that improved information access is not a marginal factor but one of the core channels through which digital participation changes farm behavior.

### 4.3. Negative mediation through risk perception

The second mediation test reveals a different mechanism. Risk perception carries a significant negative indirect effect. Once risk perception is included, the direct effects of e-commerce participation rise to 0.507, 0.542, and 0.485 for the three outcomes, while the indirect effects through risk perception are -0.138, -0.150, and -0.136, respectively. These coefficients imply that risk perception constitutes a suppressing pathway: higher perceived uncertainty is associated with weaker behavioral upgrading. In substantive terms, one part of e-commerce's

contribution lies in reducing the subjective uncertainty surrounding online transactions, quality claims, and market volatility.

Table 3. Bootstrap mediation results for the two mechanism variables.

Outcome	Path	Total	Direct	Indirect	95% CI	Share (%)
Standardized production	IAC	0.645***	0.430***	0.215***	[0.168, 0.263]	33.3
Diversified marketing	IAC	0.692***	0.460***	0.232***	[0.184, 0.280]	33.5
Green technology	IAC	0.621***	0.413***	0.208***	[0.162, 0.254]	33.5
Standardized production	RP	0.645***	0.507***	-0.138***	[-0.175, -0.091]	21.4
Diversified marketing	RP	0.692***	0.542***	-0.150***	[-0.188, -0.112]	21.7
Green technology	RP	0.621***	0.485***	-0.136***	[-0.173, -0.099]	21.9

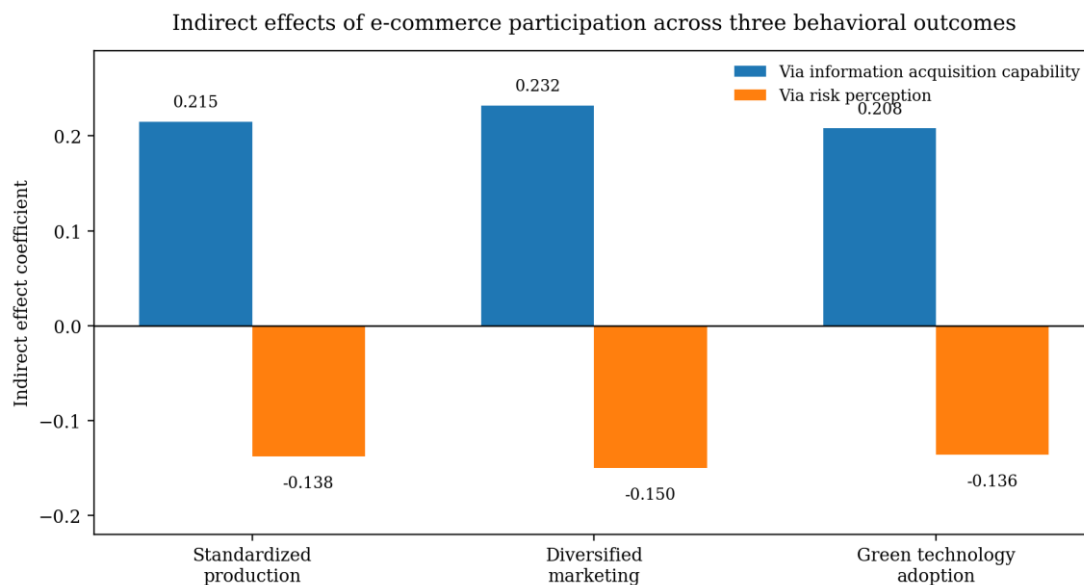


Figure 2. Comparison of the positive and negative indirect effects across the three outcomes.

#### 4.4. Comparative interpretation

A comparison of the two mediating channels yields three clear conclusions. First, the enabling mechanism is stronger than the constraining one, because the absolute magnitude and mediated share of information acquisition capability exceed those of risk perception. Second, the relative stability of the mediation shares across outcomes suggests that e-commerce participation changes farmers' behavior through a general decision-support logic rather than through outcome-specific idiosyncrasies alone. Third, diversified marketing behavior is the most responsive outcome in both channels, which is consistent with the idea that marketing decisions are especially sensitive to information breadth and perceived uncertainty.

## 5. Discussion

The mechanism pattern identified here helps refine the understanding of rural e-commerce. If scholars focus only on income or channel expansion, they may miss the internal reorganization of farmers' cognition and decision environments. The Yingkou evidence suggests that e-commerce works not only because it opens new markets, but because it makes market signals denser and more legible. Once growers can more accurately read demand, compare prices, track platform rules, and observe peer practices, they become more capable of adjusting production, marketing, and technology use.

At the same time, the negative mediation through risk perception cautions against an overly optimistic view of digital participation. Entering an online market also exposes farmers to returns, complaints, logistics delays, and volatile platform governance. If these perceived risks remain high, the behavioral gains from e-commerce will be partially offset. Thus, platform design and public service delivery should not assume that access automatically produces confidence. Confidence is itself an institutional outcome that depends on reliable logistics, transparent rules, dispute resolution, and accessible training.

For the grape industry in Yingkou, this interpretation is especially relevant. Fresh grapes are highly quality-sensitive and time-sensitive. The cost of a mismatch between online promises and actual delivery can be high, both economically and reputationally. Therefore, the information channel and the risk channel should be viewed together: one expands farmers' opportunity set, while the other governs how secure they feel in using that opportunity set.

## 6. Conclusion and implications

This article, derived from the doctoral dissertation on grape growers in Yingkou City, demonstrates that the behavioral effects of e-commerce participation operate through a dual mechanism. Information acquisition capability plays a substantial positive mediating role, whereas risk perception constitutes a significant negative mediating pathway. The two mechanisms jointly explain why e-commerce participation is associated with stronger standardized production, more diversified marketing, and greater green technology adoption. The main policy implication is that rural digitalization should be understood as a problem of behavioral capability-building rather than mere platform expansion. Governments and service organizations should invest in market-information services, technical-extension content, rule interpretation, and local demonstration training. Platforms should improve dispute resolution, logistics reliability, and user guidance so that perceived uncertainty declines together with participation costs. For growers, the practical lesson is that successful e-commerce participation depends on both learning to read information and learning to manage operational risk.

Because the data are cross-sectional and limited to Yingkou, the findings should be interpreted as structured empirical associations rather than definitive long-run causal claims. Even so, the evidence provides a clear explanation of how digital participation translates into micro-level behavioral upgrading in a specialty-fruit context.

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