agriculture

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The Determinants of Grape Storage: Evidence from Grape Growers in China

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Abstract: Storage of high-value agricultural products is essential to increase their added value. Exploring growers' storage strategies for high-value agricultural products is helpful in developing the agricultural industry. In this paper, we analyzed the factors affecting growers' storage decisions using Probit and Tobit models based on field data from 1026 grape growers in China. We conclude that the in-season price has a negative effect on growers' storage decisions. Expected price, market risk perception and grape quality have a positive effect on storage decisions. Borrowing behavior has a positive effect on the storage decisions of large-scale growers. In addition, the higher the expected price and the greater the market risk perception, the more growers prefer long-term storage; and the better the quality of the grapes, the more growers tend to store grapes in the short term.

Keywords: storage decision; long- or short-term storage; grape grower

Citation: Sun, X.; Yang, X.; Zhang, R. The Determinants of Grape Storage: Evidence from Grape Growers in China. *Agriculture* **2022**, *12*, 2063. https://doi.org/10.3390/agriculture12122063

Academic Editor: Sanzidur Rahman

Received: 17 October 2022
Accepted: 29 November 2022
Published: 1 December 2022

1. Introduction

The high-value agricultural product is one of the most dynamic and fastest-growing components of the international agricultural trade, and growers can gain more economic returns by entering high-value agricultural markets. Grapes, as one of the international high-value agricultural products, have improved the economic efficiency of the fruit trade and are of great strategic importance to cope with the changing market demand for the new era. With improved living standards, the demand for high-value agricultural products represented by fruits, vegetables, meat, poultry, and dairy proliferates [1]. Compared to grain crops, fresh grapes have high added value, are perishable, and require high storage and transportation conditions, making them difficult to store. In this context, the storage behavior of growers becomes an essential link between balancing the seasonal pressure on grapes and continuous marketing [2]. How to avoid vicious market competition and help growers sell their crops at higher prices during off-season supply shortages [3,4] and smoothing market price fluctuations [5] has become a focus of academic attention. In terms of storage motives, growers' crops need to insure themselves with storage due to no developed insurance, a credit market, and an expensive market transaction cost [6]. The factors affecting growers' storage behavior are diverse, but one prominent research strand argues that storage is closely related to price. Scholars focus on the signaling role of crops prices on crops storage based on the price expectations theory. At different times, they select grain prices for numerous studies from macro and micro perspectives. The classical storage model was proposed by Gustafson [7], followed by Deaton and Laroque [8], who propose a competitive storage model based on their model, pointing to a strong association between storage decision and price. Cafiero et al. [9] corroborate that storage and commodity prices are closely related by validating an empirical study of higher-order serial correlation. D'Hôtel and Cotty [10] simulate the effect of storage on prices using actual maize production and storage data for Burkina Faso from 2004 to 2014. The results show that heterogeneous price expectations also lead to different storage decisions by growers, further increasing price volatility. Haile [11], Peng and Xu [12], and Vollmer et al. [13] show that growers tend to make optimal planting decisions based on expected price in seasonal price volatility. In conclusion, commodity prices and their expectations influence growers' storage decision behavior.

Some scholars also point out that although the price significantly impacts growers' grain storage behavior, it is by no means the only determining factor. It has been suggested that social factors (personal characteristics, social networks, etc.) and geographical factors (storage location, market distance, etc.) are essential factors influencing growers' willingness and the extent of storage [14]. In their study of a household grain storage model, Atanu and Janic [15] show that risk preferences are critical to growers' storage policies. Lai et al. [3] concludes from a Michigan maize farm study that storage marketing decisions depend on growers' risk preferences, storage costs, and credit rates. Burke et al. [16] found through a field experiment in Kenya that imperfections in the credit market limit growers' ability to store and sell grain over time. Southern Ethiopia's research shows that if farmers have poor quality improved maize varieties, they must sell them immediately after harvest when prices are lower [17]. Research in Sub-Saharan Africa has shown higher price discounts for damaged maize in the early post-harvest period than in the lean period. Farmers do not choose to store poor quality maize [18]. Srisompun et al. [19], Dillon and Brian [20], Sun et al. [21], and Mgale and Yan [22] show that more indebted households prefer to sell rice immediately after harvest to repay their debts and therefore have to sell grain at a lower price after harvest to meet their emergency repayment needs. In addition, storage facilities and technology [23–26] and losses during storage [27–30] are also essential factors influencing storage decision behavior. It is easy to see that, in addition to price, individual subjective heterogeneity, external objective constraints, liquidity constraints, and storage costs are essential factors that influence growers' storage decisions.

Our study is based on existing literature and actual survey perceptions. It attempts to answer the following research questions:

(1) What factors influence growers to store grapes?

(2) What factors influence growers' long- and short-term storage decisions?

The results showed that in the baseline regression, in-season price, expected price, market risk perception, and grape quality were important factors influencing whether growers stored and the amount of storage. Next, we analyzed the factors of grape storage for different scales of growers. In addition to these factors, the storage behavior of large-scale growers was positively influenced by borrowing behavior. We finally analyzed the long- and short-term decisions of growers storing grapes. For growers with storage in the current year, the higher the expected price and the greater the market risk perception, the more growers tend to choose long-term storage of grapes; and the better the quality of the grapes, the more growers tend to store them for the short term.

This study aims to fill a vital research knowledge gap. First, it is an addition to the literature on storage crops categories. Although there is extensive literature on growers' storage behavior domestically and internationally, most of it is on cereal storage. Our study analyzes the critical factors affecting growers' storage concerning the uniqueness of fruit storage. Second, there are currently more qualitative studies on growers' grain storage at the macro level and fewer quantitative studies at the micro level, and there is a lack of empirical studies. This study is based on first-hand information and data from a field survey, which can objectively and realistically identify the key factors affecting the storage behavior of Chinese fruit growers. Third, our study further analyzes the differences in storage decision behavior of growers of different scales and the factors influencing long-term and short-term storage decisions based on the rational decision-making perspective of growers. The findings are helpful for understanding growers' storage behavior, predicting future trends in the grape storage industry, and guiding government policy formulation.

The rest of the paper proceeds as follows. In Section 2, we briefly present the study area, the data collection methods, and the descriptive statistics. Section 3 presents the research hypothesis and describes the empirical models developed to assess grape growers' storage decision factors. In Section 4, we report and discuss the results of our models. Section 5 provides a summary and conclusions.

2. Data

2.1. Data Source

In 2020, grape exports to China exceeded $120 million. China is the world's largest producer of fresh grapes, and grape sales are closely related to growers' welfare. The data used for this study were collected in a face-to-face survey in Beizhen, Liaoning Province, China, known for its unique natural conditions, regional advantages, and history of viticulture. Beizhen has more than 4700 constant temperature cold storage units of different scales. It is one of China's most significant fresh grapes growing and preserving areas. Currently, Beizhen has about 200,000 Mu (a Chinese unit of area (1 Mu $\approx$ 0.1647 acres; 1 Mu $\approx$ 0.0667 hectares)) grapes, with an annual production of over 300,000 tons and about 10,000 grape growers.

Before the formal research, a census of the city's grape growers was conducted, and data on 9767 grape growers in 52 villages in 10 townships were obtained. Take this as a sample frame, 7 townships were selected using a random number generator, based on which 38 villages were randomly generated again. Finally, 1840 people were randomly selected as interviewed households within the screened sample frame. We have already provided technical training to more Beizhen growers in 2019, and they knew us and believed us, which laid a good foundation for our research in 2020. In January 2020, we organized 48 researchers, composed of doctoral students and master students. All were divided into 12 teams of 4 people each, with the researchers who trained the growers being the leaders of each team, and each researcher could investigate an average of 2 or3 growers per day. A total of 10 days of one-on-one research was conducted, and a total of 1042 samples were obtained. After rigorous data screening and elimination of questionnaires lacking answers to key questions, the final valid sample was 1026.

2.2. Summary of Key Variables

The variable names, definitions, and basic descriptive statistics are presented in Table 1. The Explanatory Variables for the baseline regressions were selected as to whether the grape growers stored their grapes and the storage capacity. The Explanatory Variables are divided into four categories: First, price variables, which include the in-season price of grapes, the sales price after short-term storage, and the expected price at long-term storage. Second, risk perception variables: i.e., growers' risks perception of market price uncertainty. Third, the grape quality variable; grape quality is measured comprehensively through three objective indicators: grape sweetness, weight, and shape. Fourth, the borrowing behavior variable, which refers to whether the growers have borrowed money or not during the year. Fifth, control variables, including gender, age, marriage, education level, health status, number of laborers, yield, planting years, planting area, and storage costs.

Table 1. Descriptive statistics of grape growers.

Variable Name	Variable Interpretation and Assignment	Min	Max	Mean	Standard Deviation
Storage or not	1 = Yes 0 = No	0	1	-	0.483
Storage capacity	Grapes have been stored this year, Unit: Jin [1]	0	1,000,000	25,140.270	49,403.810
In-season price	Unit: CNY	0	7	1.118	1.023
Year-end price	Selling price after short-term storage, Unit: CNY	0	7	0.935	0.839

Table 1. *Cont.*

Variable Name	Variable Interpretation and Assignment	Min	Max	Mean	Standard Deviation
Expected price	Expected price at long-term storage, Unit: CNY	0	10	1.108	1.085
Market risk perception	1 = With effect 0 = No effect	0	1	-	0.300
Sweetness	The sugar content of grapes	14	24	17.519	1.801
Weight	Unit: Jin	0.4	5	1.867	0.559
Shape	1 = Consistent size 0 = Unequal in size	0	1	-	0.500
Borrowing behavior	1 = borrowing this year 0 = No borrowing	0	1	-	0.485
Gender	1 = Male 0 = Female	0	1	-	0.461
Age	Unit: Years	20	70	47.373	8.779
Marriage	1 = Married 0 = Unmarried	0	1	-	0.189
Education	1 = Elementary school and below; 2 = Middle school; 3 = High school; 4 = College and above	1	4	1.864	0.563
Health	1 = Unhealthy 2 = Fairly healthy 3 = Healthier 4 = Very healthy 5 = Highly healthy	1	5	3.976	1.132
Number of laborers	-	0	8	3.066	1.061
Yield	Unit: Jin	100	1,000,000	40,065.489	50,132.857
Planting years	Unit: Year	1	50	21.477	7.878
Planting area	Unit: Mu	0.5	70	10.977	6.933
Storage cost	Unit: CNY	0	100,000	12,020.398	12,774.490

[1] Jin is the name of the Chinese unit of weight (1 jin = 1.1023113 pounds).

The personal characteristics of the sample growers showed that 70% were male and 30% were female. The slight difference between the male and female ratios was that the questionnaire was set up to research the head of the household, and his wife filled in the questionnaire on his behalf when he was not at home. In terms of age, the average age of the sample growers was about 47 years old, with the youngest 20 years old and the oldest 70 years old. According to marital status, 96% were married, while 4% were single or widowed. Based on education level, the sample growers were generally less educated, with 82% having a junior high school education or less and only 1% having a college education or higher. The number of borrowers was low, accounting for only 38% of the total. A total of 90% of the growers had a strong perception of market risk and perceived uncertainty in market prices.

From the characteristics of the household life of the sample growers, the average household labor force of the sample growers was three, the average area of cultivated land operated by the household was small, 11 Mu/household, and the average cultivation time was long, about 21 years.

The production characteristics of the sample growers showed that the total grape production this year was around 40,065 Jin. Storage grapes accounted for 63% of the sample growers, averaging around 25,140 Jin. The current season price averaged 1.118 CNY, and the year-end price was 0.935 CNY. The expected selling price was 1.108 CNY, and the storage cost was about 12,020 CNY. The grapes averaged 17.5 in sweetness, 1.9 Jin in bunch weight, and diverse bunch shapes.

Overall, the research sample of this paper was well represented, and their characteristics were consistent with the current situation in rural China.

3. Model Specification

3.1. Theoretical Framework and Hypotheses

Each year, growers must decide whether to store their grapes or sell them at harvest time. This decision is complex. It is like a gambling game in which the probability of winning or losing changes each time the game is played [31]. The British economist Adam Smith proposed the "economic man hypothesis", i.e., the maximization of self-interest or utility, which is the basic motivation for individual behavior. As rational economic agents, growers make grape storage decisions to maximize profits by judging changes in future market supply.

Market supply and demand theory can provide a rational explanation for growers' grape storage and influencing factors. Market supply and demand theory is a basic theory of microeconomics that describes the relationship between demand, supply, and price. The market price of a commodity is determined by the relationship between supply and demand in the market. Fresh grapes, as one of the seasonally produced cash crops, have a significant negative correlation with changes in supply, when other external conditions are consistent. When the supply of grapes increases, the seasonal price decreases and the price decrease is more pronounced than the increase in supply. When the market demand for grapes does not increase significantly, growers choose to store large quantities of grapes to avoid the risk of loss, so the seasonal price of grapes is negatively correlated with the probability and capacity of storage. Thus, hypothesis one is proposed.

Hypotheses 1 (H1). *The higher the price of grapes in season, the fewer growers choose to store and the smaller storage capacity.*

With the development of storage and preservation techniques, grapes are available in both winter and spring to meet the increasingly diverse demands of consumers. Lucas [32]'s theory of rational price expectations suggests that producers will objectively predict future prices based on experience and all the information available now. Several studies have shown that high elasticities indicate that growers are highly sensitive to prices [33–35]. Market supply and demand theory suggests that growers will generally sell grapes when prices rise but may choose to hoard rather than trade when they expect prices to continue to climb. Conversely, growers generally decide to store longer when prices fall, but may engage in grape sales to prevent lower prices when they expect prices to continue to fall. When growers expect higher prices around spring than in the current season, they do not end up selling grapes during the current harvest but tend to store more grapes. Only growers who stored grapes would have the expected price, so for the variable expected price, we regressed it only in the second stage. Thus, hypothesis two is proposed.

Hypotheses 2 (H2). *The higher the expected price of the grapes by the grower, the greater the storage capacity.*

Risk awareness reflects the process by which growers perceive the potential impact of risk on their agricultural production and income [36]. With the transformation of traditional agriculture to modern agriculture, market risk has become a fundamental risk in addition to natural risk. The contradiction between "small farmers" and "big markets" in China exposes growers to market uncertainty, i.e., market price risk. Market risk differs from natural risk in that it is primarily the effect of external shocks on cash crops, making price fluctuations uncertain and allowing growers to adjust their storage and marketing behavior based on risk perception. When growers perceive changes in market price risk, they make decisions to store grapes based on expected returns and storage costs. Thus, hypothesis three is proposed.

Hypotheses 3 (H3). *The stronger the grower's perception of market risk, the greater the probability of storing grapes and the greater the storage capacity.*

Unlike grain crops, fresh grapes are berries and their storage require certain storage conditions and grape quality. Due to the long history of storage in Beizhen, the study site, almost every grower has well-equipped storage facilities and storage conditions do not constitute a key influencing factor. Grapes of relatively poor quality are prone to damage and infection with pathogens during storage, leading to water loss, browning, cracking, rotting and spoilage, and a tendency to decrease in price after storage. High-quality grapes are resistant to storage, do not drop grains, do not crack, and have a stable or increasing price after storage. Therefore, to avoid losses or to obtain high profits, growers make storage decisions based on the quality of the grapes. Thus, hypothesis four is proposed.

Hypotheses 4 (H4). *The higher the quality of the grower's grapes, the greater the probability of storing them and the greater the storage capacity.*

Cai et al. [37] classify the borrowing behavior of growers into traditional and informal borrowing based on the source of funds studied. The funds borrowed by growers are used for production and domestic consumption. When growers face a shortage of funds during the fall harvest season, liquidity is tight, and they are unable to meet their production and livelihood needs. Indebted growers may be forced to sell a certain amount or the entire crops immediately after the current season's harvest to obtain cash to repay the loan and to make up for the lack of funds that cannot be stored to sell at a higher price in the off-season. Thus, hypothesis five is proposed.

Hypotheses 5 (H5). *The greater the probability that growers will store grapes if they do not borrow, the greater the storage capacity.*

3.2. Empirical Models

The storage behavior of growers is an organic combination of a two-stage decision process. In the first stage, we use the Probit model to analyze the probability of storing grapes; in the second stage, we use the Tobit model to analyze the number of grapes stored by the growers. The sample data for this study are subject to selection bias, with 648 of the 1026 sample growers choosing to store grapes this year. We can only observe the actual storage that takes place and not those that may have wanted to store but do not. If we are to regress all data using OLS directly, this will lead to biased estimates. Therefore, we use Tobit regression, a standard censored model used for regression analysis when the dependent variable is missing due to some restriction in the observed values.

In the first stage, a selection equation is developed, and Probit is estimated for all grape growers to analyze the factors influencing whether growers store grapes or not. The regression equation is expressed as follows:

$$Y_t = \alpha_1 + \alpha_2 P_t + \alpha_3 R_t + \alpha_4 Q_t + \alpha_5 L_t + \alpha_6 M_t + \mu_t \tag{1}$$

The Explained Variable Y_t indicates whether the growers store grapes or not. "0" indicates that all grapes are sold during the harvest, and "1" means that the growers store some or all of the grapes after the harvest. The Explanatory variable P_t stands for the price of grapes sold in the current season, R_t stands for market risk perception, Q_t stands for grape quality, L_t stands for borrowing behavior, $\alpha_{(\alpha=1-6)}$ stand for unknown parameters, M_t stands for combinations of control variables, and μ_t stands for stochastic error.

In the second stage, the central regression equation is developed to analyze the grape storage capacity stored by growers who have storage this year. The regression equation is expressed as follows:

$$Y'_t = \lambda_1 + \lambda_2 P_t + \lambda_3 P'_t + \lambda_4 R_t + \lambda_5 Q_t + \lambda_6 L_t + \lambda_7 M_t + \mu_t \tag{2}$$

The Explained Variable Y_t is the storage capacity by growers to harvest the season. The Explanatory Variable P_t stands for the expected sales price after storage, and $\lambda_{(\lambda=1-7)}$ stands for unknown parameters. The rest of the letters have the same meaning as in Equation (1).

4. Empirical Results

4.1. Grower Storage Decision Behavior

Prior to regression, we tested for multicollinearity among the variables. The most effective method to determine the problem of multicollinearity is the variance inflation factor (VIF), which is judged by identifying the magnitude of the inflated factor of each variable of the model. From Table 2, we can see that the VIF of all variables is <10, and the maximum VIF value is 2.63. Therefore, it can indicate that the multicollinearity among variables in this manuscript is weak and can be subjected to empirical regression analysis.

Table 2. Multicollinearity test.

Variable	VIF	1/VIF
Storage cost	2.63	0.38
Year-end price	2.38	0.41
Expected price	2.02	0.49
Planting area	1.54	0.65
Age	1.40	0.71
In-season price	1.37	0.73
Planting years	1.33	0.75
Yield	1.31	0.76
Weight	1.18	0.84
Health	1.13	0.88
Gender	1.09	0.91
Shape	1.09	0.91
Sweetness	1.09	0.91
Number of laborers	1.06	0.94
Education	1.06	0.94
Market risk perception	1.05	0.95
Borrowing behavior	1.05	0.95
Marriage	1.04	0.95
Mean VIF	1.38	

The detailed estimation results are shown in Table 3. After adding control variables, in-season price, expected price, market risk perception, and grape quality significantly affected growers' storage decision behavior, consistent with H1, H2, H3, and H4.

Table 3. Benchmark regression results for growers' storage decision behavior.

	Probit	Probit	Probit	Tobit	Tobit	Tobit
Variable Name	**Storage or Not**	**Storage or Not**	**Storage or Not**	**Storage Capacity**	**Storage Capacity**	**Storage Capacity**
ln (In-season price)	−1.4541 *** (0.111)	−1.5192 *** (0.115)	−1.6796 *** (0.139)	−1.3531 *** (0.214)	−1.3477 *** (0.213)	−0.4862 *** (0.055)
ln (Expected price)	-	-	-	10.2487 *** (0.251)	10.2999 *** (0.252)	0.5442 *** (0.103)
Market risk perception	0.6308 *** (0.147)	0.6295 *** (0.148)	0.5162 *** (0.165)	1.2441 *** (0.377)	1.2468 *** (0.373)	0.3779 *** (0.112)
Sweetness	0.0184 (0.026)	0.0221 (0.027)	0.0172 (0.029)	0.0407 (0.056)	0.0573 (0.055)	0.0211 (0.015)
Shape	−0.1024 (0.096)	−0.0887 (0.098)	−0.1311 (0.108)	−0.0570 (0.204)	−0.1091 (0.204)	0.0006 (0.055)
Weight	−0.5874 *** (0.089)	−0.5819 *** (0.090)	−0.6604 *** (0.101)	−0.8280 *** (0.195)	−0.7550 *** (0.193)	−0.2322 *** (0.052)

Table 3. *Cont.*

	Probit	Probit	Probit	Tobit	Tobit	Tobit
Variable Name	**Storage or Not**	**Storage or Not**	**Storage or Not**	**Storage Capacity**	**Storage Capacity**	**Storage Capacity**
Borrowing behavior	0.1730 * (0.098)	0.1617 (0.100)	0.1154 (0.111)	0.1983 (0.206)	0.1706 (0.203)	0.0019 (0.054)
Gender	-	0.2080 ** (0.105)	−0.1112 (0.119)	-	0.5090 ** (0.218)	−0.0252 (0.060)
Age	-	−0.0071 (0.005)	−0.0061 (0.007)	-	0.0408 *** (0.012)	0.0166 *** (0.004)
Marriage	-	0.6554 *** (0.248)	0.3112 (0.275)	-	1.1974 ** (0.578)	−0.1966 (0.160)
Education	-	-	0.1280 (0.090)	-	-	−0.0198 (0.048)
Health	-	0.0046 (0.043)	−0.1144 ** (0.049)	-	0.1656 * (0.090)	0.0713 *** (0.024)
Number of laborers	-	−0.0722 (0.044)	−0.0342 (0.048)	-	−0.2413 ** (0.097)	−0.0583 ** (0.027)
ln (Yield)	-	-	0.6796 *** (0.079)	-	-	0.7231 *** (0.042)
Planting years	-	-	0.0264 *** (0.007)	-	-	0.0007 (0.004)
Planting area	-	-	0.0232 ** (0.009)	-	-	−0.0140 *** (0.005)
ln (Storage cost)	-	-	-	-	-	1.0686 *** (0.016)
Constant	1.6410 *** (0.517)	1.3833 ** (0.684)	−5.2548 *** (1.071)	−0.5059 (1.133)	−4.2928 *** (1.506)	−8.9279 *** (0.592)
Observations	1026	1026	1026	1026	1026	1026

Note: Standard error values are in parentheses. ***, ** and * represent 1%, 5%, and 10% significance levels (the same below).

Farmers who produced food crops stored them during the harvest season probably for later consumption as food at home [38], like maize, rice, wheat, and soybeans; therefore, they did not spend money on food for household consumption. This saved money that would have been spent on food purchases could then be used for other household financial uses [39]; but as a cash crops, grapes were usually stored only to earn a higher profit. From the estimation results, the in-season price was negatively significant at the 1% level in the two models, and the expected price was positively significant at the 1% level in the Tobit model. Grape prices show a recurring pattern of seasonal price fluctuations. These markets are characterized by large price fluctuations during the year. On average, grape prices are the lowest at harvest, rise throughout the year, and peak in the off-season before the next harvest. When the in-season price was high, growers faced uncertainty in storing their grapes and storage had certain costs. If the in-season price was high, the uncertainty of the future was relatively high. This uncertainty was greater than the discount rate of the expected price increase and affected their income, so they did not store grapes. As a produce with solid seasonality, grapes were affected by market supply and demand. When the grower expected the market supply to fall in the future, its price would rise, and the marginal benefit of storing at this time was greater than the marginal cost, so the grower chose to store grapes. As with food crops, in anticipation of a seasonal upward trend in price levels, storage and postponement of sales would become their rational choice, whether multiple sales or all at once. This finding supported Haile [11], Peng and Xu [12], and Vollmer et al. [13], which meant that growers may have sold their crops more promptly when prices were high and chose to store when prices were low.

In both models, market risk perception was positively significant at the 1% level. In other words, the higher the level of risk perception of the grower, the greater the probability of storing grapes and the greater the storage capacity. The price risk depended heavily on the size of the harvest that under normal conditions would be somewhat predictable [40]. When growers were fully aware of trends in market price risk, a comparison of price trends and storage costs over the next few months may allow them to consider whether they should store grapes and batch sales. When growers were unable to have a clear perception of market price risk, they were reluctant to risk storing grapes at an additional cost that could potentially harm them. Therefore, this was consistent with the result of Priya and Mitra's study [41]. When growers were fully aware of the market price risk and had a positive attitude towards storage, they would demonstrate a mental readiness to store the harvest and sell in non-harvest months.

Grape quality was positively significant at the 1% level in the two models. Grape quality was measured by sweetness, weight, and shape. The regression results showed that sweetness and shape had no significant effect, and the coefficient estimates for the weight variable were negative in both regression models. It was statistically significant at the 1% level. This meant that the better the quality of the grapes, the more willing growers were to store them, while the lower quality grapes tended to be sold in season. Grape quality was not only related to the growing technique but was also influenced by the quality of the seeds. If the grower's seeds were of poor quality, the final quality would not meet storage standards, so the grower had to sell immediately after harvest during the season when prices were lower. In addition, the price discount for damaged crops was higher in the early post-harvest period than in the lean season, so to ensure that no losses are incurred, growers would only choose to store crops when they were of good quality. This agreed with the findings of some scholars [17,18]. As the concept of standardized grapes becomes more common in Beizhen, growers understood how their quality decreased when grapes were too heavy. Moreover, the worse the quality of the grapes, the softer and more perishable the grape was, i.e., the less likely it was to be stored. Therefore, the worse the quality of the grapes, the lower the probability and capacity of growers storing grapes.

There was no significant effect of borrowing behavior on storage decision behavior, which is different from the results of some studies [19–22]. Growers with debt sold their grapes much earlier than debt-free growers. Growers tended to continue selling their grapes during the main harvest, even if prices were relatively low at that time. This is due to the urgency of needs, such as paying for production inputs borrowed during the production season, meeting daily needs, and funding for the next growing season. Possible reasons for this were the small number of borrowers and the absence of re-payment pressure in Beizhen. Reasons such as information asymmetry or lack of adequate collateral in the rural credit market led to the fact that the number of borrowings did not appear to rise in line with income growth [42]. Growers lived in a society of acquaintances based on geo-, karma-, and interest-based relationships. More than 90% of informal borrowing had no interest requirements due to mutual aid and risk-sharing effects. Moreover, most loans had no pressure on repayment terms [43]. Therefore, growers need not rush to sell their grapes for a cash repayment.

Regarding control variables, yield was positively significant at the 1% level in the two models. Most growers did not "put all their eggs in one basket". Growers with a relatively larger land holding could afford new storage technologies compared to those with a small farm area [44]. Growers with large grape yields also tended to sell their grapes in stages with the expectation of higher profits. The number of laborers had negatively significant effects in the Tobit model. Growers with less labor chose to store fewer grapes, probably because they had less labor and time. It took time and labor to store and resold large amounts of grapes, so they preferred to store small amounts of grapes. In the Tobit model, age was positively significant at the 1% level. This indicated that older growers were more experienced in growing grapes and chose to store more grapes in combination with the current year's grape market supply and demand.

4.2. Robustness Test

In this paper, we used a core database to test the robustness of whether to store grapes and the capacity of grapes stored. Based on the baseline database, we selected two towns with the most significant number of respondents (Changxing Town and Baojia Town) to build the core database and used the same model to test and analyze the factors influencing growers' storage decisions. The regression results in Table 4 showed that the in-season price, expected price, market risk perception, and grape quality significantly influenced the storage decision behavior of growers, which was consistent with the benchmark model. Therefore, the previous conclusions were robust and reliable.

Table 4. Regression results of storage decision behavior of growers in Changxing Town and Baojia Town.

	Probit	Tobit
Variable Name	**Storage or Not**	**Storage Capacity**
ln (In-season price)	−1.5017 *** (0.188)	−0.4313 *** (0.056)
ln (Expected price)	-	0.5299 *** (0.107)
Market risk perception	0.3716 (0.244)	0.3486 *** (0.119)
Sweetness	0.0084 (0.043)	0.0211 (0.016)
Shape	−0.2828 * (0.157)	−0.0131 (0.056)
Weight	−0.5750 *** (0.137)	−0.2112 *** (0.054)
Borrowing behavior	0.1254 (0.161)	0.0024 (0.056)
Gender	−0.2543 (0.176)	−0.0385 (0.062)
Age	−0.0139 (0.010)	0.0137 *** (0.004)
Marriage	0.2812 (0.372)	−0.1914 (0.164)
Education	0.1609 (0.131)	−0.0488 (0.050)
Health	−0.0972 (0.070)	0.0627 ** (0.025)
Number of laborers	−0.0246 (0.068)	−0.0848 *** (0.028)
ln (Yield)	0.7746 *** (0.113)	0.7388 *** (0.044)
Planting years	0.0334 *** (0.011)	0.0008 (0.004)
Planting area	0.0261 * (0.015)	−0.0157 *** (0.005)
ln (Storage cost)	-	1.0241 ***(0.017)
Constant	−5.5635 *** (1.553)	−8.3290 *** (0.620)
Observations	675	675

Standard error values are in parentheses.

4.3. Heterogeneity Analysis

In this paper, the total sample was divided into large-scale growers and small-scale growers for regression to deeply analyze the possible land scale variability of the estimated results of the benchmark model. Currently, there was no unified definition of land scale in the academic community, and the actual scale of operation in the central area of Beizhen is divided into 20 Mu according to the division of the Beizhen Grape Association. According to this standard, the division between large-scale and small-scale growers were relatively apparent, with 884 small-scale growers smaller than 20 Mu and 142 large-scale growers larger than 20 Mu.

As shown in Table 5, in-season price, expected price, market risk perception, and grape quality significantly influenced the storage decisions of small-scale growers. The results clearly showed that, unlike small-scale growers, the storage decisions of large-scale households were influenced by borrowing behavior. This implied that because of the large area of grapes grown by large-scale growers, the income from grape sales accounted for a higher capacity of their household income, and grape income became the most important source of household income. Interestingly, we found that borrowing behavior positively influences the storage decisions of large-scale households in the current year, which supported the views of Channa et al. [45] and Cardell and Michelson [46]. The increasing amount of capital was invested in production as the area of operation expanded. Large-scale growers had a more substantial need to lend and a significant capital gap. Therefore, storage was desired to get a higher profit for off-season sales.

Table 5. Regression results of storage decision behavior of growers of different scales.

	Small-Scale Growers		Large-Scale Growers	
	Probit	Tobit	Probit	Tobit
Variable Name	Storage or Not	Storage Capacity	Storage or Not	Storage Capacity
ln (In-season price)	−1.7975 *** (0.152)	−0.5344 *** (0.063)	−1.0958 *** (0.395)	−0.3324 *** (0.110)
ln (Expected price)	-	0.5249 *** (0.112)	-	0.5801 ** (0.262)
Market risk perception	0.5071 *** (0.176)	0.3606 *** (0.127)	0.9585 * (0.577)	0.4478 * (0.244)
Sweetness	0.0087 (0.031)	0.0307 * (0.016)	0.0847 (0.106)	−0.0346 (0.039)
Shape	−0.1717 (0.116)	−0.0215 (0.060)	0.0923 (0.380)	0.0114 (0.135)
Weight	−0.6416 *** (0.109)	−0.2266 *** (0.059)	−0.8865 *** (0.344)	−0.1952 * (0.116)
Borrowing behavior	0.0284 (0.119)	−0.0060 (0.061)	1.2279 *** (0.455)	−0.0305 (0.127)
Control variables	Controlled	Controlled	Controlled	Controlled
Constant	−4.9813 *** (1.167)	−9.2061 *** (0.649)	−4.5973 (3.334)	−9.1972 *** (1.576)
Observations	884	884	142	142

Standard error values are in parentheses.

4.4. Further Discussion

The above results indicated that growers differed in terms of storage or not and storage capacity. For these high-value cash crops, growers usually consider long-term or short-term storage. July to September is the peak harvest season, i.e., the first stage of selling grapes. October to December is the second stage of selling grapes, i.e., short-term storage before selling. Moreover, after January, growers store grapes until after Chinese New Year or spring to obtain high profits from off-season sales, i.e., long-term storage before selling. To analyze the key factors influencing growers' long- or short-term decisions, we select two groups of growers with only short-term and only long-term storage, analyzing them through a Probit model. The regression results of long- and short-term storage decisions of growers, robustness tests, and long- or short-term storage decisions of growers of different scales are shown in Table 6.

$$Y_t'' = \beta_1 + \beta_2 P_t'' + \beta_3 P_t' + \beta_4 R_t + \beta_5 Q_t + \beta_6 L_t + \beta_7 M_t + \mu_t \tag{3}$$

Table 6. Regression results related to long- and short-term decisions of growers.

Variable Name	Regression Results	Robustness Tests	Small-Scale Growers	Large-Scale Growers
ln (Year-end price)	0.2671 (0.277)	0.1366 (0.300)	0.1936 (0.298)	3.0041 (2.556)
ln (Expected price)	0.7970 ** (0.344)	0.9615 ** (0.377)	0.7034 * (0.369)	1.1296 (1.997)
Market Risk Perception	0.7619 ** (0.359)	0.7080 * (0.389)	0.9274 ** (0.410)	2.4285 (2.086)
Sweetness	−0.0983 ** (0.048)	−0.1006 **(0.051)	−0.0800 (0.050)	−1.3029 * (0.764)
Shape	0.0005 (0.181)	−0.0450 (0.196)	−0.0451 (0.194)	2.1101 (1.510)
Weight	−0.5292 *** (0.174)	−0.4559 ** (0.184)	−0.4597 ** (0.186)	−3.4517 * (1.987)
Borrowing behavior	0.2184 (0.183)	0.1577 (0.196)	0.2068 (0.198)	1.8499 (1.151)
Control variables	Controlled	Controlled	Controlled	Controlled
Cons	2.3380 (2.222)	2.8287 (2.415)	2.7202 (2.464)	10.0680 (12.150)
Observations	210	210	206	33

Standard error values are in parentheses.

The Explained Variable is the growers' choice of long-term or short-term storage, with "0" representing the choice of short-term storage and "1" representing the choice of long-term storage. The Explanatory Variable P_t'' stands for year-end price of grapes, and $\beta_{(\beta=1-7)}$ stands for unknown parameters. The rest of the letters have the same meaning as in Equation (1).

According to the model regression results, expected price, perceived market risk, and grape quality significantly influenced growers' long-term and short-term decisions. Due to expected grape prices having increased, growers tended to store for the long term. This meant that growers perceived that the price would increase as the grape marketing season ended in the off-season. By weighing the cost of storage, when the cost of storage was less than the expected revenue, growers would increase the storage time of their grapes to get higher revenue from grapes. Market risk perception had a positive effect at the 5% level of significance. Most growers with storage showed sensitivity to market price responses and did not ignore signals of rising supply and demand in the off-season grape market. Therefore, growers with a substantial risk perception preferred long-term storage relative to growers with no risk perception. Sweetness and weight were negatively affected at the 5% or 1% significance level. To put it another way, growers were concerned about long-term storage causing spoilage and total loss, so they preferred short-term storage. The regression results of the robustness test showed that expected price, market risk perception, and grape quality significantly influenced growers' long-term and short-term storage decisions. This was consistent with the regression results, indicating that the above findings are robust and reliable.

Comparing the long-term and short-term storage decisions of growers of different scales, the long- or short-term storage decisions of large-scale growers were only affected by grape quality. At the same time, small-scale growers were also affected by expected price and market risk perception. When the quality of grapes was good, both choose short-term storage. When small-scale growers had higher expected price and perceived market risks, they would choose long-term storage to make more profit.

5. Conclusions

Based on field research data from 1026 growers in Liaoning Province, this paper empirically analyzed the factors influencing growers' storage decisions and long- or short-term decisions using the Probit and Tobit model.

This paper has three conclusions. First, it is found that in-season price and expected price have significant negative and positive effects on growers' storage decisions, respectively, while market risk perception and grape quality significantly and positively influenced growers' storage decisions. Second, for different scales of growers, in-season price, expected price, market risk perception, and grape quality influenced the storage decision behavior of both large-scale and small-scale growers. The difference is that the storage behavior of large-scale growers is also positively influenced by borrowing behavior. Third, for growers with storage in the current year, the higher the expected price and the greater the risk perception, the more growers tend to opt for long-term storage of grapes, and the better the quality of the grapes, the more growers tend to prefer short-term storage. Thus, in addition to price, market risk perception, grape quality, and borrowing behavior were crucial factors influencing growers' decision to store or not, the storage capacity, and long- or short-term storage, as we expected.

Based on the above main conclusions, this paper proposes the following policy recommendations: First, the government should control all aspects of pre-production, production, and post-production strictly, guide growers to choose high-quality seeds, and optimize fertilization and medication patterns so that the concept of quality is benefit becomes a navigator for growers' production. Second, based on growers' uncertainty about market price risks, the government should increase investment in easy-to-use information and communication systems to provide farmers with accurate and effective information about market supply and demand and price fluctuations—avoid growers' concerns about market risks and enhance their access to market information. Third, the government should strengthen its support for the rural financial market, enhance growers' satisfaction with financial institutions, and improve the construction of rural financial services infrastructure—regulate informal private borrowing to alleviate the impact of liquidity constraints effectively and efficiently on growers' production and operation.

This paper also has some limitations. First, the limitation of the research area: although the research site, Liaoning Province, is to some extent representative of provinces with similar planting and storage characteristics, the generalizability of its findings needs further study. Second, the limitation of the data themselves: the data analysis in this paper used cross-sectional data, which studied the storage decisions of growers this year and did not take into account the bias caused by temporal dynamics. Future research will use two-period panel data tracking growers to examine the differences in storage decisions across periods comparing the same growers. Third, the limitations of the study variables. This paper focuses on the direct effects of some factors on growers' storage decisions, and the influence mechanisms of these variables still need to be further explored. Future research will consider introducing growers' individual risk preferences as an interaction term for the study.

Author Contributions: Conceptualization, X.S. and X.Y.; methodology, X.S. and X.Y.; software, X.S., X.Y. and R.Z.; validation, X.Y.; investigation, X.S. and X.Y.; resources, X.Y.; data curation, X.S. and X.Y.; writing—original draft preparation, X.S.; writing—review and editing, X.S., X.Y. and R.Z.; funding acquisition, X.Y. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Green Cycle High Quality and High Efficiency Special Project in Beizhen, Liaoning Province, China (grant number: 202021ZK4106), and the Innovation Team of Liaoning Higher Education Institution (grant number: Z20210116).

Institutional Review Board Statement: Not applicable.

Data Availability Statement: The data that are presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy restrictions.

Conflicts of Interest: The authors declare no conflict of interest.

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