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Impact of Novel Coronavirus Pneumonia on Agricultural Products Prices: A Case Study of Chengdu

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Abstract: Ensuring the basic stability of supply and prices of agricultural products bears on people's wellbeing and contributes to social development and stability. However, the outbreak of COVID-19 and a series of rules and regulations confining socialization adopted to deal with the epidemic have led to the prominent contradiction between supply and demand in the agricultural market, and the sharp fluctuations in the prices of agricultural products. In this paper, the price data of agricultural products in the main urban area of Chengdu in the 10 weeks before and 20 weeks after the Spring Festival from 2018 to 2020 were used to empirically study the impact of COVID-19 on local agricultural product prices by generalized multiple difference method (DID). The empirical results show that, first, compared with the Spring Festival of 2018 and 2019, the COVID-19 epidemic in the Spring Festival of 2020 led to an average increase of 105.02% in the retail prices of agricultural products in Chengdu, among which the increase of livestock and poultry, fruits and vegetables, and aquatic products was the most obvious, while the change of grain and oil prices was not significant. Second, compared with the demand side, the COVID-19 pandemic has a major impact on agricultural prices from the supply side. Third, the impact of COVID-19 on the retail prices of agricultural products is more obvious in areas where the primary industry is relatively small and industrialization is fast. Fourth, in the short term, the government's policy of suppressing prices does not restrain all agricultural prices. The above research findings provide a reference for understanding the adjustment mechanism of agricultural prices under the impact of the epidemic, and for effectively formulating relevant policies to stabilize the price of agricultural products, ensure supply, and alleviate the pressure on people's livelihood.

Keywords: new crown pneumonia epidemic; agricultural product prices; DID model; supply and demand adjustment

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1. Introduction

Price can directly reflect the relationship between market supply and demand, and also act as an indispensable factor affecting residents' life and production. The prices of agricultural products serve as the basis of all commodity prices, being a crucial economic factor related to the national economy and people's livelihood, and the basis of the stable operation of the domestic economy. Ensuring the basic stability of supply and prices of agricultural products in the market bears on people's wellbeing and contributes to social development and stability. However, the prices of agricultural products are usually volatile and easily affected by market supply and demand, weather changes, international market, unexpected events, and other factors. In order to stabilize prices, the government usually promulgates agricultural subsidies, price intervention, agricultural products rationing, price control, and other related policies.

In January 2020, the novel coronavirus outbreak was reported in Wuhan, Hubei Province. Subsequently, administrative regions at all levels (provinces, autonomous regions, cities, counties, towns, and villages) across the country successively initiated the level I response to major public health emergencies, and took strict traffic control measures to

prevent the spread of COVID-19. Obviously, the campaign has yielded fruitful results. However, measures such as traffic control and home quarantine in response to COVID-19 have "unintentionally" interfered with economic activities, causing a short-term shock to normal economic order. The impact of COVID-19 on the prices of agricultural products presents mainly in the following two aspects: (1) Supply: the supply channels and supply chains of agricultural products needed for typical life have been affected to some extent. As the agricultural product industry and its allied industries are labor-intensive, the labor cost, the production cost of agricultural products, and the stability of supply and demand relationships are all negatively affected at diverse levels. (2) Demand: During the epidemic, residents have spent more time cooking at home. Thus, they have different demands for various kinds of agricultural products, such as grain, oil, fruits, and vegetables. The implementation of various measures has led to difficulties in the dispatch of agricultural products, exacerbated the contradiction between supply and demand, caused the sharp fluctuations in the price of agricultural products, and severely affected the quality of life of residents, the national economy, and people's livelihood.

By constructing a double difference (DID) model, this paper demonstrates the marginal impact of COVID-19 on the price of agricultural products, based on the price data of agricultural products in the 10 weeks before the Spring Festival and the 20 weeks after the Spring Festival from 2018 to 2022, in 22 agricultural markets in six main urban areas of Chengdu City, Sichuan Province, China, and explores the impact mechanism of the demand side and the supply side on the price of agricultural products. In order to study the impact on the price of agricultural products of the COVID-19 epidemic as a sudden public health event, which can conductively lead to a scientific judgment on the change in trend of agricultural prices, this study brings advantageous position to the policy measures for the government to adopt differential value of agricultural products, and finally provides the reference basis promoting the steady development of the agricultural products market. Furthermore, it supports some reference for the government to adjust the price of agricultural products in the case of public health emergencies in the future.

2. Literature Review

2.1. Research on the Influencing Factors of Agricultural Product Price

At present, most studies from around the world on the influencing factors of agricultural prices are carried out from the aspects of international crude oil prices, policy factors, and financial markets. Xiao [1] Xiaoyong used the GARCH model to find that crude oil price has a significant mean spillover effect on agricultural product price [1]. Lin [2] Cheng considered that the international crude oil prices can directly affect agricultural prices, while the monetary policy mainly has indirect effects on prices for agricultural products [2]. Tian [3] Haosen, based on the SVAR model, proved the impact effect of China's monetary policy on the price of agricultural products and calculated that social financing scale and interest rate will have a positive impact on the price index of agricultural products [3]. Herve [4] used a GMM estimation model to analyze, and concluded that loose monetary policy, continuously low stock utilization rate, and inflation would lead to large fluctuations in agricultural prices [4]. Tan [5] Ying used TVP-FAVAR to make an empirical study that showed that uncertainty of economic policy is a main factor of agricultural price shock, and its effects on different links of industrial chain and different periods are different, based on the analysis of the VECM-BeKK-GARCH model [5]. Pang [6] Zhenyan believed that the futures market has a continuous impact on the price fluctuations of the spot market, and the listing of agricultural futures contracts can reduce the volatility of the spot market [6]. Ronald [7] analyzed the trend of global agricultural prices from 2005 to 2006 and believed that the depreciation of the USD and the increase of foreign exchange reserves of major grain importing countries led to the climb of agricultural prices [7]. By summarizing previous theoretical studies and empirical results, Joachim [8] concluded that futures speculation of agricultural products in the financial market was one of the crucial sources affecting the price of agricultural products [8].

Compared with the literature review, the COVID-19 epidemic has three characteristics: sudden, exogenous, and transitive. This article takes this major public health emergency as the background to study its impact on the prices of agricultural products.

Based on this, this paper proposes the following hypothesis (Figure 1).

H1. *As a sudden exogenous event, COVID-19 increased the prices of agricultural products in Chengdu.*

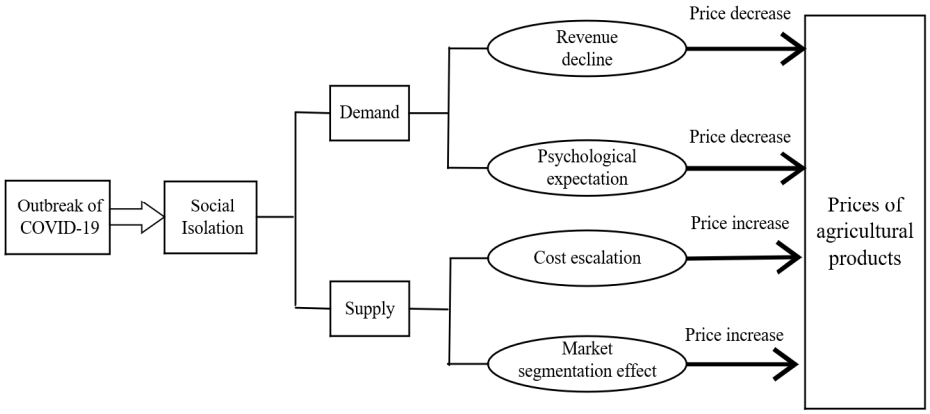

Figure 1. The theoretical mechanism analysis.

2.2. Research on the Economic and Social Impacts of the Epidemic

At present, domestic research on the impact of the epidemic on the economy and society can be divided into the following two categories: the first is to analyze the impact of the novel coronavirus pneumonia epidemic on the society and residents from the demand side. From the macroeconomic society point of view, based on the New Keynesian DSGE model, Yin [9] Yanhui analyzed both long- and short-term perspectives; he believes that although the impact of the new crown epidemic on the economy is not significant in the long run, the general economy will be briefly affected by the new crown epidemic, and that due to the epidemic, consumer demand has shrunk [9]. Zheng [10] Jianghuai, who conducted research on the consumer economy, strongly believed that the epidemic had an extensive impact on overall consumption and a more noticeable impact on the demand side [10]. Yang [11] Song analyzed the perspective of three vital industries and concluded that the epidemic brought damage to all three industries, while the tertiary industry sustained the most; from the perspective of individual residents, there appears to be an impact of the novel coronavirus pneumonia epidemic on people's demand and consuming psychology [11]. Fu [12] Zhihua believed that the novel coronavirus pneumonia epidemic not only directly restricted consumption, but also adversely affected consumption through three channels: income effect, wealth effect, and actual purchasing power effect [12]. Liu [13] Jia, based on the analysis of the research situation, said that most residents' annual income growth reduced due to the impact of the epidemic. Meanwhile, the wage income, operating income, and nonoperating income were affected to varying degrees, resulting in a decline in household consumption demand [13].

The second is to analyze the impact of COVID-19 on the society and residents from the supply side. Huang [14] Qunhui specifically analyzed the impact of COVID-19 on the supply side and believed that it would be extremely challenging to resume production and work at the enterprise level; meanwhile, the risk of supply chain disruption and industrial chain migration would increase at the industrial level [14]. Wu [15] Tingting believes that COVID-19 delivers immense impacts on industrial production; major transportation routes are closed and banned, and some transportation and logistics systems are at a standstill, causing an increase in transportation costs and storage costs of enterprises [15]. For individuals, Mo [16] Rong compared the SARS epidemic in 2003 and found that the

overlap of COVID-19 and Spring Festival holidays led to tough situations in reworking, and also caused prominent structural contradictions and rising unemployment rates [16]. Zhang [17] Mingming believes that strict epidemic controlling policies taken affect migrant workers who have returned to cities as the key targets of controlling measures; they are asked to stay at home, encountering practical difficulties such as reduced life security, increased living costs, and health protection risks [17].

Based on previous studies, the existing literature shows only the impact of the novel coronavirus pneumonia epidemic on society and residents from the perspectives of demand and supply, but lacks the impact of the two perspectives on the agricultural product market. This article will analyze from both the demand and supply perspectives, and find out which one is more dominant.

Based on this, this paper proposes the following hypothesis.

H2. *COVID-19 has an impact on the prices of agricultural products in Chengdu from both the demand side and the supply side, but the supply side plays a leading role.*

2.3. Study on the Mechanism of Epidemic Affecting Agricultural Product Price

Up until now, some domestic scholars have analyzed the effect of the epidemic agricultural prices mechanism mainly from the supply side. Liu [18] Tingting selected representative prices in different links of the live pig industry chain, such as piglet market price, live pig market price, feed market price, and other data for research [18]. Hu [19] You selected the price data of agricultural products from the wholesale market of the Ministry of Commerce to analyze the impact of the epidemic on the prices of pork, eggs, and cabbage [19]. Wang [20] Mengyu selected the 200 index of the national wholesale price of agricultural products and some data of the wholesale prices of agricultural products in Beijing and analyzed the affected degree of different agricultural products categories by using the ARIMA model [20].

Based on the present studies on the impact of emergencies on the price of agricultural products, it can be discovered that previous studies focused on the supply end of the market and selected data were all from the production end of agricultural products or the wholesale market of agricultural products. This paper selects the price data of agricultural products in the main urban area of Chengdu, reflecting the price at the demand end of the agricultural products market.

In addition, domestic scholars mostly use parameter vector autoregression model, quantile regression model, shock wave effect model, etc., to investigate the fluctuation of agricultural prices (Zheng [21] Yan; Marshal [22] Niu; Miao [23] shanshan). None of these models effectively isolates the impact of the COVID-19 outbreak on agricultural commodity prices for separate analysis [21–23], but the DID model in this paper can effectively eliminate the influence of factors on the agricultural prices during the Spring Festival, and accurately analyze how the exogenous emergency of the novel coronavirus pneumonia epidemic has caused fluctuations in agricultural prices.

2.4. Research Review

To sum up, this paper studies the impact of COVID-19 on the price fluctuations of agricultural products and evaluates the effect of price regulation policies during the epidemic, which is of considerable practical significance for stabilizing the price of agricultural products in China during the period of normalized epidemic prevention and control. There are four innovations in this paper. First, based on the current background, this paper analyzes the impact of COVID-19, a public health emergency, on agricultural prices. Second, it explores the novel influencing mechanism of agricultural product price from the perspective of demand and supply. Thirdly, the price control measures introduced by the government should be additionally included in the study as an emergency. Fourth, based on the DID model, the existing influence of Spring Festival holiday factors on the wholesale

prices of agricultural products was eliminated, and the marginal impact of COVID-19 on wholesale prices of agricultural products was clarified.

3. Model and Data

3.1. Model Building

This paper utilizes the DID method. The essence of the DID method is the fixed effect estimation of panel data, because it can largely avoid the perplexity of endogenous problems, and has gradually become a sharp weapon in the policy effect evaluation method. However, in data analysis, the estimation of the DID method is limited to a certain extent. In general, DID is only applicable to panel data.

As COVID-19 occurred in 2020, the 10 weeks before and 20 weeks after the Spring Festival of 2020 were taken as the treatment group, and the corresponding time windows of 2018 and 2019 were taken as the control group. The data were further divided into four subsamples, namely, the treatment group before the Spring Festival, the treatment group after the Spring Festival, the control group before the Spring Festival, and the control group after the Spring Festival. In this paper, two dummy variables, TREAT and POST, were set to distinguish the previous four groups of subsamples, where TREAT = 1 represents the year of epidemic occurrence, TREAT = 0 represents the year without epidemic occurrence, POST = 1 represents after the Spring Festival, and POST = 0 represents before the Spring Festival. According to the above sample definition, the benchmark regression model of the DID method can be set as follows:

$$\ln \text{price}_{ijt} = \beta_0 + \beta_1 \text{treat}_j + \beta_2 \text{post}_t + \beta_3 \text{treat}_j * \text{post}_t + \beta_4 \text{policy} + \gamma X_{jt} + \mu_i + \theta_j + \lambda_t + \varepsilon \quad (1)$$

where the subscript i represents the category of agricultural products, j represents the year, t represents the number of weeks away from the Spring Festival, the explained variable ln price represents the logarithm of the market price of the category i agricultural products during the Spring Festival t weeks away from the year j, X_{jt} represents a series of control variables, θ_j represents the dummy variable of the year, λ_t represents the dummy variable of the week, μ_i represents the fixed effect of agricultural products, and ε is the random disturbance term.

The meanings of parameters in the DID model are revealed in Table 1. According to the regression Equation (1), it can be uncovered that for the years when the epidemic has already occurred (TREAT = 1), the prices before and after the Spring Festival are, respectively, $\beta_0 + \beta_1 + \beta_4$ and $\beta_0 + \beta_1 + \beta_2 + \beta_3 + \beta_4$. In 2020, the range of price change of agricultural products before and after the Spring Festival is $\Delta Y_i = \beta_2 + \beta_3$. This includes the impact of the epidemic and the fluctuating prices of agricultural products during the Spring Festival itself. Similarly, for years without epidemic, the fluctuation of agricultural prices before and after Spring Festival is $\Delta Y_0 = \beta_2$. This difference does not include the impact of the epidemic on agricultural prices. In treatment groups before and after the Spring Festival, the agricultural product price difference ΔY_i between the control group before and after the Spring Festival is compared with the agricultural product price difference ΔY_0, which induces the net effect of the outbreak of agricultural prices as $\Delta\Delta Y = \beta_3$, which will remain the focus of the DID method. If outbreaks make agricultural prices rise, β_3 coefficient should be significantly positive.

Table 1. The meaning of each parameter in the DID model.

	Before the Spring Festival (POST = 0)	After the Spring Festival (POST = 1)	Difference
Years in which the epidemic has occurred (treatment group, TREAT = 1)	$\beta_0 + \beta_1 + \beta_4$	$\beta_0 + \beta_1 + \beta_2 + \beta_3 + \beta_4$	$\Delta Y_i = \beta_2 + \beta_3$
Years in which the epidemic has not occurred (control group, TREAT = 0)	$\beta_0 + \beta_4$	$\beta_0 + \beta_2 + \beta_4$	$\Delta Y_0 = \beta_2$
DID			$\Delta\Delta Y = \beta_3$

3.2. Data Sources

The data employed in this paper are from the prices of some markets in the main urban area of Chengdu in the market price monitoring of Chengdu Development and Reform Commission, covering 22 markets in six core urban areas of Chengdu (Jinjiang District, High-tech Zone, Wuhou District, Qingyang District, Jinniu District, and Chenghua District), with a total of 40 kinds of agricultural products. In this paper, Stata software was used to analyze the price trend of agricultural products, and heterogeneity test was conducted for varied types of agricultural products and severity of the epidemic, so as to obtain the disparate impacts of the epidemic on agricultural product prices (Table 2).

Table 2. Administrative area and farmers market.

Administrative Area	Farmers Market
Chenghua District	Balizhuang Agricultural Products Market; Jianshe Road Comprehensive Market; Yimin Market Guangmingchang Store
High-tech Zone	Heping Farmers Market; Shuangyuan Farmers Market; Xiaojiahe Farmers Market
Jinniu District	Chengdu Ziyun Transition Market; Fuqin Comprehensive Market; Huangzhong Jixian Market; Yiminsheng Fresh Vegetable Market (Xinqiao Store)
Jinjiang District	Guangming Road Vegetable Market; Hongxing Farmers Market; Jingtian Road Vegetable Market; Jingtian Road Convenience Service Point
Wuhou District	University Road Indoor Farmers Market; Gaopan Road Farmers Market; Longwan New Market; Yimin Vegetable Market Ximianqiao Store; Yulin Farmers Market
Qingyang District	Supo Comprehensive Market; Yimin Market South Street Store; Changshun Street Farmers Market

In dealing with price control measures, this paper found that the Chengdu government imposed administrative fines on the behavior of price inflation in the whole city. The government's price control measures during the epidemic were homogeneous in the whole city, so the dummy variable quantitative control measures were adopted. According to Baidu search, since February 3 in 2020 (one week before the Spring Festival), Chengdu government and relevant departments have issued various announcements and decrees to punish price gouging, so the dummy variable of regulation policy in this study is set to 0 (before the policy) and 1 (after the policy). To measure the impact of the epidemic on the price of agricultural products, the logarithm of the actual price of agricultural products (ln price) was taken as the explained variable in accordance with the common practice in the literature. In addition, other economic factors that may affect the price of agricultural products are selected as control variables. The descriptive statistical results of each variable are shown in Table 3.

Table 3. The main variables of the model and their calculation methods.

Variable Name	Variable Meaning	Observations	Mean	Standard Deviation	Minimum Value	Maximum Value
Market price log	Logarithmic market price of agricultural products	61,342	1.65	0.88	−0.51	4.28
Lunar new year	The year of the Lunar New Year in which the date falls	61,342	2018.30	8.77	2017	2019
Weeks away from the Spring Festival	The number of weeks that differ from the week of the Spring Festival	61,342	4.25	8.32	−10	20
Year	year of date	61,342	2018.83	0.89	2017	2020
Month	month of date	61,342	4.78	3.66	1	12
Implemented policies	Announcement on the government's implementation of penalties for price gouging	29,962	0.75	0.43	0	1
ChiNext Index	GEM index of the week of the date (unit: point)	61,342	6678.37	898.04	4723.74	7890.76

4. Empirical Analysis of the Impact of COVID-19 on Agricultural Prices and Policy Effects

4.1. Descriptive Statistics

Figure 2 shows the price trend of agricultural products in Chengdu market before and after the Spring Festival from 2018 to 2020. As can be perceived from the figure, the price of agricultural products in Chengdu generally rises by about CNY 1 during the Spring Festival, and the closer it is to the Spring Festival, the higher the price rises. However, the price of the Spring Festival in 2020 significantly increased compared with the other four years, and this increase does not change due to changes in the benchmark group, while the prices of agricultural products in 2018, 2019, and 2022 do not show the abovementioned price difference, and the market price difference is close to 0, with little change. The overall high price of agricultural products during the Spring Festival in 2021 is due to the outbreak of a small-scale epidemic in Pidu District, Chengdu, in early 2021. This shows that COVID-19 has delivered a significant impact on agricultural prices, which indicates that hypothesis 1 is correct.

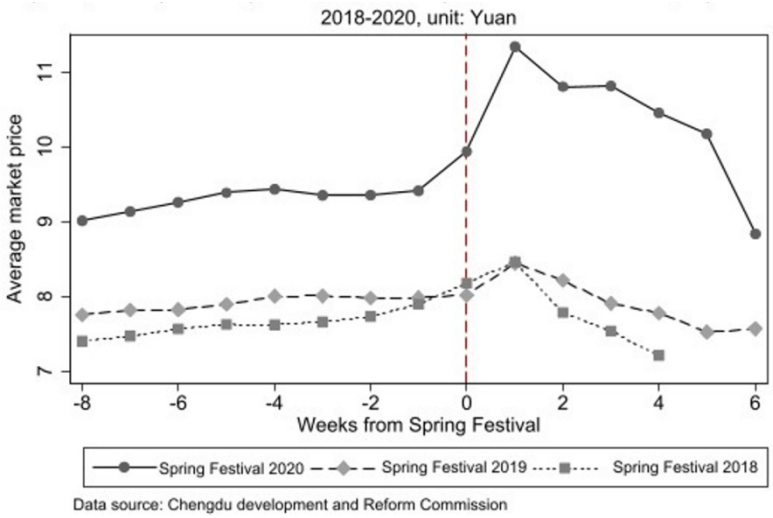

Figure 2. Price change trend of agricultural products in Chengdu farmers' market around the Spring Festival from 2018 to 2020.

To possess a more intuitive feeling of the price changes of various agricultural products, this paper produces a comparative analysis of the prices of diverse kinds of agricultural products. It can be noted from Table 4 that aquatic products and fruit and vegetable agricultural products obtain the most enormous and significant increase, while grain and oil agricultural products receive no significant increase.

Table 4. Comparative analysis of the prices of different types of agricultural products before and after the lockdown of the city.

Variable Name	Before the Lockdown (Reference Group)		After the Lockdown (Experimental Group)		Mean Gap
	Sample Size	Sample Mean	Sample Size	Sample Mean	
Livestock and poultry prices	3033	2.85	6129	2.82	−0.03
Aquatic product prices	1024	2.31	2066	2.33	0.02 ***
Fruit and vegetable prices	11,794	1.31	23,392	1.38	0.07 ***
Grain and oil prices	4626	1.45	9278	1.46	0.01

*** represent the significance levels of 1%.

4.2. The Result of DID

Table 5 reports the results of the COVID-19 differential estimates for agricultural prices. The results show that the interaction coefficient between treat and post was positive,

indicating that the price of agricultural products in the years affected by the epidemic was about $e^{0.081}$, namely, 1.0844, and specifically reflected the impact of COVID-19 on the price of agricultural products. At the same time, combined with the above theoretical analysis, the positive interaction coefficient indicates that the supply end of the agricultural market has a greater impact on the price of agricultural products than the demand end, so hypothesis 2 is correct.

Table 5. An empirical analysis of the pandemic on agricultural prices: DID model.

	Market Price Log (1)	Market Price Log (2)	Market Price Log (3)	Market Price Log (4)	Market Price Log (5)
treat_post	0.049 ***	0.047 ***	0.048 ***	0.130 ***	0.099 ***
	(0.003)	(0.004)	(0.006)	(0.006)	(0.007)
Year_dum	Yes	Yes	Yes	Yes	Yes
Month_dum	Yes	Yes	Yes	Yes	Yes
farm_produce_FE	YES	YES	YES	YES	YES
N	61,306	61,306	61,306	12,932	12,932
r2_a	0.96	0.96	0.96	0.97	0.97

*** represent the significance levels of 1%. Note: the values in brackets in the table are t values.

The robustness of the DID was also tested. Column (2) in Table 5 is included after the control variable, the results of column (3) represent clustering of product categories to market level, column (4) adjusts the time window to 4 weeks before and after the Spring Festival, column (5) adds the dummy variable of weeks, and all inspection results are the interactive coefficient, which is positive and significant. It explains that the disease significantly raised the prices of agricultural products.

Bertrand pointed out that one of the preconditions for the validity of the DUAL difference estimation is that the treatment group and the control group met the same trend assumption before receiving the treatment. Therefore, to verify the appropriateness of the DID model in this paper, a parallel trend test was conducted on the prices of agricultural products in the treatment group and the control group.

As shown in Figure 3, before the Spring Festival, the prices of agricultural products of the treatment group and the control group maintained roughly the same growth trend, while after the Spring Festival, the changing trends of the prices of agricultural products of the treatment group and the control group demonstrated significant differences. Therefore, the DID model was used in this paper to test the impact of the outbreak on the price of agricultural products, which is a prerequisite for the assumption of the similar trend.

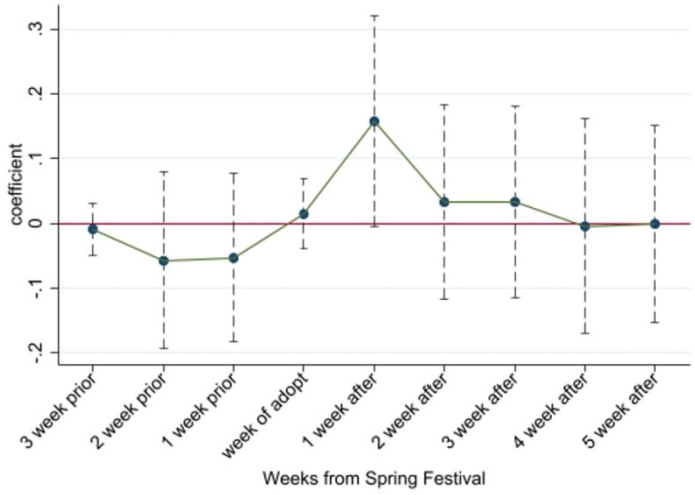

Figure 3. Parallel trends in agricultural prices. The red line is a long dotted line, and the green line is a connecting line of additional points.

Table 6 shows the results of testing the interaction term coefficients of agricultural product prices from 3 weeks before the Spring Festival to 5 weeks after the Spring Festival. Column (1) shows the estimation result without adding control variables, column (2) shows the estimation result with adding control variables, column (3) and column (4) show the estimation results of clustering agricultural products to market level and agricultural product type level, respectively. According to Table 6, regardless of which changes happened in the conditions, the prices of agricultural products displayed a significant increase in the first week after the outbreak of the epidemic.

Table 6. An empirical analysis of the pandemic on agricultural prices: DID model (three weeks before the Spring Festival and five weeks after it).

	Market Price Log	Market Price Log	Market Price Log	Market Price Log
	(1)	(2)	(3)	(4)
treat_post_3	0.067 **	−0.009	−0.009	−0.009
	(0.03)	(0.034)	(0.007)	(0.013)
treat_post_2	0.060 *	−0.0578	−0.058 ***	−0.058
	(0.033)	(0.035)	(0.005)	(0.043)
treat_post_1	0.065 **	−0.053	−0.053 ***	−0.0539
	(0.033)	(0.035)	(0.006)	(0.041)
treat_post0	0.133 ***	0.0145	0.015	0.015
	(0.033)	(0.035)	(0.021)	(0.017)
treat_post1	0.287 ***	0.157 ***	0.157 ***	0.157 ***
	(0.033)	(0.035)	(0.022)	(0.051)
treat_post2	0.202 ***	0.032	0.032 **	0.032
	(0.033)	(0.036)	(0.014)	(0.047)
treat_post3	0.203 ***	0.033	0.033 ***	0.033
	(0.033)	(0.036)	(0.009)	(0.047)
treat_post4	0.165 ***	−0.004	−0.004	−0.004
	(0.033)	(0.036)	(0.012)	(0.052)
treat_post5	0.143 ***	−0.001	−0.001	−0.001
	(0.033)	(0.035)	(0.011)	(0.048)
N	61,342	61,342	61,342	61,342
r2_a	0.0034	0.0071	0.0071	0.0071

*, **, *** represent the significance levels of 10%, 5%, and 1%, respectively. Note: the values in brackets in the table are t values.

4.3. Influencing Mechanism

4.3.1. The Impact of COVID-19 on Agricultural Prices—From the Demand Side

According to Table 7, it can be concluded that if the interaction coefficient is positive and the price of agricultural products still rises, it indicates that the demand side has less impact on the price of agricultural products than the supply side. Since this paper lacks data of transaction volume of agricultural products in Chengdu markets, this paper divides agricultural products into large demand elasticity and small demand elasticity, according to Xu Zhenning, to analyze the demand side in the price of agricultural products. Columns (1) and (2) are clustered to different levels of agricultural products, and it can be seen that the price rise of agricultural products with small demand elasticity is more significant.

4.3.2. The Impact of COVID-19 on Agricultural Prices—From the Supply Side

From the supply side, after the outbreak of the epidemic, agricultural products were unsalable, and a considerable number of agricultural products were hoarded in warehouses and not transported, leading to a rapid decline in the supply of markets. Most residents chose to rely on hoarding at home to approach their normal life needs. Therefore, this paper analyzed whether agricultural products were easy to store. In this paper, according to the storage cycle of agricultural products, agricultural products are divided into easy to store and not easy to store. Columns (3) and (4) are clustered to various levels of agricultural products. It can be seen that agricultural products that are difficult to store, such as fresh

fruits and vegetables and aquatic products, have a vaster increase in interaction coefficient, while the price of agricultural products that are easy to store, such as grain and oil and livestock and poultry, has a slight increase and is not significant. According to the analysis, this is precisely because of the outbreak of the epidemic. The government implemented policies such as closing villages and stopping production that led to insufficient supply, therefore causing the price of agricultural products to be more susceptible to the impact of the supply side.

Table 7. An empirical analysis of the price of agricultural products with different demand elasticity and supply elasticity in the epidemic: DID model.

	Market Price Log	Market Price Log	Market Price Log	Market Price Log
	Low Elasticity of Demand (1)	High Elasticity of Demand (2)	Difficult to Store (3)	Easy to Store (4)
treat_post	0.047 ***	0.058	0.063 ***	0.027
	(0.017)	(0.046)	(0.021)	(0.030)
Year_dum	Yes	Yes	Yes	Yes
Month_dum	Yes	Yes	Yes	Yes
farm_produce_FE	YES	YES	YES	YES
N	49,054	12,252	38,258	23,048
r2_a	0.95	0.89	0.91	0.98

*** represent the significance levels of 1%. Note: the values in brackets in the table are t values.

4.4. Heterogeneity Test

4.4.1. The Impact of COVID-19 on Agricultural Commodity Prices—By Category

Table 8 studies the impact of COVID-19 on the prices of different agricultural products. The first column is livestock and poultry, the second column is grain and oil, the third column is fresh fruits and vegetables, and the fourth column is raw aquatic products. The data in Table 8 show that the prices of livestock and poultry, fresh fruits and vegetables, and fresh aquatic products all rose sharply and passed the significance test at the significance level of 1%, but grain and oil prices of agricultural products were virtually unchanged, and the results are not significant.

Table 8. An empirical analysis of the epidemic on the prices of different kinds of agricultural products: DID model.

	Market Price Log	Market Price Log	Market Price Log	Market Price Log
	Livestock and Poultry	Grain and Oil	Fresh Fruits and Vegetables	Aquatic Products
treat_post	0.063 ***	0.003	0.064 ***	0.044 ***
	(0.006)	(0.004)	(0.011)	(0.009)
Year_dum	Yes	Yes	Yes	Yes
Month_dum	Yes	Yes	Yes	Yes
farm_produce_FE	YES	YES	YES	YES
N	9162	13,886	35,168	3090
r2_a	0.91	0.99	0.88	0.74

*** represent the significance levels of 1%. Note: the values in brackets in the table are t values.

This paper believes that the main reason for this may be that after the outbreak of the epidemic, Chengdu carried out a special prohibition of the slaughter and sale of live poultry in the city's markets, explicitly banning the sale of live poultry and requiring the closure of live poultry trading areas and slaughtering sites in various markets. This measure reduced the supply of livestock and poultry and increased the price of agricultural products. In addition, during the epidemic period, Chengdu implemented traffic control policies, resulting in the phenomenon of "road closure" and "village closure". As a result, logistics and transportation were limited, and fresh fruits and vegetables could not be transported in time, resulting in insufficient supply, resulting in the price of fresh fruits and vegetables rising. The reason for the price rise of fresh aquatic products may be that the production

and marketing of aquatic products were not smooth during the epidemic period, and the market trading volume was insufficient, which eventually led to the problem of aquatic products in the pond and the price rise.

There was little change in the prices of oil and grain products, suggesting that the outbreak had little impact on supply or demand, because the production area and production scale of grain and oil have not undergone big changes, the basic technological level has not undergone big regression, the long-term basic trend has not changed, the supply is stable, and the demand for food and oil will not increase or decrease rapidly due to the epidemic. Since supply and demand trends have been stable for a long time, the price level of cereals and oils will not change much.

4.4.2. The Impact of COVID-19 on Agricultural Commodity Prices—By District

Table 9 studies the impact of COVID-19 on the prices of agricultural products in diverse administrative regions. This paper classifies six major urban areas according to the proportion of agricultural GDP in the total GDP of the whole region. Jinjiang and Gaoxin are listed as the regions with large proportion of primary industry, Jinniu and Chenghua are listed as the regions with medium proportion of primary industry, and Qingyang and Wuhou are listed as the regions with small proportion of primary industry.

Table 9. An empirical analysis of the epidemic on the prices of different agricultural products in different regions: DID model.

	Market Price Log	**Market Price Log**	**Market Price Log**
	The Primary Industry Accounts for a Large Proportion	**The Primary Industry Accounts for a Medium Proportion**	**The Primary Industry Accounts for a Small Proportion**
treat_post	0.056 ***	0.033 **	0.058 ***
	(0.012)	(0.011)	(0.010)
Year_dum	Yes	Yes	Yes
Month_dum	Yes	Yes	Yes
farm_produce_FE	YES	YES	YES
N	20,317	20,514	20,475
r2_a	0.96	0.96	0.96

, * represent the significance levels of 5% and 1%, respectively. Note: the values in brackets in the table are t values.

According to the results, the prices of the three types of regions have increased significantly, but this paper does not analyze the regions with a significant proportion of primary industry. Because the areas with a significant proportion of primary industries include high-tech zones, composed of several streets under the jurisdiction of other administrative areas, statistical data may be repeated, leading to biased results. In regions with a small proportion of primary industry, due to the small proportion of agricultural GDP in this region, the local people are more dependent on the transfer of agricultural products to meet consumer demand during the outbreak of the epidemic. The implementation of traffic control and other measures will restrict the transportation of agricultural products, producing a massive increase in the price of agricultural products. In regions with a medium proportion of primary industry, agricultural GDP accounts for a large proportion. After the outbreak of the epidemic, the regional government can produce response and adjustment, mobilize the supply of agricultural products, and stabilize the price of agricultural products, so that the price of agricultural products will not increase too considerably.

4.5. Policy Effect Analysis

Table 10 shows the impact of price control measures on different agricultural products before and after the implementation of Chengdu. On 5 February 2020, a news briefing on the prevention and control of novel coronavirus pneumonia was held in Chengdu,

indicating that the investigation against price gouging would be intensified. To test the policy effect, all the data during the Spring Festival of 2020 were specially selected, and the dummy variable of the policy before 5 February 2020 was set as 0, and after that as 1. The data in Table 9 show that after the implementation of price control measures, the prices of livestock and poultry, fresh fruits and vegetables, and aquatic products declined significantly, indicating that the price control measures adopted by the government after the outbreak of the epidemic had a significant effect, However, grain policy variable coefficient is not significant, and there is no price change, which suggests that the administrative punishment of price control measures of cereals, oils, and class effect is not obvious, probably because during the outbreak, the government had to enforce a price regulation policy to control prices. For grain price, there is almost no change, as the control policy almost failed, so its policy variable coefficient is not significant.

Table 10. The influence of price stabilization policy on different kinds of agricultural products.

	Market Price Log	Market Price Log	Market Price Log	Market Price Log
	Livestock and Poultry	Grain and Oil	Fresh Fruits and Vegetables	Aquatic Products
treat_post	0.097 ***	0.002	0.160 ***	0.071 ***
	(0.008)	(0.002)	(0.023)	(0.015)
policy	−0.305 ***	−0.002	−0.087 ***	−0.045 **
	(0.012)	(0.004)	(0.020)	(0.021)
Year_dum	Yes	Yes	Yes	Yes
Month_dum	Yes	Yes	Yes	Yes
farm_produce_FE	YES	YES	YES	YES
N	4511	6794	17,147	1510

, * represent the significance levels of 5% and 1%, respectively. Note: the values in brackets in the table are t values.

5. Conclusions

This paper studied the impact of COVID-19 on the prices of agricultural products in the main urban area of Chengdu and derived the following conclusions: (1) Compared with the previous two years, the COVID-19 outbreak in the Spring Festival of 2019 achieved an average increase of 108.44% in the retail prices of agricultural products in Chengdu, among which the increase of livestock and poultry, fruits and vegetables, and aquatic products was the most obvious, while the change of grain and oil prices was not significant. (2) Compared with the demand side, COVID-19 has had a major impact on agricultural prices from the supply side. (3) The effect of COVID-19 on the retail prices of agricultural products is more distinct in areas where the primary industry is relatively small, and the industrialization process is fast. (4) In the short term, the government's policy to suppress the price of all agricultural products does not play a role in suppressing the price rise.

Based on the above analysis, this paper proposes the following suggestions:

First, we should ease employment pressure and stabilize people's incomes. With the COVID-19 outbreak, people are quarantined at home. Incomes are falling and unstable, and demand for agricultural products is falling. For urban and rural residents who are unable to migrate for work, business, or employment due to the impact of the epidemic and whose income declines have led to basic living difficulties, living subsidies and basic living security policies should be adopted to solve the employment problem during the epidemic prevention and control period, to stabilize residents' income and regulate the demand side of agricultural products.

Second, we should upgrade the supply chain of agricultural products and promote market circulation. Traffic controls and social distancing measures have been adopted throughout the country to prevent the spread of the virus. For a considerable number of agricultural products, such as livestock and poultry and fruits and vegetables, due to short storage time and strong timeliness, market circulation is blocked and they are

unsalable, which directly leads to serious losses of farmers and a substantial reduction in market supply, so the price of agricultural products is raised, increasing the pressure on people's living standards. Therefore, it is necessary to further improve the robustness of the industrial chain and supply chain, establish the storage mechanism of agricultural products, and formulate special emergency plans to ensure the effective supply of agricultural products in emergencies and to accede to the demand of the market.

Third, to avoid "one-size-fits-all", the government should implement a policy of differentiation. Due to the differences in the direction of the impact caused by COVID-19 on the prices of diverse agricultural products and the degree of impact on the prices of agricultural products in different regions, the "one-size-fits-all" price control policy adopted by the government to crack down on price gouging is flawed, and the policy target is not precise. To improve the accuracy of control policies, price control measures with various directions, such as dredging supply and stopping price gouging, should be taken for agricultural products affected by the epidemic in separate directions.

The empirical analysis part of this paper verified hypothesis 1 (As a sudden exogenous event, COVID-19 increased the prices of agricultural products in Chengdu) and hypothesis 2 (COVID-19 has an impact on the prices of agricultural products in Chengdu from both the demand side and the supply side, but the supply side plays a leading role). The contribution of this study lies in the following. First, the DID model was used for analysis, eliminating the Spring Festival factors, making the analysis more accurate, which is different from the parameter vector autoregression model, quantile regression model, and shock wave effect model used in the existing literature. Second, the data are the price data of agricultural products in the agricultural trade market in the main urban area of Chengdu; they are the price at the demand side of the agricultural product market, which is different from the price at the production side or the wholesale market of agricultural products from the supply side. The third is the analysis conclusion that the supply side has a greater impact, which is different from the conclusions of Zheng Jianghuai and others, who believe that the impact on demand is more obvious. Fourth, regarding the impact of COVID-19 on the industry, the conclusions drawn are consistent with the research of Yang Song, but this paper is attributed to the relatively small demand elasticity of the primary industry. Fifth, this paper is based on the perspective of agricultural product market research from the two aspects of demand and supply, which is different from the analysis from the perspective of society and residents.

Although the empirical analysis verified the proposed hypotheses 1 and 2, whether they are universal and applicable remains to be verified, which is also the direction of further research in the next step. At the same time, although the analysis method of the DID model is relatively mature, it still needs to be very rigorous in application.

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References

1. Xiao, X.; Zhang, S. Study on the Spillover Effect of Crude Oil Prices and Agricultural Product Prices. *Agric. Technol. Econ.* **2016**, *1*, 90–97.
2. Lin, C. Influence mechanism and effect of international crude oil price and monetary policy on the price of agricultural products in my country. *Price Mon.* **2020**, *1*, 30–35.
3. Tian, H.; Feng, H. Research on the impact of monetary policy changes on the price fluctuations of agricultural products. *Financ. Econ. Theory Pract.* **2021**, *42*, 33–40.
4. Hervé, O. Extent and possible causes of intrayear agricultural commodity price volatility. *Agric. Econ.* **2013**, *45*, 225–252.
5. Tan, Y.; Hu, H.; Li, D. Research on the price impact of economic policy uncertainty on the agricultural product industry chain: From the perspective of "bargaining power" of supply and demand. *Agric. Technol. Econ.* **2018**, *7*, 80–92.
6. Pang, Z.; Liu, L. Can the Futures Market Stabilize the Price Fluctuation of Agricultural Products: An Empirical Study Based on Discrete Wavelet Transform and GARCH Model. *Financ. Res.* **2013**, *11*, 126–139.
7. Ronald, T. Global Agricultural Supply and Demand: Factors Contributing to the Recent Increase in Food Commodity Prices. *USDA Work. Rep.* **2018**, *8*, 183–196.
8. Joachim, B.; Getaw, T. Global Food Price Volatility and Spikes: An Overview of Costs, Causes, and Solutions. *Discuss. Pap. Dev.* **2012**, *3*, 78–92.
9. Yin, Y.; Miao, Y.; Li, Y. Equilibrium Analysis of China's Monetary Policy and Fiscal Policy Coordination Mechanism—Based on Nonlinear Structural Model System. *Tech. Econ.* **2021**, *40*, 45–55.
10. Zheng, J.; Fu, Y.; Tao, J. Analysis of the impact of the new crown pneumonia epidemic on the consumer economy and countermeasures. *Consum. Econ.* **2020**, *36*, 3–9.
11. Yang, S. Analysis on the impact of the new crown epidemic on China's economic development. *China Bus. Rev.* **2020**, *12*, 27–28.
12. Fu, Z.; Wang, Z. The impact of the new crown pneumonia epidemic on residents' consumption and countermeasures. *Fisc. Sci.* **2020**, *4*, 33–40.
13. Liu, J.; Lu, Q.; Gao, M.; Zhang, Z. The impact of the new crown pneumonia epidemic on the income of rural residents and suggestions. *Rural. Financ. Res.* **2020**, *4*, 47–50.
14. Huang, Q. The impact and response of the new crown pneumonia epidemic on the supply side: Short-term and long-term perspectives. *Economics* **2020**, *5*, 46–57.
15. Wu, T.; Zhu, A. The impact of the new crown pneumonia epidemic on China's economy and countermeasures. *South. Financ.* **2020**, *5*, 3–11.
16. Mo, R.; Chen, Y.; Bao, C.; Huang, X. Comparative analysis of the impact of the new crown epidemic, SARS epidemic, and international financial crisis on employment and countermeasures. *China Labor* **2020**, *1*, 16–30.
17. Zhang, M.; Wang, D. Research on the main problems and countermeasures facing the employment of migrant workers under the impact of the new crown pneumonia epidemic. *West. China* **2020**, *1*, 119–123.
18. Liu, T.; Ying, R.; Zhou, L. Research on the economic impact of African swine fever on China's pig industry chain—Based on the perspective of market segmentation. *Rural. Econ.* **2020**, *9*, 19–26.
19. Hu, Y.; Chen, X.; Qi, S.F. Research on the impact of the new crown pneumonia epidemic on the price fluctuation of agricultural products and the policy effect. *J. Agric. For. Econ. Manag.* **2021**, *20*, 59–69.
20. Wang, M.; Deng, Y. The impact of the new crown epidemic on the prices of agricultural products and countermeasures and suggestions. *China Bus. Rev.* **2021**, *3*, 5–7.
21. Zheng, Y.; Ma, J. Research on the Dynamic Impact of Avian Influenza Epidemic Changes on the Prices of Livestock and Poultry Products—Based on Time-Varying Parameter Vector Autoregression (TVP-VAR) Model. *Agric. Mod. Res.* **2018**, *39*, 751–760.
22. Marshal, N. Research on the impact of sudden epidemics on the price of livestock and poultry products. *Price Theory Pract.* **2018**, *6*, 46–49.
23. Miao, S. The impact of the epidemic on the mutation of pork prices and the identification of the impact effect. *Heilongjiang Anim. Husb. Vet. Med.* **2019**, *2*, 6–11.