

Article

Evaluating the Minor Coarse Cereals Product Crowdfunding Platform through Evolutionary Game Analysis

Zhiyuan Yu ^{1,2} , Muhammad Hafeez ¹ , Lihan Liu ¹, Muhammad Tariq Mahmood ³ and Hong Wu ^{1,*}

¹ School of Economics and Management, Beijing University of Posts and Telecommunications, Beijing 100876, China; yuzhi@bupt.edu.cn (Z.Y.); hafeez_86@hotmail.com or hafeez@bupt.edu.cn (M.H.); liulihan@bupt.edu.cn (L.L.)

² Department of Economics and Management, Taiyuan Institute of Technology, Taiyuan 030008, China

³ Department of Commerce, Federal Urdu University of Arts, Science and Technology, Islamabad 44000, Pakistan; tm76pk@gmail.com

* Correspondence: w_hong@263.net; Tel.: +86-136-2105-0170

Received: 13 January 2019; Accepted: 27 February 2019; Published: 1 March 2019



Abstract: In the modern era, the minor coarse cereals (MCC) are particularly popular among consumers. Price fluctuations cause misperceptions for growers, but also bring about complications for processing enterprises and consumers. To solve this problem, a multi-grain product crowdfunding platform is proposed. To this end, an evolutionary game model is constructed to investigate the game equilibrium between growers and crowdfunders. The analysis determines that evolutionary game equilibrium is related to the relative price difference between the sowing period and the harvest period, and to the social/logistical cost. Under normal circumstances, the crowdfunder may default when the sowing-period price is greater than the harvest-period price. The grower may default if the sowing-period price is less than the harvest-period price. Therefore, in the design of a crowdfunding system for MCC products, a certain percentage of advance payment (30%) and certain default deposits should be collected from crowdfunders and growers, respectively.

Keywords: minor coarse cereals (MCC); product crowdfunding; evolutionary game theory; system design of crowdfunding platform

1. Introduction and Literature Review

Minor coarse cereals (MCC) is a collective term for small grains and legume crops. It also generally indicates short growing period crops, small planting area, strong regionalism, and a variety of special grain cultivation methods [1]. MCC mainly includes buckwheat, oats, sorghum, broad beans, mung beans, peas, lentils, millet, etc. [1]. In recent times, MCC is becoming more and more popular due to high nutritional value and perceived health benefits, especially in the current situation of general over-nutrition [2]. However, the price is often highly volatile, e.g., the mung bean price fluctuated between 5 Chinese Renminbi (RMB) and 12 RMB in 2016, creating misperceptions and uncertainty for growers [2]. Due to the unavailability of a futures market for MCC, it is impossible to suppress the risk of price volatility for farmers, MCC processing enterprises, and consumers [2]. This creates hurdles in the cultivation process: if the MCC price is high, then it is planted in large amounts [3]. As a result, the price plummets in the harvest season, resulting in an increase in quantity but no increase in income; when the price drops, farmers give up planting the grains, so the price rises in the next year, but farmers still do not make money themselves [3]. However, grain processing enterprises often face a higher degree of price volatility with miscellaneous grains and cannot stabilize the expected

(raw material) costs. Consumers also often face excessive prices of small grains, which causes them to change the consumption patterns.

Crowdfunding an Internet finance model for e-commerce, is growing fast [4]. Product crowdfunding refers to a crowdfunding method in which the crowdfunders pay to develop a certain product (or service) and wait until the product (or service) begins to sell; or, if it is ready for external sale, the fundraiser will provide the product (or service) to the investor at no cost or less than the cost. Lambert et al. [5] conducted an empirical analysis of crowdfunding. The technical definition of product crowdfunding is a model in which the product is released first and then the consumers pay to purchase it. If this model is applied to MCC, growers can receive a partial deposit from consumers at the current price in advance, and then sell to them at the current price after harvesting. To a certain extent, price fluctuations of MCC can be suppressed. However, the overall risk is that if the harvest-period price is higher than the original price, the growers will have losses and there is a possibility of breach of contract [6]. If the harvest price is lower than the original price, the consumer or crowdfunder will have losses and may default [6]. This paper aims to conduct an analysis from the perspective of an evolutionary game. According to the game situation, the product crowdfunding system is designed so that the advantages of the two can be used to suppress possible risks and further achieve sustainable development [7,8]

At present, product crowdfunding research mainly focuses on four aspects: (1) the concept and significance of crowdfunding; (2) the characteristics and classification of crowdfunding; (3) the influencing factors of crowdfunding success; and (4) the application of crowdfunding.

1.1. The Concept and Significance of Crowdfunding

The basic idea of crowdfunding is to raise external funds from a large number of crowdfunders. Each person provides a very little money. Belle et al. [9] developed a model that associates crowdfunding with pre-ordering and price discrimination. As compared to traditional funding, crowdfunding has the advantage of providing some consumers with an enhanced experience. On the other hand, the entrepreneur is limited by the funds available. Stanko et al. [10] studied the impact of crowdfunding on the innovation of companies. Usually the crowdfunding supporters play an active role in innovation. Crowdfunding can both seek other people's ideas and generate word of mouth for crowdfunding products. Crowdfunding supporters are the earliest adopters and supporters of product ideas, and so they may be more valuable than traditional consumers. Crowdfunding is changing what ideas come up and how. Importantly, the number of crowdfunding projects is increasing over time [11]. Crowdfunding is an alternative financing method as compared to traditional lending. Crowdfunding represents a recent web 2.0 based phenomenon and is gaining more and more scientific attention [12].

Product crowdfunding does have information asymmetry. To some extent, well-known crowdfunding platforms such as Jingdong (JD) and Taobao can compensate for information asymmetry. Crowdfunding of agricultural products, especially small grain crowdfunding, is feasible and reproducible. In particular, some of the current cases, especially China, have both investment and financing [13–16]. Specific to the crowdfunding of small grain products, the two sides can evaluate each other after the transaction; the evaluation is always on the crowdfunding platform, and there are many websites in China that specifically compensate for information asymmetry, such as word of mouth networks, comment networks, and interactive evaluations that everyone sees so that, based on their choice of credit, they can reduce information asymmetry to some extent. If the quality crowdfunders receive is always poor, they are not likely to crowdfund other small crops [12].

1.2. Characteristics and Classification of Crowdfunding

Agrawal et al. [17] argue that the most compelling feature of “crowdfunding” may be the widespread dispersion of investors. Colombo et al. found that the attraction of internal social capital was an early contribution in financing from crowdfunding [18]. Crowdfunding is more likely to occur between strangers [19]. Crowdfunding is classified into crowd lending, crowd equity, reward-based

crowdfunding, and donation-based crowdfunding [20]. Raising funds with people-based online technology is becoming more popular and trusted [21,22].

1.3. Influencing Factors of Crowdfunding Success

Ordanini et al. [23] investigated the emerging crowdfunding financing phenomenon and explored the feasibility of crowdfunding financing to attract investment. The amount of funds raised by crowdfunding has no significant impact on the post-market performance of crowdfunding products, while the number of supporters who attract crowdfunding has a significant impact [10]. Blakley et al. [21] examined the theory of emotional events to study the perception of crowdfunders. Crowdfunding is changing how entrepreneurs bring new products to market; an example of a successful crowdfunding product is Glif, which raised more than \$137,000 [23,24]. On the other side, the authors of [25] examined how online information affects the decisions of crowdfunding supporters. It was found that quality signals and electronic word of mouth have a significant positive impact on decision-makers' decisions, while [26] constructed a model based on social capital theory and conducted comparative research using objective data collected from China and the United States. It has been investigated how entrepreneurial social networks affect the crowdfunding. Chinese entrepreneurs are more prominent than in the United States. The factors that influence the success of crowdfunding are incentives and interactive feedback, similar to interests [27]. Kshetri et al. [20] studied the impact of formal and informal institutions on the success of crowdfunding projects. Crowdfunding builds enthusiasm for growers, who can then avoid the risk of price fluctuations and sell their agricultural products while eliminating many middlemen and setting high prices [2]. Crowdfunding is also motivated by the desire of food processing companies to stabilize their costs. Now that everyone has the habit of shopping online and the price is lower, physical stores are not essential for shopping. Fewer people, higher relative costs, and more obvious price fluctuations mean that consumers are still willing to be crowdfunders [16,20].

1.4. The Application of Crowdfunding:

Zvilichovsky et al. [28] discussed the project quality matching model of a crowdfunding platform with the two-sided market theory, and mainly analyzed the threshold of project quality and the efficiency of the crowdfunding platform. A crowdfunding platform is used by for-profit, arts, and cultural companies to raise funds [29]. Another study [30] considered the problem of the initial financing of creative projects and conducted crowdfunding system design. Based on incentives and constraints of investment and financing, the paper took into account the rational development of crowdfunding platforms in the early stages of development to maximize the transaction volume of creative projects and maximize the average transaction value of both parties on the platform [31,32]. The design of a crowdfunding self-feedback mechanism can effectively represent the heterogeneous incentives of three parties in the crowdfunding process [28].

Zhang et al. [13] studied the origin, characteristics, and future of agricultural crowdfunding, and proposed that agricultural crowdfunding refers to the use of Internet platforms to publish agricultural projects, raise funds for the public to help agricultural projects, and give returns to the crowdfunders; they also stated that agricultural crowdfunding has the characteristics of pooling funds and popularity and can accommodate all kinds of crowdfunding objects [14,15]. Xiao et al. [16] studied the optimal selection of platforms involving agricultural crowdfunding and concluded that both investment and financing parties prefer large-scale comprehensive agricultural crowdfunding platforms.

The research on product crowdfunding has helped with the establishment of a crowdfunding platform for small grains. However, previous research was aimed at a single crowdfunding study, while this platform requires repeated crowdfunding. Success to start with may not guarantee success in the future. Since crowdfunding is repetitive, it can be regarded as a game of interests between two parties and can be analyzed by game theory. One party is a farmer group and the other is a crowdfunding group; both parties are regarded as having limited rationality. Each group can learn

from the other and play the evolutionary games in mutual learning, so evolutionary game theory is used for analysis [33]. Crowdfunding can be used as a form of financing [26]. However, due to information asymmetry, a long cycle, and uncertain returns, equity crowdfunding has limited the development of equity crowdfunding to a certain extent. At the same time, due to the restrictions imposed by Chinese law on illegal fund-raising, there is no specific law to clarify the relationship between the two parties. Restricted to 200 people, equity crowdfunding is relatively slow, so China's equity crowdfunding development after the upsurge has been almost stagnant [31]. In the field of product crowdfunding and public welfare donation, the development is relatively good, so it is a relatively good financing method, especially in the field of public welfare donations. At present, in the Chinese market, equity crowdfunding is developing slowly. The mainstream is product crowdfunding and public welfare donation crowdfunding [6].

Specialized financial institutions can also purchase product crowdfunding platforms, and their needs can guide the supply of small grain products in advance [32]. Because they analyze and raise funds from the entire industrial chain, when the price of small grains skyrockets and crowdfunding purchases are made in advance, growers can increase the planting area and thus the supply, thereby transmitting the demand to the supply side in advance, which can stabilize the price fluctuation. Industry fluctuations and financial institutions use their own expertise and part of the funds to earn money, while growers increase their output [30]. Therefore, the participation of financial institutions is more conducive to MCC crowdfunding.

China already has crowdfunding for new products and product crowdfunding for charitable donations. The agricultural product network provides pre-sale of agricultural products. It is possible to carry out product crowdfunding with small grains. However, the specific small grain products are not yet raised. The specific agricultural product crowdfunding is based on the crowdfunding platform. Of course, it is also possible to operate it on its own. Since the platform economy is characterized by winners, it is more inclined to use well-known platforms such as Jingdong, Taobao, etc., to carry out product crowdfunding system design [32].

The evolutionary game analysis originated from the study of biological evolution. Smith (1974) and Smith et al. (1973) [34,35] applied evolutionary game analysis to study the evolution of species. Of course, the evolutionary game theory has also begun to be widely applied. Friedman [36] theorized that evolutionary games have greater potential for simulating real economic problems. He proposed a one-dimensional and two-dimensional asymptotic game model of evolutionary games and proposed many norms. Evolutionary game dynamics is an important framework for the study of biology and economics. A common method used by many researchers is the replicator dynamics equation, which ignores time and space. Roca discusses the effects of time and space. Evolutionary game theory believes that, in a series of contexts, the actors will (eventually) reach the Nash equilibrium [37]. In addition, the evolutionary model reveals the relative rationality of different Nash equilibria. Evolutionary game theory suggests that game participants do follow a Nash equilibrium [38]. Moreover, evolutionary modelling has revealed the relative rationality of different Nash equilibria. Dong et al. [39] used the evolutionary game model to study the evolutionary game of migrant workers returning to their hometowns and the local government, and discussed the equilibrium point and its stability under certain conditions. The results showed that the evolutionary game equilibrium will change significantly when the relevant parameters change. Then, the local government can change certain practices, which is equivalent to adjusting relevant parameters. In this way, the entrepreneurial decisions of migrant workers returning home can be optimized and the evolutionary game can evolve in the expected direction. Ozkan-Canbolat et al. [40] studied the application of evolutionary games in strategic innovation. Kuechle [41] used evolutionary games to examine persistence and heterogeneity in entrepreneurship. The authors of [42] studied corporate power by evolutionary game theory and mainstream economics and also used evolutionary game theory to compare corporate power with mainstream economics. Liu et al. [43] used evolutionary games to research the sustainability of collaborative innovation in strategic emerging industries. Now evolutionary games theory has been

widely used in the fields of economy, management, and supervision [33,44]. This theory, based on the premise of bounded rationality, aims to achieve stable and balanced evolution of a system by mutual learning between group members, random and repeated game-playing, and constantly adjusting the strategy [8]. The growers within the grower group learn from each other; it is the same for the crowdfunder group, which also depicts the certain bounded rationality, and then they coincide with the evolutionary game to a certain degree.

Therefore, the evolutionary game can be applied to analyze the behaviors between these two groups [7]. According to our best knowledge, no one has yet studied the combination of evolutionary games with product crowdfunding platforms. The aspiration of the study is to design MCC crowdfunding based on evolutionary game equilibrium by replicator dynamic equations. The replicator dynamic approach can more clearly reflect the equilibrium of the evolutionary game between the two groups under the corresponding utility function [34,35]. Since the two groups are bounded rational, members can learn from each other and have a similar analytical framework, so they can be analyzed mathematically. The specific results are clearer than the direct language description, and it is difficult to know whether they will balance the equilibrium points without mathematical calculations [36]. The current study also integrates the equilibrium analysis of evolutionary game and design of crowdfunding platform system. The aims of this paper are to explore the evolutionary game between growers and crowdfunders, construct a suitable evolutionary game model, and design a crowdfunding platform for MCC. In this study, crowdfunders are future buyers, not charitable donations or financial subsidies [36]. It is the producer or the grower who gets the money [36]. Buyers can be of any type, including individuals, small grain processing enterprises, and large wholesalers. For small grain processing enterprises, the cost fluctuation of raw materials is reduced, and the expected cost is stable; for individuals, it is also possible to adapt personal shopping habits in advance, setting a small amount of money aside for small grains. For large wholesalers, crowdfunding creates strong bargaining power because a small amount of deposits can cover a lot of small grains, leading to stable prices in operation, which is more conducive to growers. The growers are also very different in China. There are family-style and farm-style growers, and information from both sides is communicated via the crowdfunding platform [32].

This research is of great significance to the three rural issues [29]. Farmers not only face the problem of agricultural product price fluctuations, but also the difficulty of selling agricultural products. The research on agricultural product crowdfunding not only solves the problem of agricultural product price fluctuation but also the problem of agricultural product sales, so it has practical significance. Moreover, crowdfunding of MCC products is a supplement to the crowdfunding of existing products and has certain policy or theoretical significance [32].

The ethical hazard is more in the crowdfunding of small grain products [13]. This article considers ethical issues. To guard against dishonest dealings, crowdfunders must be made to pay a certain percentage of the margin to dissuade them from changing their minds. To prevent the growers from fulfilling the contract, the crowdfunding platform will receive a certain amount of credit. If the contract is broken, the crowdfunding platform will advance the payment to complete the performance. If, after the harvest is completed, the planter lets the funders down in some way, the crowdfunders can comment or complain to the crowdfunding platform, which builds up knowledge of operational information asymmetry and post-platform supervision [19].

This paper consists of four sections. The first section gives the introduction and literature review; Section 2 presents the MCC product crowdfunding platform and construction of game model, while the use of evolutionary game model to make a steady-state analysis, and the system design, are discussed in Sections 3–5.

2. MCC Product Crowdfunding Platform and Construction of Game Model

2.1. MCC Product Crowdfunding Platform

MCC crowdfunding is to display minor coarse cereals on the crowdfunding platform, and the growers should pay a deposit for breach of contract to the crowdfunding platform. Also, the crowdfunders should make a certain downpayment to the growers who organize planting production and, at the harvest, send the MCC through logistics to the hands of crowdfunders [45]. This model comes with pre-sale property [12]. Product crowdfunding of MCC is similar to the product (service) type crowdfunding poverty alleviation mode proposed by Bi et al. [6]. The product (service) type crowdfunding poverty alleviation refers to a model to start production under the assistance of poverty alleviation funds, then demonstrate the products (services) on a crowdfunding platform and raise funds from the general public, and ultimately return a product or service to the sponsor at a price slightly lower than the market price [46]. This is different from the product (service) crowdfunding poverty alleviation model in several aspects: first, crowdfunding of MCC products is not poverty alleviation, but one new sales model or a new mode of production expansion; second, the crowdfunding price of MCC is the market price at the time of display, while the price for poverty reduction is slightly lower than the market price and is the price at the harvest season. Third, the crowdfunder and growers of MCC both have default risks, because the price at harvest and the price at the time of display are inconsistent, and there is a possibility of default when the prices of the two parties are very different. When the harvest price is much higher than the show price, the grower may default; when the harvest price is much lower than the show price, the crowdfunder may default [32]. For this reason, it is necessary for the crowdfunding platform to collect certain default deposits from growers and also require the crowdfunder to give a downpayment to the growers [47].

2.2. Game Participants and Analysis

The stakeholders are reported in Table 1. One participant of the game group is the MCC growers, who are bounded rational. They learn strategies from each other, with the biggest goal of profits maximization. Their strategy is to {normal supply, reject supply}, and they also know the game strategy of the other group, i.e., normal crowdfunding and remorse crowdfunding. Thus, they will make choices that are beneficial to them based on the other party's strategy [48].

The other participant in the game group is the MCC processing enterprises or consumers, collectively referred to as crowdfunders, who are bounded rational. They learn strategies from each other, with the goal of utility maximization. Their strategy is to {normal crowdfunding, remorse crowdfunding}, and they are fully aware of the grower's strategy. Thus, they will make choices that are beneficial to them based on the other party's strategy.

Table 1. Game participants.

Stakeholders	Symbol	Description
MCC growers	U_s	The benefits of normal supply
	U_r	The benefits of rejecting supply
	U_a	The average benefits of mixed normal supply and rejecting supply
	X	Normal supply; the supply according to crowdfunding transactions
	$1-X$	Rejecting supply; not supply of the crowdfunding transactions
crowdfunders	U_c	The benefits of normal crowdfunding
	U_w	The benefits of remorse crowdfunding
	U_e	The average benefits of mixed normal crowdfunding and remorse crowdfunding
	Y	Normal crowdfunding; buying according to crowdfunding transactions
	$1-Y$	Remorse crowdfunding; not buying of the crowdfunding transactions

2.3. Assumptions and Variables: Descriptions for Game Model

According to the actual situation and research needs, several assumptions are made:

First, assuming that the growers of MCC sell at the selling volume Q_0 with price P_0 , while their actual growing output is Q_1 , and the price at maturity is P_1 , the growers' benefit is $P_0Q_0 + P_1(Q_1 - Q_0)$, the planting cost is C_1 , and the logistics cost is C_2 . It is not clear whether the grower or crowdfunder bears the logistical cost. If the grower's commitment coefficient is α , which is greater than or equal to zero or less than or equal to 1, then the logistical cost borne by the grower is αC_2 , so it is obvious that in the crowdfunding process the logistics cost is $(1 - \alpha) C_2$ for the consumer or crowdfunder. When growers refuse to sell and then cause crowdfunding to fail, growers should be punished with a penalty factor of β , which is greater than or equal to zero and less than or equal to 1; if the supply is rejected, the farmer should be punished with a penalty of βP_0Q_0 . Further discussion of the implementation of a penalty to maintain feasibility and operability will feature later in this paper.

Second, assume that for crowdfunders, a certain deposit γP_0Q_0 should be paid when making transactions on the crowdfunding platform, and the crowdfunding deposits factor γ is greater than or equal to zero or less than or equal to one, but not refundable when crowdfunding is initiated. Since crowdfunding is paid in advance, the purchase price P_0 is for the products of Q_0 , and the mature harvest price is P_1 . When the grower rejects the supply, the crowdfunder can receive a fine of βP_0Q_0 . Further discussion of the deposits handed over to the grower, platform, or a specially established association, etc., will feature later in this paper.

2.4. Replication Dynamic Equation Construction

The game matrix between growers and crowdfunders is as follows (see Table 2 for details).

Table 2. Game matrix between growers and crowdfunders.

		Crowdfunders	
		Normal Crowdfunding: y	Remorse Crowdfunding: $(1 - y)$
Growers	normal supply: x	$P_0Q_0 + P_1(Q_1 - Q_0) - C_1 - \alpha C_2,$ $(P_1 - P_0)Q_0 - (1 - \alpha)C_2$	$P_1Q_1 + \gamma P_0Q_0 - C_1, -\gamma P_0Q_0$
	rejecting supply: $(1 - x)$	$P_1Q_1 - \beta P_0Q_0 - C_1, \beta P_0Q_0$	$P_1Q_1 - \beta P_0Q_0 - C_1 + \gamma P_0Q_0,$ $-\gamma P_0Q_0 + \beta P_0Q_0$

Assuming that the normal supply probability of MCC growers is x then replicator dynamic equation by using normal supply($F(x)$) is tat the replicator dynamic equation ($F(x)$) for normal supply in the probability (x), and the probability of rejecting supply is $(1 - x)$. Assuming that the probability of normal crowdfunding for crowdfunders is y then replicator dynamic equation by using the normal crowdfunding is that the replicator dynamic equation ($F(y)$) for the normal crowdfunding in the probability (y) the probability of remorse in crowdfunding is $(1 - y)$.

2.4.1. For MCC Growers:

Benefits of normal supply are:

$$Us = y (P_0Q_0 + P_1 (Q_1 - Q_0) - C_1 - \alpha C_2) + (1 - y) (P_1Q_1 + \gamma P_0Q_0 - C_1) = P_1Q_1 + \gamma P_0Q_0 + y (P_0Q_0 - \gamma P_0Q_0 - \alpha C_2 - P_1Q_0). \quad (1)$$

Benefits of rejecting supply are:

$$Ur = y (P_1Q_1 - \beta P_0Q_0 - C_1) + (1 - y) (P_1Q_1 - \beta P_0Q_0 - C_1 + \gamma P_0Q_0) - P_1Q_1 - \beta P_0Q_0 - C_1 + \gamma P_0Q_0 - y \gamma P_0Q_0. \quad (2)$$

The mixed average expected benefits of MCC growers using normal supply and rejecting supply are:

$$Ua = (xUs + 1 - x) Ur. \quad (3)$$

The replicator dynamic equation for normal supply ($F(x)$) is:

$$F(x) = dx/dt = x (Us - Ua) = x (1 - x) (Us - Ur) = x (1 - x) [P_1Q_1 + \gamma P_0Q_0 + y (P_0Q_0 - \gamma P_0Q_0 - \alpha C_2 - P_1Q_0) - (P_1Q_1 - \beta P_0Q_0 - C_1 + \gamma P_0Q_0 - y\gamma P_0Q_0)] = x (1 - x) [\beta P_0Q_0 + y (P_0Q_0 - \alpha C_2 - P_1Q_0)]. \quad (4)$$

2.4.2. For Crowdfunders:

Benefits of normal crowdfunding are:

$$Uc = x [(P_1 - P_0) Q_0 - (1 - \alpha) C_2] + (1 - x) (\beta P_0Q_0) = \beta P_0Q_0 + x [(P_1 - P_0) Q_0 - (1 - \alpha) C_2 - \beta P_0Q_0]. \quad (5)$$

Benefits of remorse crowdfunding are:

$$Uw = x [-\gamma P_0Q_0] + (1 - x) (-\gamma P_0Q_0 + \beta P_0Q_0) = -\gamma P_0Q_0 + \beta P_0Q_0 - x\beta P_0Q_0. \quad (6)$$

The mixed average expected benefits of MCC crowdfunder using normal crowdfunding and remorse crowdfunding are:

$$Ue = yUc + (1 - y) Uw. \quad (7)$$

Then, the replicator dynamic equation for the normal crowdfunding ($F(y)$) is:

$$F(y) = dy/dt = y (Uc - Ue) = y (1 - y) (Uc - Uw) = y (1 - y) \{[(P_0 - P_1) Q_0 + \beta P_0Q_0 + x [2 (P_1 - P_0) Q_0 - (1 - \alpha) C_2 - \beta P_0Q_0] - [(P_0 - P_1) Q_0 - \gamma P_0Q_0 + \beta P_0Q_0 - x\beta P_0Q_0]] = y (1 - y) \{\gamma P_0Q_0 + x [(P_1 - P_0) Q_0 - (1 - \alpha) C_2]\} \quad (8)$$

3. Analysis of Evolutionary Game

3.1. Evolutionary Game and Steady State of Minor Coarse Cereal Crowdfunders

Trend and steady state of crowdfunders:

- (1) Let $F(y) = dy/dt = y(1 - y) \{\gamma P_0Q_0 + x [(P_1 - P_0) Q_0 - (1 - \alpha) C_2]\} = 0$, then $y_1 = 0, y_2 = 1, x^* = -\gamma P_0Q_0 / [(P_1 - P_0) Q_0 - (1 - \alpha) C_2]$, that is, when $x^* = -\gamma P_0Q_0 / [(P_1 - P_0) Q_0 - (1 - \alpha) C_2]$, $F(y) = 0$, then at $0 \leq y \leq 1$ all are in steady state. At this time, no matter which strategy and proportion are adopted for the MCC crowdfunder, the steady state shall not be changed with the time extended.
- (2) When $x^* \neq -\gamma P_0Q_0 / [(P_1 - P_0) Q_0 - (1 - \alpha) C_2]$, let $F(y) = y(1 - y) \{\gamma P_0Q_0 + x [(P_1 - P_0) Q_0 - (1 - \alpha) C_2]\} = 0$, then $y^*_1 = 0, y^*_2 = 1$ are two possible steady states.
 $F(y)$ is derived to obtain $F(y)' = (1 - 2y) \{\gamma P_0Q_0 + x [(P_1 - P_0) Q_0 - (1 - \alpha) C_2]\}$.
 (a) When $(P_1 - P_0) Q_0 - (1 - \alpha) C_2 > 0, \{\gamma P_0Q_0 + x [(P_1 - P_0) Q_0 - (1 - \alpha) C_2]\} > 0$.
 Then, $F(y)' = (1 - 2y) \{\gamma P_0Q_0 + x [(P_1 - P_0) Q_0 - (1 - \alpha) C_2]\}$, so $F(1)' < 0, F(0)' > 0$. Therefore, $y = 1$ is the evolutionary steady state, or ESS, indicating that the crowdfunding strategy will steadily evolve to normal crowdfunding when $(P_1 - P_0) Q_0 > (1 - \alpha) C_2$.
 (b) When $(P_1 - P_0) Q_0 - (1 - \alpha) C_2 < 0$, there exist two cases:
 When $x > -\gamma P_0Q_0 / [(P_1 - P_0) Q_0 - (1 - \alpha) C_2], \{\gamma P_0Q_0 + x [(P_1 - P_0) Q_0 - (1 - \alpha) C_2]\} < 0$, and then $F(1)' > 0, F(0)' < 0$. Therefore, $y = 0$ is the evolutionary steady state or ESS, which means that the proportion of normal supply by growers is higher, and when it exceeds the critical point as follows:

$x^* = -\gamma P_0 Q_0 / [(P_1 - P_0) Q_0 - (1 - \alpha) C_2]$, the crowdfunder will completely adopt the strategy of remorse crowdfunding. When $x < -\gamma P_0 Q_0 / [(P_1 - P_0) Q_0 - (1 - \alpha) C_2]$, $F(1)' < 0$, $F(0)' > 0$, then $y = 1$ is the evolutionary steady state or ESS, and the strategy adopted by the small grain crowdfunder is steady as the normal crowdfunding. This shows that at $(P_1 - P_0) Q_0 < (1 - \alpha) C_2$, the smaller the normal supply ratio x is, below the critical point, the crowdfunding of MCC will be interpreted as normal crowdfunding.

3.2. Evolutionary Game and Steady State of Minor Coarse Cereal Growers

The trend and steady state of MCC growers:

- (1) Let $F(x) = dx/dt = x(1-x)[\beta P_0 Q_0 + y(P_0 Q_0 - \alpha C_2 - P_1 Q_0)] = 0$, then $x_1 = 0$, $x_2 = 1$, $y^* = -\beta P_0 Q_0 / [(P_0 Q_0 - \alpha C_2 - P_1 Q_0)]$, that is, when $y^* = -\beta P_0 Q_0 / [(P_0 Q_0 - \alpha C_2 - P_1 Q_0)]$, $F(x) = 0$, then at $0 \leq x \leq 1$ all are in steady state. At this time, no matter which strategy and proportion are adopted for the MCC growers, the steady state shall not be changed with the time extended.
- (2) When $y^* \neq -\beta P_0 Q_0 / [(P_0 Q_0 - \alpha C_2 - P_1 Q_0)]$, let $F(x) = x(1-x)[\beta P_0 Q_0 + y(P_0 Q_0 - \alpha C_2 - P_1 Q_0)] = 0$, then $x_1 = 0$, $x_2 = 1$ are two possible steady states. $F(x)$ is derived to obtain $F(x)' = (1-2x)[\beta P_0 Q_0 + y(P_0 Q_0 - \alpha C_2 - P_1 Q_0)]$. It is expressed in two cases:
 - (a) At $(P_0 Q_0 - \alpha C_2 - P_1 Q_0) > 0$:
When $F(x)' = (1-2x)[\beta P_0 Q_0 + y(P_0 Q_0 - \alpha C_2 - P_1 Q_0)]$, $F(1)' < 0$, $F(0)' > 0$. Therefore, $x = 1$ is the evolutionary steady state, or ESS, indicating that the grower's strategy will steadily evolve to normal supply at $(P_0 - P_1) Q_0 > \alpha C_2$.
 - (b) At $(P_0 Q_0 - \alpha C_2 - P_1 Q_0) < 0$, there also exist two cases:
At $y > -\beta P_0 Q_0 / [(P_0 Q_0 - \alpha C_2 - P_1 Q_0)]$, $F(x)' = (1-2x)[\beta P_0 Q_0 + y(P_0 Q_0 - \alpha C_2 - P_1 Q_0)]$, and then $F(1)' > 0$, $F(0)' < 0$.
Therefore, $x = 0$ is the evolutionary steady state or ESS, which means that at $(P_0 - P_1) Q_0 < \alpha C_2$, the proportion of normal crowdfunding is higher than the critical point $y^* = -\beta P_0 Q_0 / [(P_0 Q_0 - \alpha C_2 - P_1 Q_0)]$, and then the growers' strategy will evolve to that of rejecting supply.
At $y < -\beta P_0 Q_0 / [(P_0 Q_0 - \alpha C_2 - P_1 Q_0)]$, $F(1)' < 0$, $F(0)' > 0$, then $x = 1$ is the evolutionary steady state or ESS, and the strategy adopted by the grower is stable as the normal supply. This shows that at $(P_0 - P_1) Q_0 < \alpha C_2$, when the normal crowdfunding ratio is below the critical point y^* , the strategy of growers shall evolve into that of normal supply.

3.3. Combined Model Analysis

Equations (1) and (2) are combined to obtain: $x_1 = 0$; $x_2 = 1$; $y^* = -\beta P_0 Q_0 / [(P_0 Q_0 - \alpha C_2 - P_1 Q_0)]$; $y_1 = 0$; $y_2 = 1$; $x^* = -\gamma P_0 Q_0 / [(P_1 - P_0) Q_0 - (1 - \alpha) C_2]$

Based on $0 \leq x, y \leq 1$, $0 \leq x^* = -\gamma P_0 Q_0 / [(P_1 - P_0) Q_0 - (1 - \alpha) C_2] \leq 1$, $0 \leq y^* = -\beta P_0 Q_0 / [(P_0 Q_0 - \alpha C_2 - P_1 Q_0)] \leq 1$; it can be concluded that there are five points (0,0), (0,1), (1,0), (1,1), and (x^*, y^*) for the local equilibrium point in the plane system $s = \{(x, y) | 0 \leq x, y \leq 1\}$.

According to Friedman's method, the stability of the evolutionary game equilibrium can be derived by the local stability of Jacobian matrix (J) of the system. The Jacques Matrix is:

$$J = \begin{pmatrix} (1-2x)[\beta P_0 Q_0 + y(P_0 Q_0 - \alpha C_2 - P_1 Q_0)] & x(1-x)(P_0 Q_0 - \alpha C_2 - P_1 Q_0) \\ y(1-y)[(P_1 - P_0) Q_0 - (1 - \alpha) C_2] & (1-2y)\{\gamma P_0 Q_0 + x(P_1 - P_0) Q_0 - (1 - \alpha) C_2\} \end{pmatrix} \quad (9)$$

It includes four conditions:

Condition 1:

When $\beta P_0 Q_0 + (P_0 Q_0 - \alpha C_2 - P_1 Q_0) > 0$, and $\gamma P_0 Q_0 + (P_1 - P_0) Q_0 - (1 - \alpha) C_2 > 0$. As per condition 1, the stability analysis of evolutionary game is reported in Table 3.

Table 3. Stability analysis of evolutionary game.

Equilibrium Point	Trace Symbol	Determinant Symbol	Equilibrium Results
(0,0)	+	+	Unstable
(0,1)		−	Saddle point
(1,0)		−	Saddle point
(1,1)	−	+	ESS
(x^*, y^*)	0	−	Saddle point

Its dynamic phase diagrams are illustrated in Figures 1 and 2 as follows:

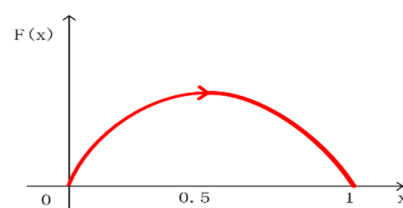


Figure 1. $F(x)$ dynamic phase diagram.

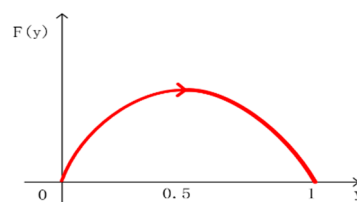


Figure 2. $F(y)$ dynamic phase diagram.

Figure 3 shows its path evolution map:

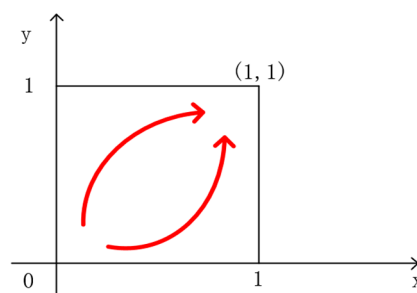


Figure 3. Two-party game path evolution map.

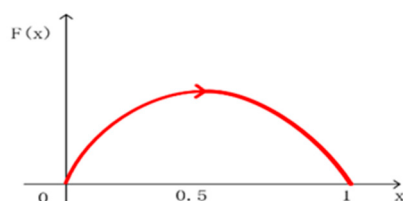
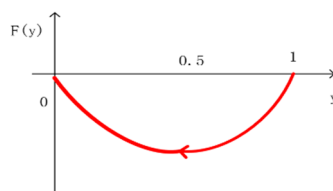
Condition 2:

When $\beta P_0 Q_0 + (P_0 Q_0 - \alpha C_2 - P_1 Q_0) > 0$, and $\gamma P_0 Q_0 + (P_1 - P_0) Q_0 - (1 - \alpha) C_2 < 0$. As per condition 2, the stability analysis of evolutionary game is reported in Table 4.

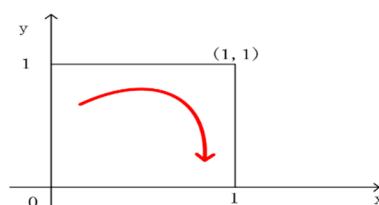
Table 4. Analysis of evolutionary game.

Equilibrium Point	Trace Symbol	Determinant Symbol	Equilibrium Results
(0,0)	+	+	Unstable
(0,1)	—	—	Saddle point
(1,0)	—	+	ESS
(1,1)	—	—	Saddle point
(x^*, y^*)	0	—	Saddle point

Figures 4 and 5 depicts the dynamic phase diagram of condition 2 as follows:

**Figure 4.** $F(x)$ dynamic phase diagram.**Figure 5.** $F(y)$ dynamic phase diagram.

While, its path evolution map is shown in Figure 6 as:

**Figure 6.** Two-party game path evolution map.

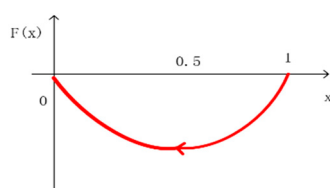
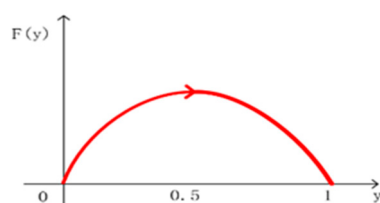
Condition 3:

When $\beta P_0 Q_0 + (P_0 Q_0 - \alpha C_2 - P_1 Q_0) < 0$, and $\gamma P_0 Q_0 + (P_1 - P_0) Q_0 - (1 - \alpha) C_2 > 0$. As per condition 3, the stability analysis of evolutionary game is reported in Table 5.

Table 5. Stability analysis of evolutionary game.

Equilibrium Point	Trace Symbol	Determinant Symbol	Equilibrium Results
(0,0)	+	+	Unstable
(0,1)	—	+	ESS
(1,0)	—	—	Saddle point
(1,1)	—	—	Saddle point
(x^*, y^*)	0	—	Saddle point

Figures 7 and 8 depicts the dynamic phase diagram:

Figure 7. $F(x)$ dynamic phase diagram.Figure 8. $F(y)$ dynamic phase diagram.

Its path evolution map is shown in Figure 9 as:

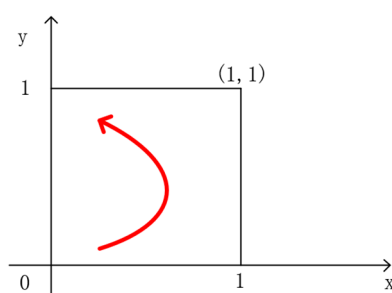


Figure 9. Two-party game path evolution map.

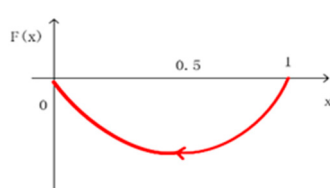
Condition 4:

When $\beta P_0 Q_0 + (P_0 Q_0 - \alpha C_2 - P_1 Q_0) < 0$, and $\gamma P_0 Q_0 + (P_1 - P_0) Q_0 - (1 - \alpha) C_2 < 0$. As per condition 4, the stability analysis of evolutionary game is reported in Table 6.

Table 6. Stability analysis of evolutionary game.

Equilibrium Point	Trace Symbol	Determinant Symbol	Equilibrium Results
(0,0)	+	+	Unstable
(0,1)	−	−	Unstable
(1,0)	+	+	Saddle point
(1,1)	+	+	Unstable
(x^*, y^*)	0	−	Saddle point

Figures 10 and 11 depicts its dynamic phase diagram:

Figure 10. $F(x)$ dynamic phase diagram.

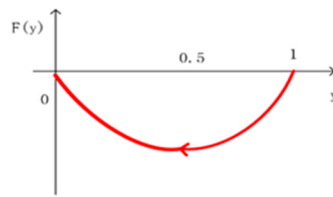


Figure 11. $F(y)$ dynamic phase diagram.

Its path evolution map is shown in Figure 12 as:

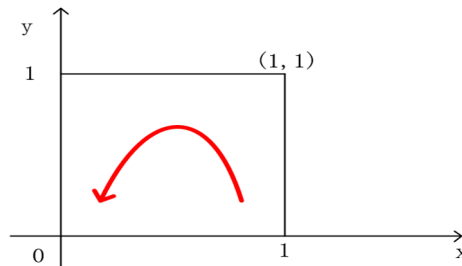


Figure 12. Two-party game path evolution map.

4. Analysis of Factors Influencing Evolutionary Game Equilibrium

Based on the previous analysis, at $(P_1 - P_0)Q_0 - (1 - \alpha)C_2 < 0$ and $x < -\gamma P_0 Q_0 / [(P_1 - P_0)Q_0 - (1 - \alpha)C_2]$, $y = 1$; at $(P_1 - P_0)Q_0 - (1 - \alpha)C_2 < 0$ and $x > -\gamma P_0 Q_0 / [(P_1 - P_0)Q_0 - (1 - \alpha)C_2]$, $y = 0$; at $(P_1 - P_0)Q_0 - (1 - \alpha)C_2 > 0$, $y = 1$.

At $(P_0 Q_0 - \alpha C_2 - P_1 Q_0) < 0$,

then: at $y > -\beta P_0 Q_0 / [(P_0 Q_0 - \alpha C_2 - P_1 Q_0)]$,

$x = 0$; at $y < -\beta P_0 Q_0 / [(P_0 Q_0 - \alpha C_2 - P_1 Q_0)]$, $x = 1$; at $(P_0 Q_0 - \alpha C_2 - P_1 Q_0) > 0$, $x = 1$.

For the critical point $x^* = -\gamma P_0 Q_0 / [(P_1 - P_0)Q_0 - (1 - \alpha)C_2]$,

The partial derivatives of γ , P_0 , Q_0 , P_1 , α , and C_2 are obtained at the critical point.

$$\begin{aligned} \frac{\partial x^*}{\partial P_0} &= -\gamma Q_0 [P_1 Q_0 - (1 - \alpha)C_2] / [(P_1 - P_0)Q_0 - (1 - \alpha)C_2]^2 < 0, \\ \frac{\partial x^*}{\partial Q_0} &= \gamma P_0 (1 - \alpha)C_2 / [(P_1 - P_0)Q_0 - (1 - \alpha)C_2]^2 > 0, \\ \frac{\partial x^*}{\partial P_1} &= \gamma P_0 Q_0^2 / [(P_1 - P_0)Q_0 - (1 - \alpha)C_2]^2 > 0, \\ \frac{\partial x^*}{\partial \alpha} &= \gamma P_0 Q_0 C_2 / [(P_1 - P_0)Q_0 - (1 - \alpha)C_2]^2 > 0, \\ \frac{\partial x^*}{\partial C_2} &= -(1 - \alpha) \gamma P_0 Q_0 / [(P_1 - P_0)Q_0 - (1 - \alpha)C_2]^2 < 0. \end{aligned}$$

This shows that, with other factors unchanged, when Q_0 , P_1 and α increase, C_2 and P_0 decrease, and the critical point x^* increases, the critical point becomes larger and x less than the critical point increases. Thus, the crowdfunding companies will have more strategies that tend to normal crowdfunding ($y = 1$), whereas, when Q_0 , P_1 , and α decrease, C_2 and P_0 increase, and the critical point x^* increases, the critical point becomes smaller and x more than the critical point increases, and thus the crowdfunders tend to remorse crowdfunding ($y = 0$). At $(P_1 - P_0)Q_0 - (1 - \alpha)C_2 < 0$, $\frac{\partial x^*}{\partial \gamma} > 0$, which means that the parameter γ changes in the same direction as the critical point x^* . With γ increasing, the critical point becomes larger and more strategies tend to be normal. With γ decreasing, the critical point becomes smaller and crowdfunders tend to remorse crowdfunding. At $(P_1 - P_0)Q_0 - (1 - \alpha)C_2 > 0$, the crowdfunding company will have more strategies that tend to normal crowdfunding ($y = 1$).

For the critical point $y^* = -\beta P_0 Q_0 / [(P_0 Q_0 - \alpha C_2 - P_1 Q_0)]$.

The derivatives for β , P_0 , Q_0 , α , C_2 , and P_1 were obtained, respectively:

$$\begin{aligned}\frac{\partial y^*}{\partial P_0} &= \beta Q_0 (\alpha C_2 + P_1 Q_0) / (P_0 Q_0 - \alpha C_2 - P_1 Q_0)^2 > 0, \\ \frac{\partial y^*}{\partial Q_0} &= \beta P_0 \alpha C_2 / (P_0 Q_0 - \alpha C_2 - P_1 Q_0)^2 > 0, \\ \frac{\partial y^*}{\partial \alpha} &= -\beta P_0 Q_0 C_2 / (P_0 Q_0 - \alpha C_2 - P_1 Q_0)^2 < 0, \\ \frac{\partial y^*}{\partial C_2} &= -\beta P_0 Q_0 \alpha / (P_0 Q_0 - \alpha C_2 - P_1 Q_0)^2 < 0, \\ \frac{\partial y^*}{\partial P_1} &= -\beta P_0 Q_0^2 / (P_0 Q_0 - \alpha C_2 - P_1 Q_0)^2 < 0.\end{aligned}$$

This shows that when Q_0 and P_0 decrease, α , C_2 , and P_1 increase, and the critical point increases, the critical point of normal crowdfunding becomes smaller and y less than the critical point y^* increases. Thus, growers mostly tend to reject supply ($x = 0$), whereas, when Q_0 and P_0 increase, α , C_2 , and P_1 decrease, and the critical point increases, the critical point of normal crowdfunding becomes smaller and y less than the critical point y^* decreases. Thus, the growers mostly tend to normal supply ($x = 1$). At $(P_0 Q_0 - \alpha C_2 - P_1 Q_0) < 0$, $\partial x^* / \partial \gamma > 0$, the critical points y^* and β are positively correlated. When β increases, the critical point becomes larger, the grower will supply normally; when β decreases and the critical point becomes smaller, the grower tends to reject the supply. At $(P_0 Q_0 - \alpha C_2 - P_1 Q_0) > 0$, the growers will gradually tend to supply normally ($x = 1$).

Considering both the critical points, x^* and y^* , when the purchase or sales volume Q_0 becomes larger and the logistical cost C_2 becomes smaller, normal supply and crowdfunding (1,1) equilibrium can be achieved, but P_0 , α , P_1 show inconsistency. When P_0 increases, α and P_1 decrease, and β increases, the willingness of growers to meet the normal supply becomes larger and that of crowdfunders becomes less. On the other hand, when P_0 decreases, α and P_1 increase, and γ becomes larger, the crowdfunding tends to be normal ($y = 1$), while the willingness of growers to meet the normal supply drops.

5. System Design and Conclusions

5.1. System Design

At $(P_0 Q_0 - \alpha C_2 - P_1 Q_0) > 0$, $x = 1$; at $(P_1 - P_0) Q_0 - (1 - \alpha) C_2 > 0$, $y = 1$. These two conditions are invalid and contradictory, because one requires that $P_1 > P_0$ while the other $P_1 < P_0$.

In addition, according to the previous model analysis for the combination of crop growers and crowdfunders, the ESS equilibrium (1,1) is what is required in the first case. The condition is that $\beta P_0 Q_0 + (P_0 Q_0 - \alpha C_2 - P_1 Q_0) > 0$ and $\gamma P_0 Q_0 + (P_1 - P_0) Q_0 - (1 - \alpha) C_2 > 0$, so it can be concluded that $P_0 (1 + \beta) - P_1 > \alpha C_2 / Q_0$ and $P_1 - P_0 + \gamma P_0 > (1 - \alpha) C_2 / Q_0$.

From the conditions concluded above, it can be seen that both β and γ require a certain proportion, otherwise it is not easy to meet the conditions and cause the evolutionary game equilibrium to change. Due to the large fluctuations in the prices of MCC, this is often as high as 20–30%, or even 100%. Based on empirical analysis, the calculations were made at the volatility of 30%: $\beta = 0.3$ and $\gamma = 0.3$. The peculiarity of this game is that if the volatility of certain p_0 and p_1 is more than 30%, the equilibrium shall become (0, 1) or (1, 0), i.e., one party defaults. Then, the crowdfunder must save 30% of his money as the downpayment, and growers need to use 30% of the money as a deposit.

The grower's deposit must be handed over to the crowdfunding platform, and the crowdfunding deposit should be paid to the growers. During this period, the interest generated by the default deposit paid by growers can be given to the crowdfunding platform, but the commission for the transaction is free; the downpayment from the crowdfunders and any interest generated are given to the growers. In actual operation, the growers pay a certain fee to the crowdfunding platform, and then the crowdfunding platform builds the MCC compensation fund with these fees to make compensation in case of the growers' breach of contract.

5.2. Conclusions

When the production of small grains is harvested, the market price will sometimes be very low [29]. The government needs to protect the interests of farmers and protect the prices of farmers. However, when the government purchases food, it entrusts the corresponding unit to purchase the farmers' food at a high price, and then subsidizes the difference to the relevant units, and its self-interest. When the farmers purchase grain at a low price, they still receive state subsidies. The subsidy that originally helped the farmers caused the farmers to get some subsidies or no subsidies, and the profit became the relevant units, which made the financial subsidy effect a discount [2]. With the agricultural product crowdfunding platform, the smooth flow of subsidies will be relative channels. When similar situations arise, it is only necessary to focus on allowing both parties to perform normally. In order to perform normally, the platform can be subsidized. The participants are repeating the game through the platform, they have to consider the future crowdfunding situation, so within the normal fluctuation range (30%) both parties can perform normally. When the price of MCC fluctuates within 30%, the two groups are bounded rationality, even if there are individuals who do not comply with the agreement, and through learning from each other within their own group will eventually abide by the treaty, that is, the evolutionary game equilibrium between the growers and the crowdfunders. Since game equilibrium is beneficial to society, especially for farmers and processing enterprises and consumers, and the game equilibrium is related to logistical costs, it is necessary to reduce the social and logistical costs. Due to the pre-sale nature of product crowdfunding, it will be stable for farmers, the supply will not change greatly, and the demand is basically stable, so the price of MCC will not change greatly. This product crowdfunding platform based on evolutionary game equilibrium will run smoothly.

In this way, the crowdfunding platform can play a role as a lever and subsidy platform, and can achieve the effect of protecting the interests of farmers with a small amount of subsidies. In this way, the financial subsidies are promoted through the platform, and the government and the crowdfunding platform are mutually promoted. The government subsidies can be quantitatively subsidized according to the transaction situation through the platform, and a small amount of subsidies can achieve the effect. Within the fluctuation range set by the crowdfunding platform, the government does not need to use the platform. Subsidies reduce financial subsidies; on the other hand, subsidies promote the development of crowdfunding platforms, and a lot of business will be carried out on the platform. All in all, subsidies promote the development of crowdfunding platforms. The crowdfunding platform has become a stabilizer for agricultural products, not just for price but also for agricultural development. The shortcoming is that when there is a contraction in the event of a disaster, the crowdfunding platform will suffer losses, but the government will not have financial subsidies. So, the government can guide the use of commercial means to protect crowdfunding platforms, such as using specialized commercial insurance [22].

Author Contributions: Conceptualization, Z.Y. and M.H.; Writing—Original Draft, Z.Y.; Writing—Review & Editing, M.T.M., L.L., and M.H.; Supervision, H.W.

Funding: This research was funded by Shanxi Social Science Planning Office Project: Shanxi Resource Transformation and Multi-level Capital Market Construction and Beijing University of Posts and Telecommunications: grant number 2018Y007 and 2018JY-A03.

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

References

1. Ren, R.; He, J.; Dong, K.; Zhang, L.; Yang, T. Competitiveness Analysis and Countermeasure Suggestions of Small Grains Industry in Gansu Province. *Chin. J. Agric. Resour. Reg. Plan.* **2014**, *8*, 141–144.
2. Wu, Y.H.; Guo, J. Analysis of Green Bean Price Fluctuations and Trend. *North. Hortic.* **2016**, *18*, 196–201.
3. Zhang, X.; Wang, L.X.; Liao, Y.C. Sustainable Development of Minor Food Crops in China. *Sci. Agric. Sin.* **2003**, *12*, 1595–1598.

4. Schwienbacher, A.; Larralde, B. *Crowdfunding of Small Entrepreneurial Ventures*; Social Science Electronic Publishing: London, UK, 2010; Volume 9.
5. Lambert, T.; Schwienbacher, A. An Empirical Analysis of Crowdfunding. *Soc. Sci. Res. Netw.* **2010**, *1*, 19–42.
6. Bi, Y.; Tao, J. Research on Poverty Alleviation Mode Based on the Complementarity of Urban and Rural Resources and Its Realizing Path. *Manag. World* **2016**, *8*, 174–175.
7. Xie, S. *Economic Game Theory*, 4th ed.; Fudan University Press: Shanghai, China, 2017; Volume 2, pp. 220–242.
8. Xie, S.M. Evolutionary Game Theory under Bounded Rationality. *J. Shanghai Univ. Financ. Econ.* **2001**, *3*, 3–9.
9. Belleflamme, P.; Lambert, T.; Schwienbacher, A. Crowdfunding: Tapping the Right Crowd. *J. Bus. Ventur.* **2014**, *29*, 585–609. [[CrossRef](#)]
10. Stanko, M.A.; Henard, D.H. Toward a Better Understanding of Crowdfunding. Openness and the Consequences for Innovation. *Res. Policy* **2017**, *4*, 784–798. [[CrossRef](#)]
11. Gerber, E.M.; Hui, J.; Kuo, P.Y. Crowdfunding: Why People are Motivated to Post and Fund Projects on Crowdfunding Platforms. In Proceedings of the International Workshop on Design, Influence, and Social Technologies: Techniques, Impacts and Ethics, Northwestern University Evanston, IL, USA, 2012; Volume 2, pp. 1–10.
12. Bouncken, R.B.; Komorek, M.; Kraus, S. Crowdfunding: The Current State of Research. *Int. J. Econ. Bus. Res.* **2015**, *14*, 407–416. [[CrossRef](#)]
13. Zhang, Y.; Sun, X. The Origin, Characteristics and Future of Agricultural Crowd-funding. *J. China Agric. Univ. (Soc. Sci. Ed.)* **2016**, *12*, 96–105.
14. Chang, W.I. Exploring Crowdfunding Performance of Agricultural Ventures: Evidence from FlyingV in Taiwan. In *International Conference on E-Infrastructure and E-Services for Developing Countries*; Springer: Cham, Switzerland, 2018; Volume 12, pp. 165–273.
15. Gerrit, K.C.; Ahlers, D.C.; Christina, G.D. Signaling in Equity Crowdfunding. *Entrep. Theory Pract.* **2015**, *4*, 955–980.
16. Xiao, J.; Zhu, H.; Jin, J. Comparative Study and Optimal Selection of Agricultural Crowd-funding Platforms. *Rural Econ.* **2017**, *1*, 24–29.
17. Agrawal, A.; Catalini, C.; Goldfarb, A. Some Simple Economics of Crowdfunding. *Innov. Policy Econ.* **2014**, *1*, 63–97. [[CrossRef](#)]
18. Colombo, M.G.; Franzoni, C.; Rossi-Lamastra, C. Internal Social Capital and the Attraction of Early Contributions in Crowdfunding. *Entrep. Theory Pract.* **2015**, *1*, 75–100. [[CrossRef](#)]
19. Lin, M.; Viswanathan, S. Home Bias in Online Investments: An Empirical Study of an Online Crowd funding Market. *Manag. Sci.* **2015**, *5*, 1393–1414. [[CrossRef](#)]
20. Kshetri, N. Success of Crowd-based Online Technology in Fundraising: An Institutional Perspective. *J. Int. Manag.* **2015**, *2*, 100–116. [[CrossRef](#)]
21. Blakley, C.D.; Keith, M.H.; Justin, W. Funders' Positive Affective Reactions to Entrepreneurs' Crowdfunding Pitches: The Influence of Perceived Product Creativity and Entrepreneurial Passion. *J. Bus. Ventur.* **2017**, *1*, 90–106.
22. Chung, J.W.; Lee, K.M. A Long-Term Study of a Crowdfunding Platform: Predicting Project Success and Fundraising Amount. In Proceedings of the HT '15 Proceedings of the 26th ACM Conference on Hypertext & Social Media, Guzelyurt, Northern Cyprus, 1–4 September 2015; Volume 9, pp. 211–220.
23. Ordanini, A.; Miceli, L.; Pizzetti, M. Crowd-funding: Transforming Customers into Investors through Innovative Service Platforms. *J. Serv. Manag.* **2011**, *4*, 443–470. [[CrossRef](#)]
24. Stanko, M.A.; Henard, D.H. How Crowdfunding Influences Innovation. *MIT Sloan Manag. Rev.* **2016**, *3*, 14–18.
25. Sheng, B.; Liu, Z.Y.; Khalid, U. The Influence of Online Information on Investing Decisions of reward-based Crowdfunding. *J. Bus. Res.* **2017**, *71*, 10–18.
26. Zheng, H.; Li, D.; Wu, J. The Role of Multidimensional Social Capital in Crowdfunding: A Comparative Study in China and US. *Inf. Manag.* **2014**, *4*, 488–496. [[CrossRef](#)]
27. Gerber, E.M.; Hui, J. Crowdfunding: Motivations and Deterrents for Participation. *ACM Trans. Comput. Hum. Interact.* **2016**, *6*, 34. [[CrossRef](#)]
28. Zvilichovsky, D.; Inbar, Y.; Barzilay, O. Playing Both Sides of the Market: Success and Reciprocity on Crowdfunding Platforms. *Coll. Sch. Manag.* **2015**, *11*, 1–45. [[CrossRef](#)]
29. Mollick, E. The Dynamics of Crowdfunding: An Exploratory Study. *J. Bus. Ventur.* **2014**, *29*, 1–16. [[CrossRef](#)]

30. Huang, L.; Zhou, Q. Research on Heterogeneous Financing Incentive and Self-feedback Mechanism Design of Creative Crowdfunding. *China Ind. Econ.* **2014**, *7*, 135–147.
31. Song, K.; Li, Y. Risk Analysis and Research on Crowdfunding Model from the Perspective of Crowdfunding Platform. *Econ. Probl.* **2016**, *12*, 47–51.
32. Meer, J. Effects of the Price of Charitable Giving: Evidence from an Online Crowdfunding Platform. *J. Econ. Behav. Organ.* **2014**, *103*, 113–124. [[CrossRef](#)]
33. Houston, A.I.; McNamara, J.M. John Maynard Smith and the Importance of Consistency in Evolutionary Game Theory. *Biol. Philos.* **2005**, *20*, 933. [[CrossRef](#)]
34. Smith, J.M. The Theory of Games and the Evolution of Animal Conflicts. *J. Theor. Biol.* **1974**, *47*, 209–221. [[CrossRef](#)]
35. Smith, J.M.; Price, G.R. The Logic of Animal Conflict. *Nature* **1973**, *246*, 15–18. [[CrossRef](#)]
36. Friedman, D. On economic applications of evolutionary game theory. *J. Evol. Econ.* **1998**, *8*, 15–43. [[CrossRef](#)]
37. Roca, C.P.; Cuesta, J.A.; Sánchez, A. Evolutionary game theory: Temporal and spatial effects beyond replicator dynamics. *Phys. Life Rev.* **2009**, *4*, 208–249. [[CrossRef](#)] [[PubMed](#)]
38. Association, A.E. Corrigenda: Do People Play Nash Equilibrium? Lessons from Evolutionary Game Theory. *J. Econ. Lit.* **1998**, *4*, 1941.
39. Dong, W.B.; Du, J.G.; Ren, J. Study on the Pioneering of Migrant Workers' Returning Based on Evolutionary Game Theory. *J. South China Agric. Univ.* **2013**, *12*, 58–63.
40. Ozkan-Canbolat, E.; Beraha, A.; Bas, A. Application of Evolutionary Game Theory to Strategic Innovation. *Procedia-Soc. Behav. Sci.* **2016**, *235*, 685–693. [[CrossRef](#)]
41. Kuechle, G. Persistence and heterogeneity in entrepreneurship: An evolutionary game theoretic analysis. *J. Bus. Ventur.* **2011**, *26*, 458–471. [[CrossRef](#)]
42. John, P.W. Mainstream Efforts to Tell a Better Story-Natural Selection as a Misplaced Metaphor: The Problem of Corporate Power. *J. Econ. Issues* **2010**, *44*, 991–1008.
43. Liu, W.W.; Yang, J.N. The Evolutionary Game Theoretic Analysis for Sustainable Cooperation Relationship of Collaborative Innovation Network in Strategic Emerging Industries. *Sustainability* **2018**, *10*, 4585. [[CrossRef](#)]
44. Shen, H.; Peng, Y.; Guo, C.X. Analysis of the Evolution Game of Construction and Demolition Waste Recycling Behavior Based on Prospect Theory under Environmental Regulation. *Int. J. Environ. Res. Public Health* **2018**, *15*, 1518. [[CrossRef](#)] [[PubMed](#)]
45. Liu, Z.; Chen, M.C.; Chao-Liang, M.A. Perceived Value Structure of Investors and Pricing Strategy of Crowdfunding Products. *Financ. Forum* **2016**, *5*, 47–58.
46. Chen, Y.T.; Zhang, R.; Liu, B. Decisions on Production and Pricing with Strategic Consumers for Green Crowdfunding Products. *Int. J. Environ. Res. Public Health* **2017**, *9*, 1090. [[CrossRef](#)] [[PubMed](#)]
47. Strauss, R. *Crowdfunding, Demand Uncertainty and Moral Hazard: A Mechanism Design Approach*; Sfb 649 Discussion Paper; Humboldt University: Berlin, Germany, 2015; Volume 7.
48. He, J.; Zhang, L.; Fu, X.; Tsai, F.-S. Fair but Risky? Recycle Pricing Strategies in Closed-Loop Supply Chains. *Int. J. Environ. Res. Public Health* **2018**, *15*, 2870.

