

Evolutionary Game of Group Cooperation Institutions for Chaoshan Businessmen in Ming and Qing Dynasties

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Chaoshan businessmen were widely involved in internal group cooperation. Based on historical and comparative institutional analysis, it is found that the cooperative behavior of Chaoshan businessmen in the Ming and Qing Dynasties is not simply an economic behavior. It reflects the historical evolution of the interaction between the regional cultures concerning the sea, clan and Confucianism, the governance of merchant groups with blood and geographical characteristics, and the beliefs of merchants in Mazu and Guan Yu. The evolutionary game theory is used to investigate the evolutionary process and the evolutionary stable strategy of the internal cooperative behavior of Chaoshan businessmen. It shows that due to the joint influence of regional culture, governance of merchant groups and beliefs of merchants, a multilateral collective punishment mechanism for untrustworthy merchants and a loss compensation mechanism for trustworthy merchants are established through channels such as chambers of commerce and ancestral temples. Thus, it reinforces the group cooperation institutions of integrity within Chaoshan merchant groups in the Ming and Qing Dynasties.

Keywords: Chaoshan businessmen, group cooperation, historical and comparative institutional analysis, evolutionary game

INTRODUCTION

Merchant groups are the commercial products of China's economic history. The Chaoshan businessmen are typical representatives passed down and famous in China and abroad. Still, they have rarely been given academic attention and studied in depth. As one of the traditional Chinese cultures, the culture of Chaoshan businessmen has nurtured generations of elite Chaoshan businessmen, implicitly shaped their ideology and behavioral preferences and profoundly influenced their business strategies and trade development. With the geographical advantage of Chaoshan as a coastal place of cultural prosperity, Chaoshan businessmen have been engaged in maritime trade since the Sui and Tang dynasties. After introducing policies prohibiting or lifting maritime trade during the Ming and Qing Dynasties, Chaoshan businessmen's red boats flourished for a while. Because of this, Chaoshan businessmen, Shanxi businessmen and Huizhou businessmen became the three most powerful merchant groups in China in modern times. And Chaoshan businessmen differ from other businessmen organizations that fell in the long history but still stand firmly in their glory.

The resumption of Kaisa Group Holdings Ltd trading, the dispute between Baoneng and Vanke and other commercial events all involve the giants of Chaoshan businessmen who have been uniting against their rivals. The business community has frequently discussed these events. It should be thoroughly explored and studied by the academic and business sectors to figure out why Chaoshan businessmen choose group cooperation and how to maintain group cooperation, which is the secret of Chaoshan businessmen's glory until now.

However, there is less research literature on the Chaoshan businessmen than the Huizhou businessmen and Shanxi businessmen, and a more scientific and complete research system has not yet been established. Chaoshan businessmen are relatively uniformly defined by scholars, who believe that Chaoshan businessmen are businessmen of Chaoshan origin influenced by Chaoshan's cultural background based on its geographical origin (Huang, 2008; He, 2014; Yi, 2017). Their related studies mainly focus on the history of their businessmen organizations, their cultural spirit, and their guildhalls. Many scholars have analyzed the institutions related to merchant groups, mainly on Huizhou businessmen and Shanxi businessmen (Cai et al., 2008; Yong, 2009; Zhang and Ge, 2012; Zheng, 2017). Some scholars have also conducted institutional analyses related to the Chaoshan businessmen's enterprise model, the Qiaopi¹ system, and the governance system of merchant groups (Yi et al., 2017; Peng and Shao, 2014; Hu and Chen, 2013; Zhao et al., 2019).

The Chaoshan businessmen of the Ming and Qing Dynasties were representatives of the early Chaoshan businessmen. Their group cooperation system reached a mature and stable equilibrium, which is an ideal sample for studying the group cooperation of Chaoshan businessmen. Currently, scholars are more interested in the historical development and the organizational system of the Chaoshan businessmen from historical and sociological perspectives. Moreover, they point out that the research related to the Chaoshan businessmen is often closely related to their commerce, such as the trading industry, trade networks, and the Maritime Silk Road (Wu, 2015; Wu, 2016; Chen, 2020). It is undeniable that the economic activities of Chaoshan businessmen are governed by material practices, cultural beliefs, and values that are socially constructed and historically relevant. However, few studies have focused on and studied microscopic business strategies in conjunction with economic thought. Hence, the research related to Chaoshan businessmen is not realistic and of little practical value.

This study attempted to study the business strategies for cooperation within the Chaoshan businessmen organizations in the Ming and Qing Dynasties and sort out and analyze their group cooperation institutions' evolutionary paths and internal mechanisms. The evolutionary game discards the assumption of "perfect rationality" and adopts the assumption of "limited rationality" for the decision-makers. It allows the game players to conduct trial and error and adjust their strategies and treats the process of group strategy adjustment as a dynamic evolutionary process, which is more in line with the actual situation. Thus, the historical and comparative institutional analysis framework was used to analyze how the group cooperation institution of Chaoshan businessmen evolved in the Ming and Qing Dynasties. It was found that the choice of business cooperation strategies for Chaoshan businessmen was profoundly affected by various factors. These factors included regional maritime culture, clan culture and Confucianism, and the governance of merchant organizations that emphasized kinship and geopolitical ties. The factors also include the beliefs of Mazu (a Chinese goddess of the sea said to protect fishers and sailors), Guan Yu (a famous general at the end of the Han Dynasty) and Han Yu (a pioneer of Neo-Confucianism and essayist and poet in China's late Tang dynasty).

Moreover, a multilateral punishment mechanism for untrustworthy merchants and a loss compensation mechanism for trustworthy merchants were developed through organizational channels such as the guildhalls and the Qiaopi Bureau. Thus, it has strengthened the group cooperation institution of integrity among the Chaoshan businessmen in the Ming and Qing Dynasties. Compared with the existing studies, the possible contributions of this paper are as follows: First, it enriches and complements the research on Chaoshan, especially the research on Chaoshan businessmen, and explores how the group cooperation mechanism of Chaoshan businessmen evolved in the Ming and Qing Dynasties. Second, it expands the scope of historical and comparative institutional analysis in the Chinese context, enriches the institutional economics research of Chinese businessmen organizations, and unlocks the black box of the group

cooperation institution of Chaoshan businessmen in the Ming and Qing Dynasties. Finally, based on the study of Chaoshan businessmen in the Ming and Qing Dynasties, some practical recommendations for the cooperation of contemporary Chaoshan businessmen were proposed in this paper. These recommendations will help promote the open cooperation of contemporary Chaoshan businesses, enhance the performance of overseas Chinese businessmen in the new era, and solidify efforts to develop the economic activities among countries along the Belt and Road.

LITERATURE REVIEW ON CHAOSHAN BUSINESSMEN

Chaoshan businessmen are an integral part of the history of commerce in China and even globally. Compared with Huizhou businessmen and Shanxi businessmen, there is less academic literature on Chaoshan businessmen, and especially there is no academic research that combines relevant theories. Therefore, the research on Chaoshan businessmen needs to be strengthened and improved.

The research on Chaoshan businessmen mainly focuses on the development history of businessmen organizations, culture and spirit of Chaoshan businessmen and guildhalls. In the study of the development history of merchant group, Lin (1997) collected and organized the data on the history of business development of Chaoshan businessmen and described in detail the history of oceanic trade and the business system of ancient businessmen organizations among Chaoshan businessmen. Some scholars have also investigated the development of salt, sugar production, textile and other handicraft industries in the Chaozhou region during the Qing Dynasty from the perspective of merchant industries. Besides, they elaborated on the relationship between the maritime trade of the Chaoshan businessmen and the commercial economy of local handicrafts (Chen, 1992; Wu, 2015). Chaoshan merchants formed businessmen organizations through years of maritime trade. As Chaoshan merchants were engaged in maritime trade all year round, they were closely related to the Maritime Silk Road in ancient and even modern times, which scholars have widely studied, revealing the vital role of Chaoshan businessmen in the Maritime Silk Road (Wu, 2016; Chen, 2020; Cai, 2021). The profound regional clan culture in Chaoshan made Chaoshan businessmen believe in both clan culture and collectivism among their fellow countrymen. Thus, the governance system of businessmen organizations, which combines the characteristics of the clan and geopolitical fellowship of Chaoshan businessmen, was bred (Yi et al., 2017; Zhao et al., 2019).

Based on the study of the development history of businessmen organizations, many scholars have summarized the cultural spirit of Chaoshan businessmen, arguing that maritime culture, clan culture and religious beliefs have profoundly influenced the group behavior of Chaoshan businessmen. Clan culture and family culture have received significant attention from scholars. It is believed that although the clan concept hindered the economic development of the Chaoshan region, it fostered the group cooperation spirit of the Chaoshan business elite (He et al., 2014). Wu (2015) elaborated on the maritime trade of the Chaoshan businessmen, summarizing that they were bold in risk-taking, good at management, worshipping gods and goddesses, and uniting as a group in maritime trade. In addition, the Chaoshan business culture has inherited the culture of traditional Chinese central plains, especially the Confucian culture. It is deeply influenced by the maritime culture, as it is centered on the five aspects of “expertise, hard work, faith, righteousness and kinship” (Wang, 2007; Zheng, 2010).

The guildhalls, the Qiaopi Bureau and the Chaoshan businesses have served as the carriers of the Chaoshan businessmen organizations and their spirit and have also been extensively concerned and studied by scholars. Some scholars have revealed how Chaoshan businessmen organizations developed in foreign countries through an in-depth investigation of the history of Chaozhou Guild Hall in Suzhou, Singapore, and Hong Kong (Cai, 1991; Lin, 1997; Xu, 2018). Some scholars have also studied the Qiaopi Bureau, the private or proxy economic organization of overseas Chaoshan businessmen in modern times. And they found that the clan relations of the Chaoshan businessmen, their social network organizations, and their cultural beliefs supported the operation of the Qiaopi system, enabling the collective punishment mechanism and maintaining the stability of the Qiaopi system (Zhang and Xue, 2018; Hu, 2021). The history of business development has been analyzed utilizing single-case or multi-case comparative studies. And it is argued that GuanXi (the system of social networks and influential relationships which facilitate

business and other dealings) substantially facilitates business development (Thomas, 1993; William and Elisabeth, 2007; Maria and Paloma, 2019).

Especially for the far-reaching, mature and stable Chaoshan businessmen in the Ming and Qing Dynasties, it has become a common business system to cooperate in groups for maritime activities. A review of studies on Chaoshan businessmen shows that few scholars have noticed the internal grouping behavior of Chaoshan businessmen. In this paper, it is argued that the analysis of the business system of internal group cooperation of Chaoshan businessmen in the Ming and Qing Dynasties contributes to understanding the basis for Chaoshan businessmen's cooperation decisions. Therefore, based on the theories and frameworks of historical and comparative institutional analysis, this paper will further conduct a comprehensive and systematic analysis of Chaoshan businessmen's internal group cooperation system during the Ming and Qing Dynasties according to specific historical records, and further verify by evolutionary game.

HISTORICAL AND COMPARATIVE INSTITUTIONAL ANALYSIS

Theoretical Basis

"The origin of institutions and their evolution" is an essential issue in institutional economics, and it has received much attention from sociologists and economists. Guided by the question of why different societies evolve along different institutional paths, Grief argued that the evolutionary process of institutions could not be well explained by the institutional analysis of traditional economic history and the new institutional economics. He proposed a new analytical framework and empirical methodology: historical and comparative institutional analysis (HCIA) in conjunction with previous findings. Grief (1998) argues that HCIA offers a historical viewpoint in examining institutions' origin, development, and change processes, a comparative perspective attempting to examine spatial and temporal differences in institutions, and an analytical perspective using historical pre-post correlation models for empirical analysis. In HCIA, an institution is a non-technically determined constraint seen as an endogenous outcome. In other words, institutions are, in a sense, self-imposed rather than dependent on external forces such as cultural beliefs or evolutionary processes.

HCIA mainly uses the mirror image presented by game theory on equilibrium studies to further intensify the analysis. Equilibrium analysis is used to study institutions as products of equilibrium constraints, enabling the examination of static, internal and self-reinforcing constraints that arise in strategic situations without external constraints. The origin and evolution of institutions reflect the internal relationships between social decision-makers, past institutions, and the environments in which they interact, which lays the foundation for testing the origin and evolution of institutions. The core of the HCIA approach is an inductive and empirical analysis of the relevance of particular institutions. Based on this approach, it evaluates and synthesizes micro, historical and comparative evidence and perceptions (from pre-post correlation models and microeconomic theoretical models), thus demonstrating the importance of synthesizing historical and comparative studies. By examining the evolutionary process of the business social institutions of the cultural beliefs of the Maghreb and Genoese merchants, Greif (1989; 1993; 1994) constructed a repeated game model with limited rationality to reveal the different institutional structures of two different merchant organizations, which led to the differences in their fates. Greif (1998) suggested that the formation and change of the business institutions and the institutional equilibrium could also be investigated by using the evolutionary game, which has been recognized by scholars in China and abroad, such as Aoki (2001; 2007), Dong (2007) and Nie (2008). The HCIA approach proposed by Greif et al. views the evolution of institutions from a historical, comparative, and analytical perspective. It mainly applies the mirror image provided by the equilibrium study in game theory and examines the institutions using equilibrium analysis, taking them as the product of equilibrium constraints. Inspired by this, this paper also uses the concept of the evolutionary game to study the cooperative system of Chaoshan businesses and conducts HCIA on the equilibrium path of their institutions.

INTERACTION OF REGIONAL CULTURE, GOVERNANCE OF MERCHANT GROUPS AND BUSINESSMEN'S BELIEFS

Unlike inland areas, the ocean is the most influential factor for Chaoshan businessmen (Huang, 2008; Lin, 2008). The ocean has not only made Chaoshan businessmen brave to fight against obstacles and hardships, but more importantly, it has shaped their sense of cooperation as a group to survive the stormy waves. The Chaoshan people, who believe all Chaoshan people worldwide as one family, usually team-up. The Chaoshan people used to collaborate for private trading with foreigners, and they were loyal to the group and crossed the sea in groups. It is evidenced in Ming Shi Lu (Records of the Ming Dynasty). It wrote that "the coastal people of Chaozhou, Guangdong Province, enticed 55 rogues from neighboring counties to engage in private maritime trade with Java. Thus twenty-two people defected to Java. The rest returned, and their boats would depart for maritime trade again." With the expansion of maritime trade activities, Chaoshan businessmen either temporarily resided overseas or settled outside the homeland. Thus the guildhalls of the Chaoshan people gradually emerged both in China and abroad (Huang, 2008). Chaozhou Guild Hall is the most famous cooperation medium for Chaoshan businessmen in China and abroad. It was defined as a group of people from the same province, prefecture or county living outside their hometown, assembling to build houses and gather annually. Its purpose was to strengthen the ties of fellow countrymen and provide relief to the poor, sick, or dead, or those who were unemployed and unable to support themselves while living away from their hometown. In the commercial war, Chaoshan businessmen would try their best to promote and support the newcomers from their hometowns. In contrast, the newcomers could stand firm with their predecessors, and jointly defend the interests of their fellow countrymen, forming a commercial force with geopolitical ties. Thus, overseas trade made Chaoshan businessmen in Ming and Qing Dynasties loyal to and more willing to cooperate with their fellow countrymen.

Han Yu's banishment to Chaoshan had great cultural significance for Chaoshan and businessmen. On the one hand, Han Yu's arrival changed the cultural landscape of Chaozhou, and the Chaozhou literati Lin Dachuan commented that "to this day, he has been the teacher for hundreds of generations." According to the Biography of Han Yu in the New Book of Tang and other historical records, Han Yu led local people to drive crocodiles out of Chaozhou, advocated rituals, and established schools for local people. The people highly recognized Han for his great concerns about their lives and the implementation of etiquette education. On the other hand, Han Yu introduced Confucianism to the grassroots and laid the foundation for the regional culture represented by Confucianism.

Moreover, the Confucian values he promoted were inner-worldly asceticism, the control of the desire of materials with morality, the importance of harmony, the unity between man and heaven, and the love of the benevolent (Zheng, 2010), which further shaped the religious beliefs of Confucianism. Integrity is an important category of Confucian ethical thought, which is deeply integrated into the business and management of Chaoshan businessmen. The inscription of the Chaozhou Guild Hall in Suzhou, built in the Kangxi reign, says, "If faithfulness and trust are mutually assured, then each of us will get what we want." It also profoundly shows that Chaoshan businessmen in the Ming and Qing Dynasties operated in good faith and adhered to the principle of making profits with morality and justice, quite like a Confucian merchant. Given this, they have gained a high reputation in the market.

The hierarchical order of home - family - clan has been deeply rooted in the behavioral preferences of Chaoshan businessmen and has strongly shaped and developed the governance system of their organizations. The clan activities originated from the advocacy of the Confucian scholars in Chaozhou. The Records of Sun's Clan Alliance were written during the Zhengde reign of the Ming dynasty. The Code of Ethics of the Nangan Countrymen was implemented in Chaozhou during the Jiajing reign of the Ming dynasty. Based on this, the clans were managed based on conventions in Ming Dynasty, which continued into the Qing dynasty (Zhao et al., 2019). During the Ming and Qing Dynasties, more and more Chaozhou people started their business at sea, including businessmen, political exiles, prodigals expelled from their clans, laborers who sold themselves, and common people who went out to make a living. Faced with an unfamiliar foreign culture, Chaoshan businessmen longed for the support and comfort of their fellow countrymen, and the existence of Chaozhou Guild Hall and Chinese associations precisely met their

spiritual needs. In particular, overseas Chaoshan businessmen set up secret societies and temples overseas to organize their activities in the early days. They later converted them into guild houses to strengthen their strength and seek group cooperation by using the cultural tradition of clan identity.

Due to the clan culture, the governance of Chaoshan businessmen's organizations is characterized by blood and geographical ties. As a result, Chaoshan businessmen, who uphold the spirit of solidarity and cooperation, take extra care of their fellow members. They even set up Chaozhou Guild Hall in various parts of China and even Southeast Asia to facilitate the networking and exchange among Chaozhou businessmen and promote mutual economic and trade cooperation. They also built business networks of honesty and trustworthiness (Chen, 2003). If a family business commits dishonest acts in such an honest business network, it will be communicated to Chaoshan businessmen through Chaozhou Guild Hall in different places. Many Chaoshan businessmen will not cooperate with it, thus establishing a multilateral collective punishment mechanism. The Chaoshan businessmen gained a good reputation in the market and were welcomed by businessmen worldwide.

The group cooperation practices of Chaoshan businessmen cannot be separated from their religious beliefs. When they went to the sea to make a living, Chaoshan people and Chaoshan businessmen were bound to face the dangers of the sea, such as typhoons, reefs and undercurrents. They always expected the gods to help them get rid of bad luck, overcome difficulties and grow up healthily, contributing to a belief in religious deities, such as Mazu and Guan Yu (Zheng, 2010; Zhao et al., 2019). Because they were born by the sea, Chaoshan businessmen had regarded Mazu as their local ancestor, thus fostering a strong sense of local community among Chaoshan businessmen and reflecting their demand for unity and harmony. In the Chaoshan region, where the clan concept was prevalent, Guan Yu was worshiped by the clans for his loyalty and honesty, leading to clan disputes and even armed fights (He et al., 2014). At the same time, Chaoshan businessmen also became internally united and honest, and it was transformed into a code of conduct. Chaozhou businessmen were commented on in the Chaozhou Chronicles, saying that "Chaozhou merchants with some credit could get loans from the financial sector and buy or sell goods on credit. Of those who have operated in a large business, 60% to 70% rely on credit, and 20% to 30% rely on capital. So Chaoshan merchants were able to run a big business with a small amount of credit." With the change of dynasties and the accumulation of thoughts, the principle of harmony (e.g., Gentlemen seek harmony but not uniformity) and patriarchal etiquette (e.g., People with the same surname feel closer) were deepened. Coupled with the inheritance of Guan Yu's practice of making attainments in loyalty and justice and honoring his words, Chaoshan businessmen of the Ming and Qing Dynasties developed a multilateral punishment mechanism within their acquaintances based on honesty and integrity to constrain merchants' honest conduct.

For Chaoshan businessmen, their regional culture, the governance of merchant groups and merchant beliefs are inseparable. The maritime culture and the Confucian culture of the Central Plains are united in the governance of businessmen organizations. Due to the clan affiliation and the sentiments of fellow countrymen, the businessmen ventured across the ocean were characterized by group cooperation. Thus a distinctive governance model for businessmen organizations emerged. The religious beliefs of merchants further strengthen the internal integrity of the governance of these organizations.

EVOLUTIONARY GAME OF GROUP COOPERATION INSTITUTIONS AMONG CHAOSHAN BUSINESSMEN

This section will develop an evolutionary model of group cooperation among Chaoshan businessmen in the Ming and Qing Dynasties, a dynamic game system changing with time. For research and analysis, the following hypotheses are made for this evolutionary model:

Assumption 1 Pairwise game: Although individual Chaoshan businessmen face other group members when making decisions, it is always possible to hypothesize that the game is played between Chaoshan businessmen in pairs.

Assumption 2 Symmetric game: The two-game players receive different payoffs simply because they adopt different action strategies, independent of the properties of the players themselves. The game payoffs

are symmetrically distributed with no difference between the two players. This chapter hypothesizes that both Chaoshan businessmen are identical in terms of factors related to their attributes, such as resource endowment, and both players receive different payoffs simply because they continue to adopt a cooperative or non-cooperative strategy.

Assumption 3 Myopia: When a Chaoshan businessman changes his strategy, he always takes the current strategy distribution as a known condition and then changes to the best strategy corresponding to it.

The above assumptions show that among similar Chaoshan businessmen, the strategy of insisting on cooperation or not is directly related to the payoffs. HCIA results indicate that Chaoshan businessmen in Ming and Qing Dynasties would do business together across the sea. Therefore, the evolutionary game of the cooperation system of Chaoshan businessmen in the Ming and Qing Dynasties was established based on the cooperation relationship reached by these Chaoshan businessmen. Suppose both players insist on a cooperative strategy among similar Chaoshan businessmen. In that case, both players are willing to make efforts and negotiate for better development opportunities and better sharing of resources to achieve synergistic development.

Therefore, through mutual cooperation, both players can obtain additional benefits, which can not be achieved by both players without cooperation. At the same time, costs are incurred by both players in their efforts to reach cooperation. They need to pay for the cost of implementing and maintaining collaborative projects such as establishing strategic partnerships and building infrastructure together. In addition, they have to make compromises and sacrifices to achieve cooperation, such as the opportunity cost of waiving part of the project payoffs through negotiation to not cause unhealthy internal competition.

Suppose one player chooses to adhere to the cooperation strategy and the other player chooses not to cooperate. In that case, the non-cooperative player may seek personal gain by using the cooperation agreement and its convenience and gain the payoffs of the cooperative player, even though it has invested in cooperation in the initial stage. At the same time, the non-cooperative player has to bear the cost of violating the principle of integrity for the cooperation of businessmen organizations, such as sanctions from the chambers of commerce. The cooperative player has to pay some costs to reach the cooperation, such as investment in entering into agreements, building infrastructure, maintaining partnership, and purchasing raw materials for products, which can be regarded as the cost of choosing cooperation. But at the same time, the cooperative player will be compensated to a certain extent by the reputational payoffs of integrity. The cooperative player will be spread among guildhalls by word of mouth to be recognized in trade and commerce and gain more payoffs. Based on the above analysis, the model is set as follows:

Chaoshan businessmen in Ming and Qing Dynasties had two strategies. Strategy 1 (cooperative) is to develop the market as a group for synergistic development; the other is strategy 2 (non-cooperative), to betray the cooperation agreement reached and develop independently. In the cooperation strategy chosen by the Chaoshan businessmen, both players are expected to gain market revenue $r(r > 0)$. Because both players have similar resource endowments, they both gain market revenue $\frac{r}{2}$ from the cooperation while each player bears the cost of reaching cooperation as $C(C > 0)$. If one player chooses to cooperate and the other player chooses not to cooperate based on a cooperative relationship established, the non-cooperative player will receive the payoffs $f(f > 0)$ of breaking the cooperation agreement for personal gain after deducting the costs of entering into the cooperation in the first stage, as well as suffer some losses $P(P > 0)$ due to the triggering of the integrity penalty mechanism. The cooperative player needs to pay the cost $L(L > 0)$ of continuing to cooperate but reaps the reputation compensation $S(S > 0)$ from businessmen organizations and chambers for their compliance with integrity.

When similar Chaoshan businessmen enter into a cooperative relationship, the payoffs resulting from the cooperation between the two players are $\frac{r}{2} - C$. If both players do not cooperate, there will be no payoffs from the cooperation. If one player insists on cooperation and the other player betrays cooperation, the payoff of the cooperative player is $S - L$, and the payoff of the defecting player is $f - P$.

Accordingly, the payoff matrix can be obtained for groups of similar Chaoshan businessmen (A and B) who adopt strategy 1 (cooperative) and strategy 2 (non-cooperative), respectively (Table 1):

TABLE 1
PAYOFF MATRIX FOR SIMILAR CHAOSHAN BUSINESSMEN AFTER ENTERING INTO A COOPERATIVE RELATIONSHIP

		Chaoshan businessman B	
		策略1(cooperative)	策略2(non-cooperative)
Chaoshan businessman A	Strategy 1 (cooperative)	$\frac{r}{2} - C$,	$S - L$,
		$\frac{r}{2} - C$	$f - P$
	Strategy 2 (non-cooperative)	$f - P$,	$0, 0$
		$S - L$	

Suppose $p(0 \leq p \leq 1)$ denotes the proportion of Chaoshan businessmen who adopt Strategy 1 (cooperative) in the Ming and Qing Dynasties, then the proportion of those who adopt Strategy 2 (non-cooperative) is $1-p$. $r_1=(1,0)$ means the region selects Strategy 1 (cooperative) with probability 1, and $r_2=(0,1)$ means the region selects Strategy 2 (non-cooperative) with probability 1. Since Chaoshan businessmen groups A and B are identical, the fitness of Chaoshan businessmen to choose Strategy 1 is obtained from the matrix:

$$f_{r^1} = p\left(\frac{r}{2} - C\right) + (1-p)(S - L)$$

The fitness of Chaoshan businessmen to choose Strategy 2 is obtained from the matrix:

$$f_{r^2} = p(f - P)$$

The average fitness is:

$$\bar{f} = pf_{r^1} + (1-p)f_{r^2}$$

The dynamic replicator equation of this game is obtained as :

$$F(p) = p(1-p)\left[p\left(\frac{r}{2} - C - f + P\right) + (1-p)(S - L) \right]$$

The stable state of the replicator dynamics can be easily solved:

$$p_1^* = 0, \quad p_2^* = 1,$$

$$p_3^* = \frac{L-S}{\frac{r}{2} - C - f + P + L - S}$$

The below can be derived:

$$F'(p_1^*) = -(L-S)$$

$$F'(p_2^*) = -\left(\frac{r}{2} - C - f + P\right)$$

$$F'(p_3^*) = (1-p_3^*)(L-S) = \frac{\frac{r}{2} - C - f + P}{\frac{r}{2} - C - f + P + L - S} (L-S)$$

According to the stability theory of differential equations, the following results can be obtained:

Proposition 3.1 When $S > L$ and $f - P > \frac{r}{2} - C$,

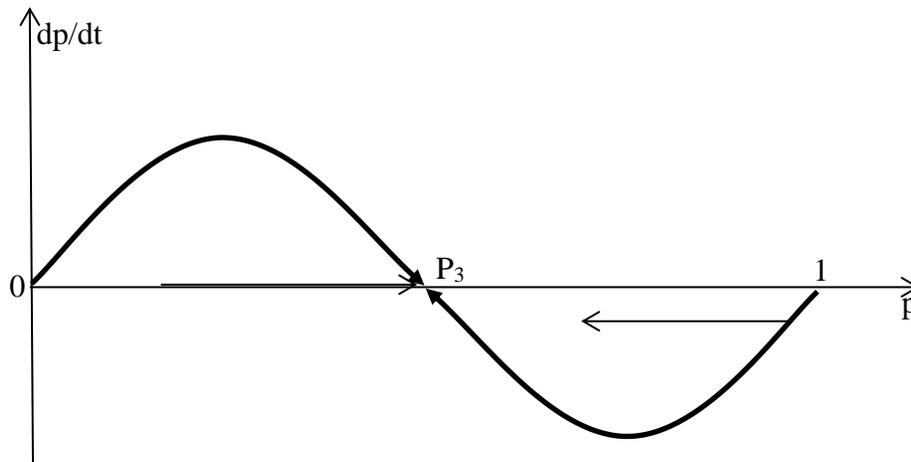
$$\Leftrightarrow \text{i.e., } L - S < 0 \text{ and } \frac{r}{2} - C - f + P < 0,$$

It can be derived that $0 < p_3^* < 1$, $F'(p_1^*) > 0$, $F'(p_2^*) > 0$, $F'(p_3^*) < 0$,

At this point, p_3^* denotes the Evolutionary Stable Strategy (ESS) for this game.

Proposition 3.1 If the net payoffs ($f - P$) of the non-cooperative player for breaking the agreement are greater than the net payoffs ($\frac{r}{2} - C$) it would have obtained if it had chosen the cooperative strategy, and the reputation compensation of the cooperative player can compensate for the loss of cooperation ($S > L$), the ESS is (non-cooperative, cooperative). The final point of stability is that one player continues to violate the agreement while the other ultimately cooperate.

FIGURE 1
DYNAMIC EVOLUTIONARY PHASE DIAGRAM OF PROPOSITION 3.1



Proposition 3.2 When $S > L$, $f - P < \frac{r}{2} - C$ and $\frac{r}{2} - C - f + P < S - L$,

$$i.e., 0 < \frac{r}{2} - C - f + P < S - L,$$

It can be derived that $0 < p_3^* < 1$, $F'(p_1^*) > 0$, $F'(p_2^*) < 0$, $F'(p_3^*) > 0$,
At this point p_2^* is the ESS for this game.

Proposition 3.3 When $S > L$, $f - P < \frac{r}{2} - C$ and $S - L < \frac{r}{2} - C - f + P$,

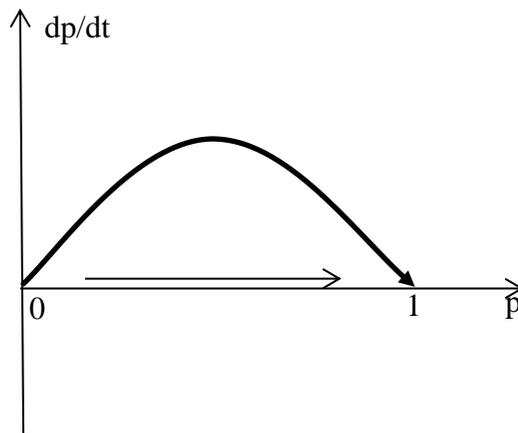
$$i.e., 0 < S - L < \frac{r}{2} - C - f + P, p_3^* < 0, F'(p_1^*) > 0, F'(p_2^*) < 0,$$

At this point p_2^* is the ESS for this game.

From Proposition 3.2 and Proposition 3.3, it can be seen that p_2^* is the ESS for the game when $S > L$ and $f - P < \frac{r}{2} - C$.

In other words, if the net payoffs ($f - P$) of the non-cooperative player are less than the net payoffs ($\frac{r}{2} - C$) it would have obtained if it had chosen the cooperative strategy and the reputation compensation of the cooperative player can compensate for the loss of cooperation ($S > L$), the ESS is (cooperative, cooperative). Both players will eventually choose a cooperative strategy, and neither player will dare to betray or suddenly not cooperate.

FIGURE 2
DYNAMIC EVOLUTIONARY PHASE DIAGRAM OF PROPOSITION 3.2 AND PROPOSITION 3.3



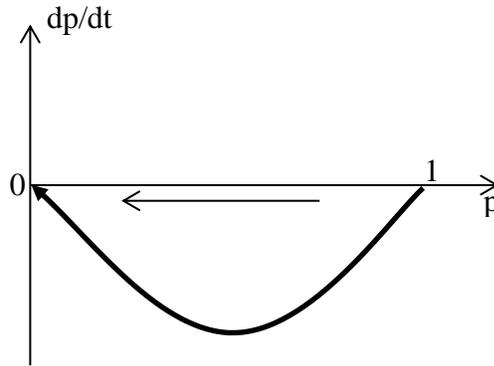
Proposition 3.4 When $S < L$ and $f - P > \frac{r}{2} - C$,

$$i.e., L - S > 0 \text{ and } \frac{r}{2} - C - f + P < 0,$$

It can be derived that $p_3^* > 1$, $F(p_1^*) < 0$, $F(p_2^*) > 0$,
At this point p_1^* is the ESS for this game.

Proposition 3.4 If the net payoffs ($f - P$) obtained by the non-cooperative player for breaking the agreement are greater than the net payoffs ($\frac{r}{2} - C$) it would have obtained if it had chosen the cooperative strategy, and the reputation compensation received by the cooperative player is not sufficient to compensate for the loss of cooperation ($S > L$), then its ESS is (non-cooperative, non-cooperative). That is, both players will eventually choose the non-cooperative strategy.

FIGURE 3
DYNAMIC EVOLUTIONARY PHASE DIAGRAM OF PROPOSITION 3.4



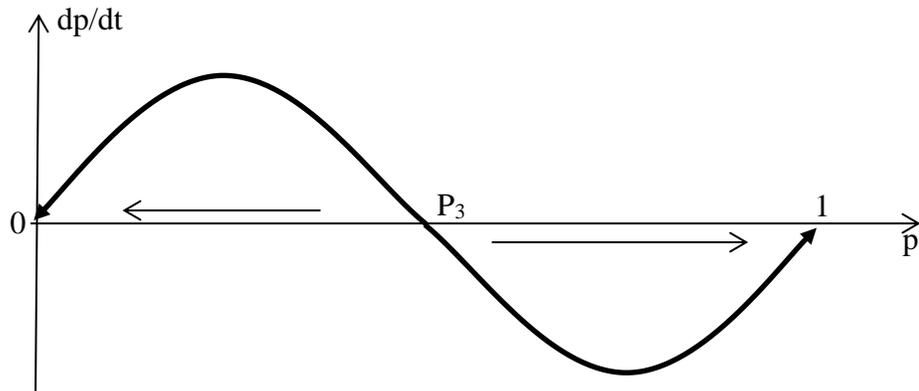
Proposition 3.5 When $S < L$ and $f - P < \frac{r}{2} - C$,

i. e., $L - S > 0$ and $\frac{r}{2} - C - f + P > 0$,

It can be derived that $0 < p_3^* < 1$, $F(p_1^*) < 0$, $F(p_2^*) < 0$, $F(p_3^*) > 0$,
At this point, p_1^* and p_2^* are the ESS for this game.

Proposition 3.5 If the net payoffs ($f - P$) obtained by the non-cooperative player for breaking the agreement are less than the net payoffs ($\frac{r}{2} - C$) it would have obtained if it had chosen the cooperative strategy, and the reputation compensation ($S < L$) received by the cooperative player is not sufficient to compensate for the loss of cooperation, its ESS is either (cooperative, cooperative) or (non-cooperative, non-cooperative). That is, the final strategy option of the game player varies with the parameters. It requires further discussion on the parameters.

FIGURE 4
DYNAMIC EVOLUTIONARY PHASE DIAGRAM OF PROPOSITION 3.5



Under certain conditions, the initial state of both sides of the region will directly determine their strategic options. The position of p_3^* may affect the interval of initial state choice. In other words, the chances of different ESSs eventually realized by replicator dynamics is closely related to the parameter of

$p_3^* = \frac{L-S}{\frac{r}{2}-C-f+P+L-S}$ (*i. e.* $p_3^* = \frac{1}{\frac{\frac{r}{2}-C-f+P}{L-S}+1}$). Therefore, the parameter status in the initial state

determines the final choice of the strategy. $\frac{r}{2}, P$ denote half of the additional market payoffs of the cooperation and the loss arising from the punishment. The larger $\frac{r}{2}, P$, the closer the point of p_3^* is to the direction of 0, and the interval with the point 1 becomes larger. It means that the interval of p_0 choosing Strategy 1 becomes larger. It indicates the increase in $\frac{r}{2}, P$ may intensify the motivational tendency of Chaoshan businessmen to choose Strategy 1 (cooperation, cooperative) and vice versa. C, f denote the cost of reaching cooperation and the payoffs of breaking the cooperation agreement by the non-cooperative player for personal gain, respectively. The greater C, f , the closer the point p_3^* is to the direction of 1, and the greater the interval with the point 0. It means that the interval of p_0 choosing Strategy 2 becomes larger. It indicates that an increase in C, f may intensify the motivational tendency of Chaoshan businessmen to choose Strategy 2 (non-cooperative, non-cooperative) and vice versa. L denotes the irreversible loss of initial cooperation cost paid by the cooperative player to reach cooperation. The greater L , the closer the point p_3^* is to the direction of 1, and the greater the interval with the point 0. It means that the interval of p_0 choosing Strategy 2 becomes larger. And it indicates that increase in L may intensify the motivational tendency of Chaoshan businessmen to choose Strategy 2 (non-cooperative, non-cooperative), and vice versa. S denotes the reputation compensation gained by the cooperative player for compliance with integrity. The greater S , the closer the point of p_3^* is to the direction of 0, and the interval with the point 1 becomes larger. It means that the interval of p_0 choosing Strategy 1 becomes larger. It indicates the increase in S may intensify the motivational tendency of Chaoshan businessmen to choose Strategy 1 (cooperation, cooperative), and vice versa.

CONCLUSION

Based on the evolutionary game theory of limited rationality, a game model of group cooperation strategies of Chaoshan businessmen in the Ming and Qing Dynasties was constructed in this paper. It revealed the evolutionary path of the cooperation system of the participants. Further, it explored the inner mechanism of the cooperation strategy of Chaoshan businessmen in the Ming and Qing Dynasties under different constraints. The main conclusions were as follows:

- (1) When the non-cooperative player's net profits are greater than those it would have obtained if it had cooperated, one player chooses not to cooperate first, the other player's decision depends on whether the reputation compensation can compensate for the loss of cooperation. When the reputation compensation is sufficient to compensate for the loss of cooperation, the other player will continue to cooperate, and otherwise, it will choose not to cooperate.
- (2) When the non-cooperative player's net payoffs are less than those it would have received if it had cooperated, and the reputation compensation is sufficient to compensate for the loss of cooperation, Chaoshan businessmen in Ming and Qing Dynasties may continue to cooperate. However, when the reputation compensation is not enough to compensate for the loss of cooperation, Chaoshan businessmen may be promoted towards a cooperative strategy by increasing the cooperation profit, increasing the punishment cost of betrayal, increasing the reputation compensation, decreasing the cooperation cost, decreasing the profit of betrayal, and decreasing the loss of betrayal suffered by the cooperative player.

Given the evolution of the group cooperation institution of Chaoshan businessmen in the Ming and Qing Dynasties from the perspective of HCIA, it was believed that Chaoshan businessmen in the Ming and Qing Dynasties were adventurous and were highly capable of developing the markets due to the influence of the maritime culture. At the same time, due to the uncertainty of the market, they could only know the cost of betrayal, but they cannot determine the cost of betrayal. Still, their commercial interests could be maximized by adhering to the strategy of the group cooperation. In addition, due to the influence of Confucianism and the dissemination of religious beliefs, Chaoshan merchant Groups, concerned about blood and geographical ties, established networks of acquaintances through guildhalls, clans and even their mother tongue. On the one hand, a multilateral collective punishment mechanism based on reputation was

spontaneously formed for the untrustworthy Chaoshan businessmen. Chaoshan businessmen who breached the agreement would be expelled from the circle of Chaoshan businessmen in the future, and no one would cooperate with them, making them pay a heavy price. On the other hand, the Chaoshan businessmen who keep their word may suffer temporary losses by being betrayed. Still, they can also be comforted by other Chaoshan businessmen and compensated accordingly. Moreover, their reputation would be widely disseminated through guildhalls and other channels, which enabled them to win a good business reputation and lay a foundation for future business cooperation.

Therefore, Chaoshan businessmen in the Ming and Qing Dynasties did not dare to break their agreements but firmly kept their promises, greatly reducing internal credit risk and lowering transaction costs. As a result, Chaoshan businessmen were more willing to cooperate, which led to the group cooperation institution of Chaoshan businessmen organizations. The regional culture, the governance of businessmen organizations, and the beliefs of businessmen have contributed to the group cooperation institutions of Chaoshan businessmen, which have been continuously reinforced by themselves.

DISCUSSION

First of all, this paper presents the group cooperation institutions of Chaoshan businessmen in the Ming and Qing Dynasties from the perspective of HCIA, with certain limitations in collecting, organizing and analyzing historical materials such as historical sources and local chronicles. Due to the ambiguity of some records, the translation and interpretation of relevant materials are subjective to some extent. Still, various parties have verified them to improve their accuracy. With the development of modern commerce and the advancement of science and technology, clan-based and regional group cooperation has its limitations. The cooperation mechanism between contemporary Chaoshan businessmen and Chaoshan businessmen rooted overseas in Ming and Qing dynasties and even other periods should be further studied.

Second, the game model in this paper is established on the assumption that the Chaoshan businessmen of the Ming and Qing Dynasties had almost similar capacities. Therefore, the proposed game model has not yet considered the asymmetrical players of Chaoshan businesses of different sizes. Generally speaking, as shown in the organizational system of chambers of commerce and guildhalls mentioned above, Chaoshan businessmen supported the disadvantaged members through business organizations or social groups such as chambers of commerce and guildhalls to achieve win-win cooperation and common prosperity. Thus, the cooperation mechanism between large-scale and small-scale Chaoshan businessmen should be investigated. In addition, many modern Chaoshan businesses cooperate with non-Chaoshan businesses, and their cooperation mechanism and development prospects should also be regarded as priorities for future research.

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ENDNOTE

- ¹ Qiaopi, also known as ‘Yinxin’, refers to the remittances, letters, reports, account books and remittance receipts, resulting from communication in the 19th and 20th centuries between the many men who left China’s southeast coast to work overseas and their families and relatives living in Southeastern China.

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