Relational Capital and Blockchain: Can Smart Contracts Redefine the Nature of Inter-organisational Cooperation?

José Brache and Anne Marie Zwerg-Villegas

Abstract The relational view posits that the relational capital derived from the social network process may facilitate the achievement of organisational strategic objectives in inter-organisational cooperation (Liu et al. in Journal of World Business 45:237–249, 2010). However, scholarly literature and business media are rife with examples of inter-organisational cooperation hindering the accomplishment of management goals (Brache and Felzensztein in International Business Review 28:25–35, 2019), with over fifty percent of alliances failing to meet their initial objectives (Kaplan et al. in Harvard Business Review 88:114–120, 2010). Blockchain technology introduces the opportunity to create, operate, and effectively regulate decentralized autonomous organisations (DAOs) with functions that include ownership, governance, decision-making, and profit distribution (Sims in New Zealand Universities Law Review 28:423–458, 2019). Smart contracts in the blockchain could serve as an automaton to efficiently modify cooperation behaviours, thus improving the potential for successful cooperation. Using a game theory approach to formulate a series of propositions, this study explores how smart contracts and blockchain technology help develop and manage relational capital. As a theoretical contribution, this chapter explains how smart contracts solve the natural frictions that arise in collaborative projects and offers a set of recommendations for policymakers and practitioners looking to engage in inter-organisational cooperation using smart contracts as a mediating tool.

Keywords Relational capital · Blockchain · Smart contracts · Inter-organisational relationships · Intellectual capital · Cooperation

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1 Introduction

The contemporary economy increasingly consists of global and inter-organizational alliances to source both tangible and intangible resources and foment the achievement of organizational strategic objectives (Brache & Felzensztein, 2019). However, despite the ubiquity of inter-organisational collaboration, only half of these arrangements succeed in meeting their objectives (Kaplan et al., 2010). Cooperation implies an investment on the part of each participating firm with the expectation of benefit. Game theory modelling clearly demonstrates the risks involved with collaboration and the rational tendency to defect.

Relational capital theory indicates that trust, communication, and commitment between co-operators improve the potential for success. Relational capital is a firm resource that results from the social network processes. In this regard, the relational view affirms that competitive advantages can be accessed beyond firm-level resources and might be embedded in intertwined collaborative relationships (Liu et al., 2010). Still, scarcity mindset and proprietary knowledge vulnerability in alliances moderates the beneficial influence of relational capital (Lee et al., 2007; Wiedmer et al., 2020).

Blockchain technology introduces an opportunity to create, operate, and effectively regulate decentralised autonomous organisations (DAOs) with functions that include ownership, governance, decision-making, and profit distribution (Sims, 2019). This implies that, while over fifty percent of alliances fail to meet their initial objectives (Kaplan et al., 2010), smart contracts in the blockchain could serve as an automaton that may efficiently modify cooperation behaviours. Thus, blockchain technology, including smart contracts, may resolve many of the negative cooperation behaviours leading to the failures amply reported in the cooperation literature.

This chapter explores how blockchain technology and smart contracts could develop and manage relational capital. A game theory approach formulates a series of propositions to guide academic researchers and practitioners in understanding the applications of blockchain technology in the development of intellectual capital. As a theoretical contribution, this chapter explains how smart contracts solve the natural frictions that arise in collaborative projects and offers a set of recommendations for policymakers and practitioners looking to engage in inter-organisational cooperation using smart contracts as a mediating tool.

1.1 Cooperation

The essential mathematical principles addressing the issue of cooperation can be found widely in the evolutionary dynamics literature stream. These principles create models for human populations as well as other species in regards to the evolution of cooperation. Game theory is commonly used in this field as an appropriate research tool (Xia et al., 2012).

Table 1 Payoffs according to the Prisoner's Dilemma

		Individual 2	
		Co-operate	Defect
Individual 1	Co-operate	Benefit-Cost, Benefit-Cost	−Cost, Benefit
	Defect	Benefit, −Cost	0, 0

Cooperation is a strategy that flourishes in nature and is present among many organisms. Humans are the "super co-operators" because of the high degree of complexity present in human–human cooperation. Mathematical models that simulate cooperation should include the fact that individuals who cooperate have a cost "C" to facilitate the receipt of a benefit "B" on the other cooperating individual's behalf. Defectors do not assume a cost and facilitate no benefit (Nowak, 2006). This scheme proposes a framework to understand the dynamics of cooperation and its possible outcomes. The standard payoffs for participating individuals are shown in Table 1.

Understanding the cooperation model portrayed in Table 1 enables the integration of context effects into the model. The context will affect each individual's cost and benefits entering a cooperation dilemma; therefore, context can be crucial in determining the cooperation equilibria. Relational capital now acquires a relevant role in cooperation dynamics.

1.2 Relational Capital

Contemporary inter-organisational cooperation is global in nature, which is inherently complicated and risky. Thus, relational capital becomes gradually more important as a predictor of cooperation success. Relational capital is a firm resource that results from social network processes. In this regard, the relational view affirms that competitive advantages can be accessed beyond firm-level resources and might be embedded in intertwined collaborative relationships (Liu et al., 2010). Literature suggests that relational capital plays a vital role in alliances dealing with the exchange of both tangible and intangible resources.

In the case of tangible resources, global competition increases the perception of scarcity, and the threat of scarcity impacts firm sales and purchasing decisions. Behavioural research demonstrates that the scarcity mindset foments competition rather than collaboration. Relational capital—based on trust, communication, and commitment (Lee et al., 2007)—may moderate scarcity-induced competitiveness. However, scarcity-specific supply chain research finds evidence that competitive behaviour continues, with less propensity for collaboration involving critical resource supplies, regardless of the extent of relational capital (Wiedmer et al., 2020).

As the global economy becomes dependent upon knowledge as a source of competitive advantage, inter-organisational cooperation increasingly involves information exchange and learning opportunities. Firms in “learning alliances,” specifically, have the primary objective of internalizing critical information, knowledge, or capabilities from their partners (Khanna et al., 1998). However, firms in these alliances are in a delicate situation. If they contribute too little, the alliance will not flourish. If they contribute too much, the partner will reap the extent of the benefits. Relational capital helps balance these extremes by facilitating learning interactions while reducing opportunistic behavior (Lee et al., 2007).

1.3 Blockchain and Smart Contracts

Blockchain technology has a wide range of industry applications, given its capability to foment decentralization, tamper-proofing, transparency, and traceability (Wang et al., 2021). The smart contract is a specific blockchain technology providing security and financial benefits in commercial settings. Standard features include self-execution, self-enforcement, transparency, and flexibility (Wang et al., 2021). As such, smart contracts are especially useful in high-value financial transactions. We propose that the smart contract blockchain technology is useful in inter-organizational cooperation above and beyond relational capital. In high stakes alliances, whether due to high monetary investment, vulnerability of proprietary knowledge, or lack of trust between new partners, smart contracts provide a mechanism to ensure each partner’s commitment and collaboration to at least a minimally agreed upon standard.

To demonstrate the usefulness of such blockchain smart contract technologies, we first model a series of inter-organisational export ventures in their absence. The scenarios evaluated using the following model highlight the logical and rational tendency for each firm to defect.

2 The Model

The following models consider two firms (Firm 1 and Firm 2) that cooperate in an export venture. Both firms have the choice to cooperate or defect and must make the decision simultaneously. They may communicate before deciding. If they decide to cooperate, they may cooperate at five different levels. Each level represents the cost of the firm related to the specific export venture. C1 represents the cost to Firm 1; C2 represents the cost to Firm 2. Table 2 depicts the matrix of choices.

The total income that each firm will secure from the cooperative action (the export venture) is the benefit. B1 is the benefit for Firm 1. B2 is the benefit for Firm 2. Consistent with game theory, we propose that each firm’s benefit as a direct result of

Table 2 Cost matrix of choice combinations

C1/C2	1	2	3	4	5
1	1,1	1,2	1,3	1,4	1,5
2	2,1	2,2	2,3	2,4	2,5
3	3,1	3,2	3,3	3,4	3,5
4	4,1	4,2	4,3	4,4	4,5
5	5,1	5,2	5,3	5,4	5,5

Table 3 Payoff matrix

		Firm 2	
		Cooperate	Defect
Firm 1	Cooperate	B1-C1, B2-C2	−C1, B2
	Defect	B1, −C2	0, 0

the cooperative action will be a function of the cost matrix of choice combinations: $b_i = F_i$ (Cost Matrix of Choice Combinations).

In this model, we present the following separate functions for Firm1 and Firm2.

$$B1 = C1 * \lambda + C2 * \beta \tag{1}$$

$$B2 = C1 * \pi + C2 * \alpha \tag{2}$$

where

λ The return that Firm1 achieves from its own investment (cost).
β The return that Firm1 achieves from the investment (cost) of Firm2.
π The return that Firm2 achieves from its own investment (cost).
α The return that Firm2 achieves from the investment (cost) of Firm 1.

Table 3 represents the final payoffs corresponding to each firm.

2.1 Evaluating Multiple Scenarios

Initially, we evaluated the resulting payoff matrices of 17 different scenarios that reflect different value combinations of λ, β, π, and α at all levels of the cost matrix of choice combinations. Nash equilibriums are identified in each case. λ, β, π, and α capture the internal and external factors affecting the firm's performance.

The chosen scenarios are built as a matrix on the following logic, giving the Firm 1 example. The same would apply to Firm 2.

Table 4 Scenario values

Scenario	λ	β	π	α
1	1.2	0.2	1.2	0.2
2	0.2	0.2	1.2	0.2
3	1.2	0	1.2	0.2
4	0.2	0	1.2	0.2
5	1.2	0.2	0.2	0.2
6	0.2	0.2	0.2	0.2
7	1.2	0	0.2	0.2
8	0.2	0	0.2	0.2
9	1.2	0.2	1.2	0
10	0.2	0.2	1.2	0
11	1.2	0	1.2	0
12	0.2	0	1.2	0
13	1.2	0.2	0.2	0
14	0.2	0.2	0.2	0
15	1.2	0	0.2	0
16	0.2	0	0.2	0
17	1	0	1	0

- Recover + Margin: The firm recovers its own investment (C1 in the case of Firm 1), has a profit on its own investment (C1), and also has a profit on the investment of the other firm (C2).
- Does Not Recover + Margin: The firm does not recover its own investment (C1 in the case of Firm 1), does not have profit on its own investment (C1), but does have a profit on the investment of the other firm (C2).
- Recovers + 0 Margin: The firm recovers its own investment (C1), has a profit on its own investment (C1), but does not have a profit on the investment of the other firm (C2).
- Does Not Recover + 0 Margin: The firm does not recover its own investment (C1), does not have profit on its own investment (C1), and does not have profit on the investment of the other firm (C2).

Table 4 provides the values for each variable in each of the evaluated scenarios.

In each of the potential payoff scenarios below, Nash equilibria are highlighted in italic.

	Scenario 1																			
	Firm 2																			
	1,1				1,2				1,3				1,4				1,5			
Firm 1	*0.4*	*0.4*	−1	0.2	*0.6*	*0.6*	−1	0.2	*0.8*	*0.8*	−1	0.2	*1*	*1*	−1	0.2	*1.2*	*1.2*	−1	0.2
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	2,1				2,2				2,3				2,4				2,5			
	0.6	*0.6*	−1	0.2	*0.8*	*0.8*	−2	0.4	*1*	*1*	−2	0.4	*1.2*	*1.2*	−2	0.4	*1.4*	*1.4*	−2	0.4
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	3,1				3,2				3,3				3,4				3,5			
	0.8	*0.8*	−3	0.6	*1*	*1*	−3	0.6	*1.2*	*1.2*	−3	0.6	*1.4*	*1.4*	−3	0.6	*1.6*	*1.6*	−3	0.6
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	4,1				4,2				4,3				4,4				4,5			
	1	*1*	−4	0.8	*1.2*	*1.2*	−4	0.8	*1.4*	*1.4*	−4	0.8	*1.6*	*1.6*	−4	0.8	*1.8*	*1.8*	−4	0.8
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	5,1				5,2				5,3				5,4				5,5			
	1.2	*1.2*	−5	1	*1.4*	*1.4*	−5	1	*1.6*	*1.6*	−5	1	*1.8*	*1.8*	−5	1	2	2	−5	1
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*

	Scenario 2																			
	Firm 2																			
	1,1				1,2				1,3				1,4				1,5			
Firm 1	−0.6	0.4	−1	0.2	−0.4	0.6	−1	0	−0.2	0.8	−1	0.2	0	1	−1	0.2	0.2	1.2	−1	0.2
	0.2	−1	*0*	*0*	0.04	−2	*0*	*0*	0.6	-3	*0*	*0*	0.8	−4	*0*	*0*	1	−−5	*0*	*0*
	2,1				2,2				2,3				2,4				2,5			
	−1.4	0.6	−1	0.2	−1.2	0.8	−2	0	−1	1	−2	0.4	−0.8	1.2	−2	0.4	−0.6	1.4	−2	0.4
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	3,1				3,2				3,3				3,4				3,5			
	−2.2	0.8	−3	0.6	−2	1	−3	1	−1.8	1.2	−3	0.6	−1.6	1.4	−3	0.6	−1.4	1.6	−3	0.6
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	4,1				4,2				4,3				4,4				4,5			
	−3	1	−4	0.8	−2.8	1.2	−4	1	−2.6	1.4	−4	0.8	−2.4	1.6	−4	0.8	−2.2	1.8	−4	0.8
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	5,1				5,2				5,3				5,4				5,5			
	−3.8	1.2	−5	1	−3.6	1.4	−5	1	−3.4	1.6	−5	1	−3.2	1.8	−5	1	−3	2	−5	1
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*

	Scenario 3																			
	Firm 2																			
	1,1				1,2				1,3				1,4				1,5			
Firm 1	*0.2*	*0.4*	−1	0.2	*0.2*	*0.6*	−1	0	*0.2*	*0.8*	−1	0.2	*0.2*	*1*	−1	0.2	*0.2*	*1.2*	−1	0.2
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	2,1				2,2				2,3				2,4				2,5			
	0.4	*0.6*	−1	0.2	*0.4*	*0.8*	−2	0.4	*0.4*	*1*	−2	0.4	*0.4*	*1.2*	−2	0.4	*0.4*	*1.4*	−2	0.4
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	3,1				3,2				3,3				3,4				3,5			
	0.6	*0.8*	−3	0.6	*0.6*	*1*	−3	0.6	*0.6*	*1.2*	−3	0.6	*0.6*	*1.4*	−3	0.6	*0.6*	*1.6*	−3	0.6
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	4,1				4,2				4,3				4,4				4,5			
	0.8	*1*	−4	0.8	*0.8*	*1.2*	−4	0.8	*0.8*	*1.4*	−4	0.8	*0.8*	*1.6*	−4	0.8	*0.8*	*1.8*	−4	0.8
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	5,1				5,2				5,3				5,4				5,5			
	1	*1.2*	−5	1	*1*	*1.4*	−5	1	*1*	*1.6*	−5	1	*1*	*1.8*	−5	1	*1*	*2*	−5	1
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*

	Scenario 4																			
	Firm 2																			
	1,1				1,2				1,3				1,4				1,5			
Firm 1	−0.8	0.4	−1	0.2	−0.8	0.6	−1	0.2	−0.8	0.8	−1	0.2	−0.8	1	−1	0.2	−0.8	1.2	−1	0.2
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	2,1				2,2				2,3				2,4				2,5			
	−1.6	0.6	−1	0.2	−1.6	0.8	−2	0.4	−1.6	1	−2	0.4	−1.6	1.2	−2	0.4	−1.6	1.4	−2	0.4
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	3,1				3,2				3,3				3,4				3,5			
	−2.4	0.8	−3	0.6	−2.4	1	−3	0.6	−2.4	1.2	−3	0.6	−2.4	1.4	−3	0.6	−2.4	1.6	−3	0.6
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	4,1				4,2				4,3				4,4				4,5			
	−3.2	1	−4	0.8	−3.2	1.2	−4	0.8	−3.2	1.4	−4	0.8	−3.2	1.6	−4	0.8	−3.2	1.8	−4	0.8
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	5,1				5,2				5,3				5,4				5,5			
	−4	1.2	−5	1	−4	1.4	−5	1	−4	1.6	−5	1	−4	1.8	−5	1	−4	2	−5	1
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*

	Scenario 5																			
	Firm 2																			
	1,1				1,2				1,3				1,4				1,5			
Firm 1	0.4	−0.6	−1	0.2	0.6	−1.4	−1	0.2	0.8	−2.2	−1	0.2	1	−3	−1	0.2	1.2	−3.8	−1	0.2
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	2,1				2,2				2,3				2,4				2,5			
	0.6	−0.4	−1	0.2	0.8	−1.2	−2	0.4	1	−2	−2	0.4	1.2	−2.8	−2	0.4	1.4	−3.6	−2	0.4
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	3,1				3,2				3,3				3,4				3,5			
	0.8	−0.2	−3	0.6	1	−1	−3	0.6	1.2	−1.8	−3	0.6	1.4	−2.6	−3	0.6	1.6	−3.4	−3	0.6
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	4,1				4,2				4,3				4,4				4,5			
	1	0	−4	0.8	1.2	−0.8	−4	0.8	1.4	−1.6	−4	0.8	1.6	−2.4	−4	0.8	1.8	−3.2	−4	0.8
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	5,1				5,2				5,3				5,4				5,5			
	1.2	0.2	−5	1	1.4	−0.6	−5	1	1.6	−1.4	−5	1	1.8	−2.2	−5	1	2	−3	−5	1
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.06	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*

	Scenario 6																			
	Firm 2																			
	1,1				1,2				1,3				1,4				1,5			
Firm 1	−0.6	−0.6	−1	0.2	−0.4	−1.4	−1	0.2	−0.2	−2.2	−1	0.2	0	−3	−1	0.2	0.2	−3.8	−1	0.2
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	2,1				2,2				2,3				2,4				2,5			
	−1.4	−0.4	−1	0.2	−1.2	−1.2	−2	0.4	−1	−2	−2	0.4	−0.8	−2.8	−2	0.4	−0.6	−3.6	−2	0.4
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	3,1				3,2				3,3				3,4				3,5			
	−2.2	−0.2	−3	0.6	−2	−1	−3	0.6	−1.8	−1.8	−3	0.6	−1.6	−2.6	−3	0.6	−1.4	−3.4	−3	0.6
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	4,1				4,2				4,3				4,4				4,5			
	−3	0	−4	0.8	−2.8	−0.8	−4	0.8	−2.6	−1.6	−4	0.8	−2.4	−2.4	−4	0.8	−2.2	−3.2	−4	0.8
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	5,1				5,2				5,3				5,4				5,5			
	−3.8	0.2	−5	1	−3.6	−0.6	−5	1	−3.4	−1.4	−5	1	−3.2	−2.2	−5	1	−3	−3	−5	1
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.06	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*

	Scenario 7																			
	Firm 2																			
	1,1				1,2				1,3				1,4				1,5			
Firm 1	0.2	−0.6	−1	0.2	0.2	−1.4	−1	0.2	0.2	−2.2	−1	0.2	0.2	−3	−1	0.2	0.2	−3.8	−1	0.2
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	2,1				2,2				2,3				2,4				2,5			
	0.4	−0.4	−1	0.2	0.4	−1.2	−2	0.4	0.4	−2	−2	0.4	0.4	−2.8	−2	0.4	0.4	−3.6	−2	0.4
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	3,1				3,2				3,3				3,4				3,5			
	0.6	−0.2	−3	0.6	0.6	−1	−3	0.6	0.6	−1.8	−3	0.6	0.6	−2.6	−3	0.6	0.6	−3.4	−3	0.6
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	4,1				4,2				4,3				4,4				4,5			
	0.8	0	−4	0.8	0.8	−0.8	−4	0.8	0.8	−1.6	−4	0.8	0.8	−2.4	−4	0.8	0.8	−3.2	−4	0.8
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	5,1				5,2				5,3				5,4				5,5			
	1	0.2	−5	1	1	−0.6	−5	1	1	−1.4	−5	1	1	−2.2	−5	1	1	−3	−5	1
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*

	Scenario 8																			
	Firm 2																			
	1,1				1,2				1,3				1,4				1,5			
Firm 1	−0.8	−0.6	−1	0.2	−0.8	−1.4	−1	0.2	−0.8	−2.2	−1	0.2	−0.8	−3	−1	0.2	−0.8	−3.8	−1	0.2
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	2,1				2,2				2,3				2,4				2,5			
	−1.6	−0.4	−1	0.2	−1.6	−1.2	−2	0.4	−1.6	−2	−2	0.4	−1.6	−2.8	−2	0.4	−1.6	−3.6	−2	0.4
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	3,1				3,2				3,3				3,4				3,5			
	−2.4	−0.2	−3	0.6	−2.4	−1	−3	0.6	−2.4	−1.8	−3	0.6	−2.4	−2.6	−3	0.6	−2.4	−3.4	−3	0.6
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	4,1				4,2				4,3				4,4				4,5			
	−3.2	0	−4	0.8	−3.2	−0.8	−4	0.8	−3.2	−1.6	−4	0.8	−3.2	−2.4	−4	0.8	−3.2	−3.2	−4	0.8
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	5,1				5,2				5,3				5,4				5,5			
	−4	0.2	−5	1	−4	−0.6	−5	1	−4	−1.4	−5	1	−4	−2.2	−5	1	−4	−3	−5	1
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*

	Scenario 9																			
	Firm 2																			
	1,1				1,2				1,3				1,4				1,5			
Firm 1	*0.4*	*0.2*	−1	0	*0.6*	*0.4*	−1	0	*0.8*	*0.6*	−1	0	*1*	*0.8*	−1	0	*1.2*	*1*	−1	0.2
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	2,1				2,2				2,3				2,4				2,5			
	0.6	*0.2*	−1	0	*0.8*	*0.4*	−2	0	*1*	*0.6*	−2	0	*1.2*	*0.8*	−2	0	*1.4*	*1*	−2	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	3,1				3,2				3,3				3,4				3,5			
	0.8	*0.2*	−3	0	*1*	*0.4*	−3	0	*1.2*	*0.6*	−3	0	*1.4*	*0.8*	−3	0	*1.6*	*1*	−3	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	4,1				4,2				4,3				4,4				4,5			
	1	*0.2*	−4	0	*1.2*	*0.4*	−4	0	*1.4*	*0.6*	−4	0	*1.6*	*0.8*	−4	0	*1.8*	*1*	−4	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	5,1				5,2				5,3				5,4				5,5			
	1.2	*0.2*	−5	0	*1.4*	*0.4*	−5	0	*1.6*	*0.6*	−5	0	*1.8*	*0.8*	−5	0	*2*	*1*	−5	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*

	Scenario 10																			
	Firm 2																			
	1,1				1,2				1,3				1,4				1,5			
Firm 1	−0.6	0.2	−1	0	−0.4	0.4	−1	0	−0.2	0.6	−1	0	0	0.8	−1	0	0.2	1	−1	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	2,1				2,2				2,3				2,4				2,5			
	−1.4	0.2	−2	0	−1.2	0.4	−2	0	−1	0.6	−2	0	−0.8	0.8	−2	0	−0.6	1	−2	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	3,1				3,2				3,3				3,4				3,5			
	−2.2	0.2	−3	0	−2	0.4	−3	0	−1.8	0.6	−3	0	−1.6	0.8	−3	0	−1.4	1	−3	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	4,1				4,2				4,3				4,4				4,5			
	−3	0.2	−4	0	−2.8	0.4	−4	0	−2.6	0.6	−4	0	−2.4	0.8	−4	0	−2.2	1	−4	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	5,1				5,2				5,3				5,4				5,5			
	−3.8	0.2	−5	0	−3.6	0.4	−5	0	−3.4	0.6	−5	0	−3.2	0.8	−5	0	−3	1	−5	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*

	Scenario 11																			
	Firm 2																			
	1,1				1,2				1,3				1,4				1,5			
Firm 1	*0.2*	*0.2*	−1	0	*0.2*	*0.4*	−1	0	*0.2*	*0.6*	−1	0	*0.2*	*0.8*	−1	0	*0.2*	*1*	−1	0.2
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	2,1				2,2				2,3				2,4				2,5			
	0.4	*0.2*	−1	0	*0.4*	*0.4*	−2	0	*0.4*	*0.6*	−2	0	*0.4*	*0.8*	−2	0	*0.4*	*1*	−2	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	3,1				3,2				3,3				3,4				3,5			
	0.6	*0.2*	−3	0	*0.6*	*0.4*	−3	0	*0.6*	*0.6*	−3	0	*0.6*	*0.8*	−3	0	*0.6*	*1*	−3	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	4,1				4,2				4,3				4,4				4,5			
	0.8	*0.2*	−3	0	*0.8*	*0.4*	−4	0	*0.8*	*0.6*	−4	0	*0.8*	*0.8*	−4	0	*0.8*	*1*	−4	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	5,1				5,2				5,3				5,4				5,5			
	1	*0.2*	−3	0	*1*	*0.4*	−5	0	*1*	*0.6*	−5	0	*1*	*0.8*	−5	0	*1*	*1*	−5	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*

	Scenario 12																			
	Firm 2																			
	1,1				1,2				1,3				1,4				1,5			
Firm 1	−0.8	0.2	−1	0	−0.8	0.4	−1	0	−0.8	0.6	−1	0	−0.8	0.8	−1	0	−0.8	1	−1	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	2,1				2,2				2,3				2,4				2,5			
	−1.6	0.2	−2	0	−1.6	0.4	−2	0	−1.6	0.6	−2	0	−1.6	0.8	−2	0	−1.6	1	−2	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	3,1				3,2				3,3				3,4				3,5			
	−2.4	0.2	−3	0	−2.4	0.4	−3	0	−2.4	0.6	−3	0	−2.4	0.8	−3	0	−2.4	1	−3	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	4,1				4,2				4,3				4,4				4,5			
	−3.2	0.2	−4	0	−3.2	0.4	−4	0	−3.2	0.6	−4	0	−3.2	0.8	−4	0	−3.2	1	−4	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	5,1				5,2				5,3				5,4				5,5			
	−4	0.2	−5	0	−4	0.4	−5	0	−4	0.6	−5	0	−4	0.8	−5	0	−4	1	−5	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*

	Scenario 13																			
	Firm 2																			
	1,1				1,2				1,3				1,4				1,5			
Firm 1	0.4	−0.8	−1	0	0.6	−1.6	−1	0	0.8	−2.4	−1	0	1	−3.2	−1	0	1.2	−4	−1	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	2,1				2,2				2,3				2,4				2,5			
	0.6	−0.8	−2	0	0.8	−1.6	2	0	1	−2.4	2	0	1.2	−3.2	2	0	1.4	−4	2	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	3,1				3,2				3,3				3,4				3,5			
	0.8	−0.8	−3	0	1	−1.6	−3	0	1.2	−2.4	−3	0	1.4	−3.2	−3	0	1.6	−4	−3	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	4,1				4,2				4,3				4,4				4,5			
	1	−0.8	−4	0	1.2	−1.6	−4	0	1.4	−2.4	−4	0	1.6	−3.2	−4	0	1.8	−4	−4	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	5,1				5,2				5,3				5,4				5,5			
	1.2	−0.8	−5	0	1.4	−1.6	−5	0	1.6	−2.4	−5	0	1.8	−3.2	−5	0	2	−4	−5	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*

	Scenario 14																			
	Firm 2																			
	1,1				1,2				1,3				1,4				1,5			
Firm 1	−0.6	−0.8	−1	0	−0.4	−1.6	−1	0	−0.2	−2.4	−1	0	0	−3.2	−1	0	0.2	−4	−1	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	2,1				2,2				2,3				2,4				2,5			
	−1.4	−0.8	−2	0	−1.2	−1.6	−2	0	−1	−2.4	−2	0	−0.8	−3.2	−2	0	−0.6	−4	−2	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	3,1				3,2				3,3				3,4				3,5			
	−2.2	−0.8	−3	0	−2	−1.6	−3	0	−1.8	−2.4	−3	0	−1.6	−3.2	−3	0	−1.4	−4	−3	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	4,1				4,2				4,3				4,4				4,5			
	−3	−0.8	−4	0	−2.8	−1.6	−4	0	−2.6	−2.4	−4	0	−2.4	−3.2	−4	0	−2.2	−4	−4	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	5,1				5,2				5,3				5,4				5,5			
	−3.8	−0.8	−5	0	−3.6	−1.6	−5	0	−3.4	−2.4	−5	0	−3.2	−3.2	−5	0	−3	−4	−5	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*

	Scenario 15																			
	Firm 2																			
	1,1				1,2				1,3				1,4				1,5			
Firm 1	0.2	−0.8	−1	0	0.2	−1.6	−1	0	0.2	−2.4	−1	0	0.2	−3.2	−1	0	0.2	−4	−1	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	2,1				2,2				2,3				2,4				2,5			
	0.4	−0.8	−1	0	0.4	−1.6	−2	0	0.4	−2.4	−2	0	0.4	−3.2	−2	0	0.4	−4	−2	0
	0	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	3,1				3,2				3,3				3,4				3,5			
	0.6	−0.8	−3	0	0.6	−1.6	−3	0	0.6	−2.4	−3	0	0.6	−3.2	−3	0	0.6	−4	−3	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	4,1				4,2				4,3				4,4				4,5			
	0.8	−0.8	−4	0	0.8	−1.6	−4	0	0.8	−2.4	−4	0	0.8	−3.2	−4	0	0.8	−4	−4	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*
	5,1				5,2				5,3				5,4				5,5			
	1	−0.8	−5	0	1	−1.6	−5	0	1	−2.4	−5	0	1	−3.2	−5	0	1	−4	−5	0
	0.2	−1	*0*	*0*	0.4	−2	*0*	*0*	0.6	−3	*0*	*0*	0.8	−4	*0*	*0*	1	−5	*0*	*0*

	Scenario 16																			
	Firm 2																			
	1,1				1,2				1,3				1,4				1,5			
Firm 1	−0.8	−0.8	−1	0	−0.8	−1.6	−1	0	−0.8	−2.4	−1	0	−0.8	−3.2	−1	0	−0.8	−4	−1	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	2,1				2,2				2,3				2,4				2,5			
	−1.6	−0.8	−2	0	−1.6	−1.6	−2	0	−1.6	−2.4	−2	0	−1.6	−3.2	−2	0	−1.6	−4	−2	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0.8	−4	*0*	*0*	0	−5	*0*	*0*
	3,1				3,2				3,3				3,4				3,5			
	−2.4	−0.8	−3	0	−2.4	−1.6	−3	0	−2.4	−2.4	−3	0	−2.4	−3.2	−3	0	−2.4	−4	−3	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	4,1				4,2				4,3				4,4				4,5			
	−3.2	−0.8	−4	0	−3.2	−1.6	−4	0	−3.2	−2.4	−4	0	−3.2	−3.2	−4	0	−3.2	−4	−4	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	5,1				5,2				5,3				5,4				5,5			
	−4	−0.8	−5	0	−4	−1.6	−5	0	−4	−2.4	−5	0	−4	−3.2	−5	0	−4	−4	−5	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*

	Scenario 17																			
	Firm 2																			
	1,1				1,2				1,3				1,4				1,5			
Firm 1	*0*	*0*	−1	0	*0*	*0*	−1	0	*0*	*0*	−1	0	*0*	*0*	−1	0	*0*	*0*	−1	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	2,1				2,2				2,3				2,4				2,5			
	0	*0*	−2	0	*0*	*0*	−2	0	*0*	*0*	−2	0	*0*	*0*	−2	0	*0*	*0*	−2	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	3,1				3,2				3,3				3,4				3,5			
	0	*0*	−3	0	*0*	*0*	−3	0	*0*	*0*	−3	0	*0*	*0*	−3	0	*0*	*0*	−3	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	4,1				4,2				4,3				4,4				4,5			
	0	*0*	−4	0	*0*	*0*	−4	0	*0*	*0*	−4	0	*0*	*0*	−4	0	*0*	*0*	−4	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*
	5,1				5,2				5,3				5,4				5,5			
	0	*0*	−5	0	*0*	*0*	−5	0	*0*	*0*	−5	0	*0*	*0*	−5	0	*0*	*0*	−5	0
	0	−1	*0*	*0*	0	−2	*0*	*0*	0	−3	*0*	*0*	0	−4	*0*	*0*	0	−5	*0*	*0*

From the results of the scenario evaluations, as summarized in Table 5, we report these findings: (1) cooperation equilibria only appear as a choice when both firms recover their investment (cost), i.e., C1 for Firm 1 and C2 for Firm 2; (2) in all cases in which firms do not recover their investment (cost), there is a strictly dominant strategy to defect for both firms; (3) in all cases in which firms do not recover their investment (cost), and there is a strictly dominant strategy to defect, the payoffs for Firm 1 and Firm 2 depend on the degree of cooperation chosen and not all combination of the Cost Matrix Choice Combination provide a positive result for both players. Even when both Firm 1 and Firm 2 decide to cooperate, their payoffs might be negative.

An additional scenario (Scenario 17), where $\lambda = 1$, $\pi = 1$, $\beta = 0$ and $\alpha = 0$, shows no requirement of a positive return greater than the investment (cost) of each firm for cooperation to appear as a Nash equilibrium. All that is required is investment (cost) recovery (Table 5).

Table 5 Matrix of Nash Equilibriums resulting from the payoffs of the different scenarios considering all the cost matrix choice combinations

	Recovers cost + Margin	E	Does not Recover + Margin	E	Recovers + 0 Margin	E	Does not recover + 0 Margin	E
	A		B		C		D	
Recovers cost + Margin	*$\lambda = 1.2$ $\beta = 0.2$ $\pi = 1.2$ $\alpha = 0.2$*	*C, D*	$\lambda = 1.2$ $\beta = 0.2$ $\pi = 0.2$ $\alpha = 0.2$	D	*$\lambda = 1.2$ $\beta = 0.2$ $\pi = 1.2$ $\alpha = 0.0$*	*C, D*	$\lambda = 1.2$ $\beta = 0.2$ $\pi = 0.2$ $\alpha = 0.0$	D
A	*AA (1)*		AB (5)		*AC (9)*		AD (13)	
Does not Recover + Margin	$\lambda = 0.2$ $\beta = 0.2$ $\pi = 1.2$ $\alpha = 0.2$	D	$\lambda = 0.2$ $\beta = 0.2$ $\pi = 0.2$ $\alpha = 0.2$	D	$\lambda = 0.2$ $\beta = 0.2$ $\pi = 1.2$ $\alpha = 0.0$	D	$\lambda = 0.2$ $\beta = 0.2$ $\pi = 0.2$ $\alpha = 0.0$	D
B	BA (2)		BB (6)		BC (10)		BD (14)	
Recovers + 0 Margin	*$\lambda = 1.2$ $\beta = 0.0$ $\pi = 1.2$ $\alpha = 0.2$*	*C, D*	$\lambda = 1.2$ $\beta = 0.0$ $\pi = 0.2$ $\alpha = 0.2$	D	*$\lambda = 1.2$ $\beta = 0.0$ $\pi = 1.2$ $\alpha = 0.0$*	*C, D*	$\lambda = 1.2$ $\beta = 0.0$ $\pi = 0.2$ $\alpha = 0.0$	D
C	*CA (3)*		CB (7)		*CC (11)*		CD (15)	
Does not recover + 0 Margin	$\lambda = 0.2$ $\beta = 0.0$ $\pi = 1.2$ $\alpha = 0.2$	D	$\lambda = 0.2$ $\beta = 0.0$ $\pi = 0.2$ $\alpha = 0.2$	D	$\lambda = 0.2$ $\beta = 0.0$ $\pi = 1.2$ $\alpha = 0.0$	D	$\lambda = 0.2$ $\beta = 0.0$ $\pi = 0.2$ $\alpha = 0.0$	D
D	DA (4)		DB (8)		DC (12)		DD (16)	

*E = Equilibria, C = Cooperate, D = Defect
*Scenario number in parentheses ()

3 Conclusions

This chapter explores the factors that determine the emergence of cooperation equilibria in an export cooperation venture by modelling and evaluating several possible scenarios that account for firms' internal and external factors in cooperation projects. The evaluation of the proposed model demonstrates that when firms cooperate and choose among different cooperation levels, their cooperation levels do not affect the emergence of cooperation equilibria. The factors that condition the emergence of cooperative equilibria are the returns of cost for each of the firms involved in the cooperative endeavour. Thus, according to the proposed model, if $\lambda \geq 1$ and $\pi \geq 1$ simultaneously, cooperation equilibria emerge. This implies that firms will cooperate only with the assurance of recovering the costs invested in the cooperative venture. Otherwise, the logical and rational outcome of the simulation game would be to defect.

Given the tendency to defect, additional measures are required to foment inter-organisational cooperation, including relational capital. We suggest that blockchain technologies such as smart contracts are the contemporary mechanism to promote trust between potential co-operators. The models indicate that firms remain committed when they have the assurance of cost recovery. With their inherent characteristics of self-execution, self-enforcement, transparency, and flexibility (Wang et al., 2021), smart contracts can provide this assurance. Even in cases where the cooperating firms have no prior experience on which to develop the trust, communication, and commitment of relational capital, smart contracts could supersede this limitation.

4 Practical and Managerial Contributions

The most important practical implications for policymakers and managers point to creating cooperative environments that allow for sustainable cooperation strategies. For policymakers, this might include creating special programs that guarantee the recovery of the costs from export cooperative ventures. Such programs should increase cooperation and firm export performance. For managers, this chapter should motivate cooperative alliances when there is the assurance of recovering the costs involved in the cooperative export venture.

The markets are increasingly recognizing the potential of blockchain technologies to facilitate inter-organizational transactions. This chapter suggests that firms and governments consider their potential, particularly those of smart contracts, as a mechanism of promoting inter-organisational cooperation such as that between export venture partners.

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