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Game Theory Analysis of Global Supply and Demand Restructuring under the Sino-US Trade Conflict

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Abstract:

The trade conflict between China and the United States began in 2018. Before the conflict broke out, the two countries had already formed a deeply interdependent and mutually beneficial economic relationship. However, this symbiotic relationship was under multiple huge pressures: the continuous expansion of the US trade deficit with China, the intensification of intellectual property disputes, and the continuous escalation of geopolitical struggles. All these factors lay the groundwork for the conflict. The trade conflict between China and the United States has transcended the realm of a simple bilateral dispute and has subsequently evolved into a strategic game of readjusted global supply chain supply and demand patterns. This paper uses mathematical game theory as the analytical basis to dissect the strategic interaction motives of the trade tariff war between China and the United States, analyze the countermeasures, and propose a dynamic model for reconstructing the global supply and demand relationship. It is believed that this conflict is essentially an evolution process from the classic Prisoner's Dilemma to a dynamic repetitive game. Through the theoretical mechanism of the Prisoner's Dilemma, we can analyze the non-optimal Nash equilibrium outcome of the initial tariff war, and thereby further explore the response strategies for supply and demand reorganization.

Keywords: Nash Equilibrium; Prisoner's Dilemma; Game Theory; Sino-US Trade War; Global Supply Chains.

1. Introduction

In the context of the globalization era characterized by the deep integration of supply chains, all countries are confronted with the resurgence of geostrategic competition. The trade friction between China and the United States in 2018 was precisely at the core of this transformation. This conflict initially only

involved a contest over tariffs on specific goods, but then rapidly escalated into an all-round confrontation covering energy, technology, investment and ideology, almost affecting every sector of the global economy. The competition between China and the United States reflects the structural contradictions of the above-mentioned issues: On the one hand, the United States is deeply concerned about the hollowing out of its own industries and is extremely anxious about China's rise. On the other hand, China has demonstrated its determination to pursue self-reliance and autonomy in the field of science and technology. In addition to tariff barriers, the two sides have also evolved into three economic wars: tariff wars, technology wars and financial wars. All these competitions fully demonstrate the strategic purpose of reshaping the global supply chain and curbing the upgrading of China's industries and technologies. The US technology blockade has impacted the global semiconductor and 5G sectors, while countermeasures have affected agriculture and manufacturing, all of which have shaken the foundation of the multilateral order centered on the World Trade Organization.

Traditional economic models are insufficient to effectively explain the interdependent strategic and political motives behind this conflict. This is precisely where mathematical game theory proves indispensable it allows us to model the US and China as rational strategic actors, whose decisions are contingent upon anticipated actions of the other. This paper seeks to answer the following core questions: Game theory can explain the persistent escalation of the US-China trade conflict despite mutual economic damage, and this part needs to explore the specific ways it provides such an explanation. There exist certain game-theoretic dynamics that underpin the restructuring of global supply and demand networks, and this part requires identifying and analyzing what these dynamics are.There may be a specific stable equilibrium that defines the future global economic order, and this part needs to investigate what this stable equilibrium could be.

2. Theoretical Framework: Core Game Theory Models

2.1 Prisoner's Dilemma (PD)

The classic Prisoner's Dilemma is a non-cooperative game in which players must choose between two core options: cooperation (pursuing mutual benefit and win-win) and betrayal (seeking personal gain at the expense of the other party). Due to the special structure of the payoff matrix, the betrayal strategy holds an advantageous position for both parties. This leads to a Nash Equilibrium where both sides choose to defect, an outcome that is worse for than mutual cooperation would have been.

This model aptly explains the incentive structure behind the rapid tariff escalation between China and the US in 2024-2025. During this period, the US. first issued Executive Order 14257. Then, in line with its reciprocal tariff policy, it continuously raised additional tariffs on Chinese goods. By April 2025, the specific tariff rate had been adjusted from 34% to 84%. In response, China implemented targeted and escalating countermeasures. These actions eventually led to a stalemate, and in this context, the Nash Equilibrium (Defect, Defect) prevailed.

The dynamics of this process reflected a classic Prisoner's Dilemma logic. Each side perceived tariff hikes, which constitute a defection strategy, as the dominant way to safeguard short-term interests. For instance, the U.S. aimed to pursue "reciprocal tariffs" and protect its domestic industries through this approach. China, on the other hand, took such measures to defend its core trade interests. Even so, the mutual defection between the two sides continued to shrink the overall "gain pie" for both economies.

2.2 Tit-for-Tat

The "Tit-for-Tat" strategy was first proposed by the mathematician Anatole Lapoport, providing a practical solution to break the vicious cycle of the Prisoner's dilemma. The core principles of this strategy revolve around the following four major steps, and a series of measures are taken to deal with betrayal, thereby promoting mutually beneficial cooperation: First, take cooperation as the action guideline. For instance, China dispatched a negotiation team at the early stage of the conflict. This move not only demonstrated its sincerity but also conveyed its willingness to seek mutual benefit and win-win results. Secondly, timely checks and balances should be implemented against acts of betrayal. When the other party takes uncooperative actions, promptly take corresponding countermeasures to curb their further confrontational behavior. For instance, when China encounters unilateral trade restrictions imposed by the other side, it takes tariff countermeasures. Third, use strategic forgiveness to safeguard future cooperation opportunities. That is to say, retaliation should be limited to a targeted response rather than an unlimited escalation, leaving room for the other party to return to cooperation. For instance, the Chinese government stated that this round of tariffs would be the "final" measure, clearly sending a signal that the door to cooperation remains open. Fourth, maintain the transparency and predictability of strategy implementation. The rule of tit-for-tat is simple, clear and consistent. The opponent can easily understand and predict how their actions will be responded to: if the other party chooses to cooperate, they will surely receive an equal amount of cooperation in return. This predictability prompts the other party to be

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more inclined to choose cooperation rather than betrayal in the long run [1].

2.3 Sequential and Repeated Games

This trade dispute, a game of seeking maximum gains, is not an isolated incident but a continuation of a long-term game. The players will observe each other's past behaviors and may adopt strategies such as "it-for-Tat". This repeated game eventually makes cooperation a possible and stable outcome, as the threat of long-term punishment is often more deterrent than the short-term benefits of a single betrayal. Furthermore, the game is sequential. The US, as the initiator, moved first, with China responding. This sequence allows for the use of threats and commitments. The credibility of retaliatory threats is crucial—China's immediate and proportionate retaliation in the first round demonstrated resolve, making its future threats credible [2].

3. Analysis of the Tariff War: A Prisoner's Dilemma in Action

The US initiation of the trade war in 2018 constituted a defection from the existing cooperative framework (the WTO-led system). The Trump administration's actions, aimed at reducing trade deficits and addressing intellectual property concerns, also carried political benefits from portraying China as an unfair trader. Faced with this defection, China chose a Tit-for-Tat response, leading both nations into a full-blown trade war [3]. The mutual punishment was evident: increased costs for importers and consumers, supply chain disruptions, and reduced trade volumes. Studies by the IMF, World Bank, and numerous economists confirmed net negative effects for both economies, validating the Prisoner's Dilemma's prediction of a sub-optimal outcome [4]. The repeated nature of the game was visible in cycles of tariff announcements, negotiations (e.g., the "Phase One" deal), and further threats. The payoff matrix below illustrates the strategic choices:

In the trade game model involving Player A (the US) and Player B (China), both sides have two strategy options: Cooperate (No Tariffs) and Defect (Impose Tariffs). The comparison of payoff matrices for different strategy combinations is as follows (Table 1):

Table 1. Payoff matrix in international trade policy

1	Cooperate, Cooperate	Low tariffs, WTO rules, free trade, global stability. Lowest trade costs, highest efficiency.	Pareto Optimal
2	Cooperate, Defect	Defector (e.g., US imposing tariffs unilaterally) gains political points and potential short-term market protection. The cooperator (e.g., China not retaliating initially) suffers industry loss	Defector Wins, Cooperator Lose
3	Defect, Cooperate	Inverse of above.	
4	(Defect, Defect	Mutual tariffs, sustained retaliation, trade war. Both suffer economic losses (higher costs, lower profits, supply chain chaos).	Nash Equilibrium

This structure explains China's eventual adoption of a Tit-for-Tat strategy: unreciprocated cooperation was unsustainable. First of all, the United States' unilateral imposition of tariffs on China is equivalent to a "betrayal." If China remains silent, it will fall into the "cooperator's disastrous defeat" in the prisoner's dilemma. Such an outcome would mean China not only bears economic losses alone but also is interpreted globally as experiencing a decline in competitiveness, which in turn confirms the fallacy of "Make America Great Again." [4] A reciprocal counterattack has therefore become a necessary move to hold the bottom line and force the other party to recalculate costs. Secondly, counterattack does not mean unlimited escalation. China will cap the additional tariffs on the United States at 125% and reserve room for negotiations through reversible measures such as exclusion lists and temporary exemptions. This is equivalent to sending a signal in repeated games: "As long as you reduce tariffs first, I will immediately withdraw synchronously." Such conditional cooperation is different from raising tariffs to 125% and then completely withdrawing from the game; the purpose is to leave a way out for both sides to get out of the "double betrayal" quagmire. Finally, when the marginal loss is higher than expected, the party under the greatest pressure will naturally be more motivated to let go first. In recent years, the United States has implemented temporary exemptions on some consumer electronic products such as mobile phones, which is precisely due to three considerations: domestic inflationary pressure, damage to key constituencies, and the cost of coordinating with allies. Although it has not fully returned to the old tariff level, it has shown that reducing tariffs in exchange for cooperation is more in line with its long-term interests than continuing confrontation.

4. Motivations for Supply-Demand Restructuring: The Ripple Effect of the Dilemma

The Prisoner's Dilemma logic explains the root cause of this deadlock: when trapped in (Defect,Defect) Nash equilibrium, unilaterally dissolving confrontation (switching to cooperation) will put the country in a passive position in the short term. Therefore, both sides were aware of this mutually damaging situation, but it was difficult for them to withdraw first, eventually leading to a "bad but stable" impasse. To break this deadlock, it is necessary to extend cooperation to other potential areas through negotiation and communication and transform a single game into a repetitive interaction of a benefit matrix structure covering different factors, ultimately forming a dynamic "cooperative competition" equilibrium state that swings back and forth between competition and cooperation.

Tariffs and non-tariff barriers act as the fuse, triggering the reorganization of the global supply chain. As the initiator of the trade conflict, the main goal of the United States is to reduce the trade deficit with China and curb the development of China's high-tech industry. To achieve these strategic goals, the United States has adopted measures such as imposing tariffs, implementing export controls (for instance, restricting China's access to key materials like semiconductors), and using the Entity List to prevent American companies from supplying goods to Chinese companies. These measures have prompted the supply chain to start shifting away from China. Through the repatriation strategy and nearshore outsourcing strategy, the industrial focus has been redeployed to the United States and its ally countries, such as Mexico and Vietnam. In response, China is making efforts to maintain economic stability, strengthen supply chain security and achieve technological autonomy. China has adopted retaliatory tariff measures, implemented asymmetric countermeasures including restricting the export of key materials such as rare earths, and accelerated the process of import substitution. These measures demonstrate China's strategic focus on nurturing domestic suppliers and exploring new markets outside the United States.

5. Navigating the Restructuring: Strategic Implications for China

China's strategy should focus on altering the game's payoff structure, moving from a reactive PD trap towards a more constructive repeated game equilibrium.

5.1 Policy Level

The Chinese government can take the following targeted measures: First, leverage existing advantages to cultivate asymmetric checks and balances and establish a credible deterrent. For instance, promoting technological development in key areas such as rare earths and strengthening inventory management can serve as effective strategic deterrence measures. Second, establish mechanisms such as the Regional Comprehensive Economic Partnership Agreement, unilaterally lower tariffs on other countries, expand market access for foreign investment, and promote high-level opening up to the outside world. These measures will send a signal of cooperation to the global community (excluding the United States), thereby increasing the opportunity cost of the United States' unilateral withdrawal. Third, actively participate in formulating new international rules, including frameworks such as the CPTPP and DEPA. This effort will help establish dynamic standards for adjusting the global supply and demand relationship in the future. Fourth, expanding domestic demand is the fundamental way to change the rules of the game. By fostering a strong and self-sustaining domestic market, reduce reliance on the outside world [5]. Fifth, encourage local enterprises to diversify and establish backup systems for key materials to build the resilience of the supply chain, thereby ensuring business continuity and viability in extreme circumstances.

5.2 Corporate Level

Chinese companies and enterprises can implement the following key strategies: First, expand into emerging economies to actively seek market diversification. These economies include ASEAN countries, the Middle East, the European Union, and partners within the Belt and Road Initiative (BRI). This expansion helps reduce enterprises' reliance on demand from the United States. Secondly, give priority to diversifying the supply chain to minimize operational risks to the greatest extent. This point is of vital importance. Enterprises should purchase raw materials and key components from other locations, such as increasing production and procurement from Southeast Asia, in order to reduce the risk impact brought about by regional policy changes. Last but not least, enterprises should also take measures to strengthen themselves, such as focusing on deeply cultivating the domestic market and making full use of China's huge domestic consumer base to resist the uncertainties in the international game market. At the same time, we should accelerate the pace of technological upgrading and innovation, especially focusing on key "bottleneck" areas. Through the above-mentioned measures of import substitution, not only can China's independent innovation capacity be enhanced, but also its long-term competitive edge can be consolidated.

6. Conclusion

The application of mathematical game theory provides a

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powerful perspective for understanding the Sino-US trade conflict and its impact on global supply and demand. This analytical approach goes beyond static economic assessment, enabling it to capture the strategic games such as interdependence and credible threats that are characteristic of the current era. The Sino-US trade dispute exhibits typical features of the Prisoner's Dilemma, which helps explain why both sides quickly escalated into a tariff war that harms each other. However, when the conflict evolves into a prolonged and multi-dimensional game, the limitations of relying solely on a single game model become apparent. It is worth noting that the reshaping of the global supply and demand pattern is not a passive outcome, but a strategic adjustment made by countries and enterprises in response to the new risks brought about by Sino-US competition. The future direction of this game depends on the changes in the interests of all parties over time. If the cost of confrontation becomes unbearable for any party, the strategies of all parties may shift back to cautious cooperation, seeking development in the new balance of intensified competition. Ultimately, game theory will remain a crucial tool for outlining these potential development paths and understanding the strategic logic that underpins them.

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