#### Hanoi University Faculty Of Information Technology

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#### Application of Game Theory in trading conflict resolution of global cooperation in economics between member countries in WTO using Fair Evolutionary Multiobjective Optimizer (FEMO) [1]

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## Abstract

Cooperation between countries and different economies is an inevitable trend for development in all aspects, but contradictions and trading conflicts still exist even though they have been resolved by many methods. This article suggests the use of game theory to resolve conflicts of economic cooperation between countries in the WTO participating in global cooperation. Therefore, the purpose of using game theory is to understand and analyze the behaviour or decisions of global cooperative countries that are one the typical cases of conflict situations. Based on the FEMO [1] algorithm model, it will show the main tensions when cooperating based on trade and protectionist principles, and point out common causes leading to domestic conflicts and conflicts when cooperating between countries' families. From there, we came up with issues that need to be resolved including unfair competition between economic cooperation partners, the need to use domestic goods and taxes caused by the trade war to minimize failures, aim to solve problems and offer some strategic choices for players who use game theory joining the world trade market.

# Chapter 1 Introduction

In the twentieth century, the world had to witness the fierce "Cold War" lasting 7 decades among countries in the Soviet Union and America - the leading country in terms of economic potential. The war only ended when the Soviet Union disintegrated and the US suffered a heavy defeat in terms of both humans and property. From this event, the world will always have a lot of violent changes between the world's major countries in the arms races, aircraft production, missiles,... will constantly increase and accompanied by the trade conflict taking place at a very drastic level, bringing many consequences to the world's security-politics and economy including the world's trade partners that affect their overall trade relationship (Peterson et al, 2020) [2].

A specific example of a trade war is the escalation of tensions between the US and China since 2018, President Donald Trump has significantly revised his foreign economic-related policies, the United States has introduced protectionist policies towards China – one of the biggest trade partners. In the same year, bilateral trade between the US and China reached 683 billion USD, of which US exports and imports were 120 billion USD and 563 billion USD respectively (ITC, 2020) [3]. President Donald Trump has imposed substantial tariffs on Chinese products. Soon after, China also announced a corresponding response package when levying 25% tariffs on 659 items imported from the US with a value of 50 billion USD. There are many researchers and specialists give explanations for this situation as the US wants to keep in check this country (Bown Chad, 2020)[4] because the US has always considered China "the center of all US trade problems", "cause of the trade balance deficit" (Nguyen Anh Thu Vu Thanh Huong, 2019) [5].



Figure 1.1: United States - China in Trade War Tax Problems (%)

Fig 1.1 illustrates the market of Chinese was initially more kept safe for many companies in the US. In 2020, due to the conflict of commerce, the regular US tariff will increase by 19.3% and cover imports valuing \$550 billion, and China's normal tax will reach about 20.3%. After many events, China had negotiated to get a commercial agreement in the early stages, therefore, this country had to pay about 200 billion USD to buy American products by the end of 2021 to serve the life of China's people. In a recent research paper in 2020, author Hufbauer (2020) [6] also found that the agreement was unlikely to decrease tariffs on China's goods because it could have a negative impact on other countries. Moreover, China could lessen imports from developing countries to meet the proposed commitments. As a result, this transaction broke the law related to international commerce standards.

Furthermore, in 2009, when the global trade conflict created a worldwide economic crisis, the GDP of many countries was dragged down by about 2.1% and global trade by 12.4% (Eddy, Robert, 2019) [7]. Economists such as Barbieri and Levy, or Anderton and Carter have provided data on trade wars between world powers such as US-China, and EU-Russia-US. Additionally, trade conflict is not only bilaterally but also global which affected the world trade and economic system, and the result has created harsh consequences regarding the wave of tariffs on steel, aluminium and petroleum, the political interests, import and export value of the countries participating in the world free trade market, especially the developing countries (Marano et al, 2013) [8]. The elimination of hostilities and the promotion of cooperation are therefore important steps toward a peaceful economy. One method of easing hostilities and bringing about cooperation between two countries is often legalism initiated by third-party states (Polachek, 2015) [9]. During the past 30 years, the world has suffered fiercely from the trade war. In addition to causing damage to human lives, conflict causes protracted disruption, significant disruption to economic activities and infrastructure, and limits the development of developing regions such as Africa, Asia and South America (Cali and Oliver, 2015) [10]. Since 2000, the International Development Association (IDA) has provided more than \$11.2 billion in assistance to countries affected by conflict errors. Specifically, nearly 90% of conflicts between 2000 and 2015 caused countries in Central Africa and the Middle East to be profoundly affected by their territorial location, gross national product and production lines (Abiad et al, 2018) [11]. In this study, we will explore how changes in imports and exports, GDP, consumption indexes and the monetary application supply system affect risk and ambient intensity.

For protectionism and bargaining strategies, they are considered real deterrent threats that can act as a brake in a formal currency war (Askari and colleagues, 2020) [12]. Many research papers give out the best solutions for cooperation between countries to gain as much profit as possible without investing large amounts of resources, but the highest efficiency has not been achieved. Countries participating in international integration easily cause conflicts and competition between domestic multinational companies and large multinational companies in terms of products and services. Any country participating in global cooperation must resolve the tension between economic goals and product quality. Moreover, there will be proposed solutions to opportunities and challenges for countries in the coming time to promote trade and investment cooperation, contributing to the development of the country as well as bringing benefits to the two partners. We generalize the results from those conflicts so that players can make the right decisions and lean towards a peaceful resolution as a method to optimize business interests. Our paper will give an overview of the main concepts and theories within Game Theory and provide examples of how these tools can be used to resolve conflicts between different related parties and nations. In particular, we offer solutions and balance points to help players achieve the highest results based on the FEMO [1] algorithm. In addition to the loop, the prisoner's dilemma is improved to be able to generalize a general model for the NASH equilibrium for general players. This research listed some payoffs, which players will receive after resolving conflicts, and suggested several particular strategies for them from the model simultaneously.

### Chapter 2

## Literature review

The economic development history of many countries has demonstrated the benefits that an open, multinational, globally cooperative economy brings. Regardless of the economic level, when making the right policies or making the right decisions, there are huge benefits. In particular, for some countries that used to have underdeveloped and developing economies, reasonable global cooperation will bring huge benefits, opening up opportunities to accelerate economic growth. economic benefits for investors. For example, from 2011 to 2015, according to the U.S news world report, developing countries in Southeast Asia and West Asia currently have a stable and positive environment both economically and politically.

One of the typical examples of economic development and political stability is the growth and increase in income of the citizens of that country. According to the data that the authors have collected, since 1980, in all three classes of citizens in society, the average income level has almost increased positively, even though it is the middle-income and high-income classes moderate, or low (Paris, Hashem, 2014) [13].

In addition, many products in large quantities have been positively received by the international market. Therefore, the WTO is considered a promising door with a potential economy with high speed, an attractive market with millions of consumers, and a country with an important role and position. important in international relations. In addition, negotiations also help many countries in the WTO block such as the US, EU, Taiwan, China, Japan... reduce trade barriers through negotiation and application of non-discrimination principles leading to production costs falling dramatically, the prices of goods and services dropping, and ultimately, the cost of living. Up to now, the barriers to international trade have been removed a lot by bilateral trade agreements and international agreements and thus we have benefited significantly from the economic integration process. Non-discrimination



Figure 2.1: The average level of economic globalization by income categories (KOF index) [13]

is just one of the principles of the WTO trading system. Other rules include: "Transparency, clear communication of policies, principles and regulations, trust in economic conditions, commitment to reducing economic barriers and increasing access the market of some countries to other countries is legally binding, simplifies and standardizes customs procedures, eliminates bureaucracy, centralizes the database of information and other measures set to simplify".

International commerce is the exchange of products and services (tangible and intangible goods) between countries, based on the premise of equal exchange to benefit both sides. For most nations, that parallels a significant proportion of GDP. Trade agreements not only negotiate tax cuts, but also non-tariff measures such as limiting the number of imports, import licensing, sanitary and phytosanitary measures, foreign investment, foreign trade, and authority purchasing, as well as trade facilitation through simplified customs procedures. Historically, free trade was generally centred on agricultural items, but industrial goods frequently requested protection. The contemporary scenario, particularly in wealthy countries, is the polar opposite. In the United States, Japan, and Europe, encouraging development in the agricultural field is the principal reason, therefore, this makes the sector have many more restrictive and strict provisions in commercial agreements between cooperating countries for protectionist substances than in other sectors of economic consumption. Trade between countries is often controlled by universal rules through WTO contracts. Despite the fact that there are a lot of trade agreements between countries in the same region, for example, the AFTA cooperates with ASEAN or MERCOSUR has partners in African countries... However, there are some unsuccessful trade contracts due to not having the shared commercial purposes or special interests for those countries. The benefits of international economic and business negotiations include: both parties have benefits, one party on a side that does not benefit, and both parties do not benefit from three types of negotiations: win-win, win-lost, and lost-lost.

Commercial protection or trade protection is to apply some regulations in the area of operations including job opportunities, food hygiene and safety, labour, environmental conditions and origin of some imported products to care for the consumer's interests as well as domestic products. In theory, the protection of trade leads to momentary advantages for domestic product manufacturers, with the aim of protecting the rights of workers. The drawbacks are caused by the fact that they allow national manufacturers to guess at the selling price (or service provider) to bring them the best profit or take timely measures to improve product quality and price. This brings harmful consequences to consumers regarding their future essential needs. Protectionism is not the primary cause of the global economic downturn, but it is a concerning and avoidable aspect. This is also reflected in the political sector such as the US government's policy and the priority of states to purchase domestically produced goods. Trade protection provides a variety of interests for national and national political security. The most basic benefit of commercial protection is that local industries are kept up and expand market share, meanwhile, foreign enterprises meet difficulties in the economic growth index and another potential risk of selling.

In recent years, countries that recovered economically after the war - WTO relations have had a step-by-step development and increase in the actual economy now with seafood prices, especially shrimp, being high, along with positive signals from the market for seafood products. However, the conflict of cooperation is not limited to sharing costs or benefits between members in WTO that sometimes have conflicts driven by countries due to non - cooperative behaviours. Specifically, according to the Vietnam Association of Seafood Exporters and Producers (VASEP), the US is the second-largest export market of Vietnamese pangasius and basa fish. A turning point marking economic development was in 2007, Vietnam joined the WTO and became the 150th member, attracting a lot of investment capital from



Figure 2.2: Data source: Eurostat [15]

abroad, specifically reaching around a 71billion USD in 2008 (Vuong, 2014) [14]. Vietnam also recognized a stable economic development rate of about 6.8 %, 7.1 % and 7% in 2017, 2018 and 2019 in turn. Despite the considerable effects of the COVID-19 pandemic in the period 2019-2020, the country's economic growth index is promised to be 2 or 2.5%(Vuong et al, 2021) [15]

In these tables, it can be seen that the EU is among the leading significant partner in many fields, especially in economy, trade and investment, actively contributing to the process of socio-economic development and international economic integration of the EU. Southeast Asia region. Currently, the EU is the leading major trading partner and the second-largest export market of Vietnam.

However, these items have faced a lot of pressure, especially from the US Department of Commerce regarding anti-dumping lawsuits. This has caused Vietnam's seafood processing and exporting companies to suffer the largest increase of 0.19 USD/kg, while previously these businesses used to enjoy a tax rate of 0%. However, the conflict of cooperation is not limited to sharing costs or benefits between Vietnam and WTO countries that sometimes have conflicts driven by countries due to non - cooperative behaviours. Different negotiation methods have been proposed to resolve conflicts in the economy between global cooperation in the WTO and one of them has been mentioned in the report 'US- Vietnam: game theory perception of Ngan N.Kim, Naval Postgraduate School Monterey CA (2012) [16]

concerning the subject of international conflict settlement, such as China, United States, Vietnam... in the dispute of two Truong Sa and Hoang Sa in Vietnam's east sea. It is not only the economic relations and cooperation between South-east Asian countries that take place but also other cooperation, overcoming the contradictions or differences in politics and economy between China and Turkey. Although these two countries still have disagreements and conflicts of economic and political interests due to disparities in status and development (McCall and Keskin, 2022) [17]. However, this is the best way for the disadvantaged side, rather than Turkey, to get as much benefit and growth as possible. Although, this method still faces disagreement from the Turkish people with 54% (Janell Fetterolf and Jacob Poushter, 2017) [18].

In addition, in 2021, a group of authors from major universities around the world (Jing, Youngping, Fuqiang, 2021) [19] published the results of their analysis of cooperation and non-cooperation. By showing a graph showing the outcome of conflict or economic cooperation of countries in the Mekong and Lancang basins, they have demonstrated the effectiveness of strategies for cooperation.



Figure 2.3: The proportion of publications regarding water occurrences in the Lancang-Mekong River basin that are cooperative or conflicting. [19].

Global cooperation for the benefit of enterprises and their countries in terms of foreign currency earnings, business and cooperation are strengthened and expanded. The higher the quality of the export, the stronger the consumption, the more valuable the export market, and the greater the profit of that exporting country.

The articles used to demonstrate the problems, difficulties, or challenges of countries in international cooperation mentioned above have contributed to helping us to synthesize, analyze and support our research. In addition, this also helped us to synthesize the problem, find the cause, and the solution from the most general to specific examples. This is exactly what previous studies, although extremely elaborate and meticulous, have not achieved results - a study that covers many aspects that need attention.

This paper illustrates the beneficial practicality of the game theory approach in formulating global cooperation policy. The article helps to resolve conflicts related to them in the field of economics by showing the basic concept of game theory and providing some basic related models for a deep understanding of this topic.

# Chapter 3 Description of the problem

In this paper, we want to find out the causes of conflicts, identify possible conflicts and find solutions in the field of economics and international cooperation among countries around the world. When countries cooperate to achieve economic benefits, there may be disagreements or disputes over profits or other factors that can directly affect players. Strategies need to be devised based on factors directly involved in the game such as market, price, and geographical distance. When developing the economy, players also need to consider solving the problem of benefits and investment so that they can achieve maximum efficiency and minimize losses and failures while cooperating.

Countries participating in global cooperation, or in the WTO, are the strategic decision-makers in this game (Asian countries, EU, US,...). These are players, participating in cooperation, also known as economic cooperation games, based on the spirit of voluntary negotiation and evaluation. The members will negotiate with each other about cooperation goals, possible results or profits, motivations for the combination, circumstances and advantages of players when participating, commercial principles and principles. WTO or game protection rules must be followed. The activities of two or more decision-makers have an impact on the outcome (players). As stated previously, based on the goals of global cooperation, the advantages of bargaining, and the principles of the "prisoner's dilemma", the reader can define the objectives of the nation. However, these obvious common interests cause disputes and contradictions, which can lead to an escalation of hostilities, to the detriment of all players, especially weaker players or neighbouring countries.

Below is a chart depicting typical conflicts when countries engage in international cooperation, in this case, the conflict between the US and China. By using this table describing the outcomes of failed collaborations, we emphasize the impact of failed collaborations and the importance of strategies and algorithms to account for the decisions people make. play should take out. The conflict in economic cooperation between the two economic superpowers the US and China affects not only the two countries participating in the cooperation but also the countries involved.



Figure 3.1: Scenarios under investigation. Source: Source: Estimates from Comtrade and staff (2017). In 2017, the US imported \$526.1 billion in goods at CIF (USITC), while it imported \$17.4 billion in services. (census.gov) [20]

In figure 3.1, readers can easily see the effects of balanced and unbalanced cooperation. When the quantity of exports and imports is equal, then the quantity of exports and imports differs between China and the US.

Furthermore, when collaboration between these two countries does not achieve the best results, even if the cooperation fails, conflicts arise, and the affected countries are not only the US and China but also other countries. neighbouring or related. This has had enormous effects on participating countries around the world and directly affects their income streams.

·	Lists 1 and 2 implemented on both sides		25pp increase tariff surcharge on bilateral US-CHN trade		25pp increase tariff surcharge on bilateral US-CHN trade and decline in investor's confidence	
	\$million	%	\$million	%	\$million	%
USA	-29,414	-0.2	-84,501	-0.4	-312,789	-1.6
China	-33,123	-0.3	-301,919	-2.5	-425,749	-3.5
Mexico	2,766	0.2	16,467	1.4	-9,522	-0.8
Canada	1,731	0.1	10,637	0.6	-18,676	-1.1
EAP excl. China	2,954	0.1	12,769	0.3	-53,957	-1.3
SAR	-192	0.0	6,644	0.2	-27,181	-0.9
LAC	2,929	0.1	2,047	0.1	-32,778	-1.1
AFR	95	0.0	196	0.0	-6,409	-1.1
ECA	659	0.0	-6,933	0.0	-342,447	-1.7
MENA	-29	0.0	193	0.1	-2,752	-1.2
HICs	3,349	0.1	3,676	0.1	-106,978	-1.7
ROW	2,184	0.0	7,439	0.1	-95,649	-1.1
Global	-34,771	0.0	-266,344	-0.3	1,359,471	-1.7

Figure 3.2: Income Effect (million USD at 2017 prices) [20].

	Lists 1 and 2 implemented on both sides		25pp increase tariff surcharge on bilateral US- CHN trade		25pp increase tariff surcharge on bilateral US- CHN trade and decline in investor's confidence	
	\$million	%	\$million	%	\$million	%
USA	-38,480	-1.7	-166,622	-7.2	-207,796	-8.9
China	-40,495	-1.7	-190,092	-7.9	-238,224	-9.3
Mexico	2,953	0.7	14,197	3.3	332	0.1
Canada	1,858	0.4	8,396	1.6	-2,288	-0.4
EAP excl. China	4,037	0.2	23,649	1.0	-13,851	-0.6
SAR	204	0.0	3,684	0.7	-4,235	-0.8
LAC	1,361	0.3	2,513	0.6	-6,845	-1.6
AFR	123	0.1	454	0.3	-1,731	-1.2
ECA	4,880	0.1	12,751	0.1	-149,636	-1.7
MENA (Egypt)	19	0.0	160	0.4	-334	-0.9
HICs	2,152	0.2	6,993	0.6	-13,075	-1.2
ROW	3,313	0.1	14,548	0.4	-33,713	-1.0
Global	-59,486	-0.3	-275,661	-1.2	-673,699	-2.9

Figure 3.3: The effect on total exports (million USD at 2017 prices and per cent deviations from the baseline).

Source: WB staff estimates [20]

According to a World Bank report cited above (Caroline, Michael, Maryla, Michael, 2018) [20], the trade conflict between the two superpowers, America with China have reduced global exports by 3% (about \$674 billion) and Global earnings fell 1.7 per cent (\$1.4 trillion), with damage affecting all regions and countries in the WTO. This is illustrated by three case studies on the investment sector between China and the US (World Bank, 2018) [20].

In international economic cooperation, the types of conflicts that occur are diverse and occur not only at a single event but between two different processes. To review and analyze the characteristics of conflict, based on the concept that many different criteria of conflict can be used to consider, for example, the degree of impact of the conflict will have different types and characteristics, based on the field of conflict also has different characteristics. However, following the characteristics of the study, which is to propose a conflict handling model based on game theory and the FEMO [1] algorithm, the characteristics of the conflict will be considered from the perspective of data used to model the problem. describe the problem following the algorithm model to handle the conflict. Therefore, the characteristics of the conflict to be analyzed will be related to some of the following factors (Ngoc, 2020) [21]:

- About the players: conflicts occur between players (countries participating in international cooperation) and important descriptive data related to the calculation, making of strategies, and decisions of the players.
- About the strategic factor: the countries participating in the cooperation have non-conflict actions and conflicting actions, these actions are related to the occurrence of conflicts of interest between the two countries. above players, this is the part most directly related to the problem of conflict in math problems. Constraints are factors that are not related to the data of the problem, it is related to the factors of rules, the rationality when considering the combination of factors together.
- About the payoff function: with the player's strategies, how valuable it is to evaluate the overall solution of the entire selection of players, depending on the situation where it is necessary to minimize cost, the payoff function for the smallest value will give the best solution or maximize the benefit, the payoff function for the maximum value will give the best solution.

In the game of resolving trading conflicts, the players are countries in developing and developed countries participating in the WTO to compete with each other to achieve the desire to develop the country's economy who are called *traders*. These members will have these below important characteristics which help them determine the best results in a specific situation and can come up with the most reasonable strategies based on their decisions as well as other parties related to:

- Gross domestic product (GDP): Represents the number of goods and services produced per person, giving the average standard of living of the citizens of each country. GDP per capita has steadily increased globally over time, and with it, the standard of living worldwide has also increased significantly.
- Consumer price index (CPI): The number of goods that consumers use and spend that contribute to the growth and prosperity of an economy
- **Inflationary rate:** Is an important indicator of current and future inflation trends. This index helps policymakers to identify whether the consumer price movement is a short-term or is it a long-term trend.
- Money supply This is one of the important factors helping maintain stability and stimulate economic growth, short-term and long-term effects, and then makes appropriate recommendations.
- Oil price: A factor that is always on top of an economy today, fluctuations in oil prices on the world market have had a significant impact on the economies of many countries.

With careful preparation and investment, members in the WTO taking part in the world economy will have to compete related to the trading conflict to get the deserved payoff through the following strategies:

- **Dominant strategy:** Helping members achieve better results than expected. If the player adopts this strategy, one will get results that are in line with the competition, however, there is still a risk that the player does not apply the benefits of this strategy. Cooperation in the world is dominated or may not be beneficial to both parties.
- **Dominated strategy:** Although there are preparations for the desired payoffs, the player still cannot get any results in all situations. The strategy will happen when in the process of making the exchange more profitable no matter what the opponent does. Furthermore, in a cooperative-competitive relationship, not every given direction needs to have a dominant strategy.

		What your colleague does		
This table show payoffs to y	ou for various outcomes	Cooperate	Defect	
		Fairy good	Very bad	
	Cooperate	REWARD for mutual co-operation	SUCKER's PAYOFF	
What you do		Very good	Fairy bad	
	Defect	TEMPTATION to defect	PUNISHMENT for mutual defection	

Therefore, determining the strategic advantage during consultation and discussion is important in determining achievable payoffs.

Image by Sabrina Jiang © Investopedia 2020 [22]

Through this table, we can understand that each player will be faced with a strategic choice that will give them rewards and must consider carefully whether this strategy presents risks or predicaments (Bhuiyan, 2016) [22]: if cooperate with his partner successfully, he will get a reward for cooperation, but vice versa if defect will make his situation worse or not; or should he make his decision to considerable benefit for himself and the worst outcome for his colleague and additionally at the risk that his colleague will also be punished, thereby causing both two get worse (Nie et al, 2014) [23]. This situation lies between whether to trust a partner or not, and whether it is possible to become a "Sucker's payoff". Furthermore, he also hopes that the two can reap a "Reward" for working together, but there is always the possibility that both will pay a "Punishment" for defecting (Morgan, 2001) [24]. From the data in this table, it can be seen that there are positive benefits to using game theory in solving economic disputes, especially in the process of cooperation, through which countries will find the right development partner, and get more rewards. This makes it possible for players to be as safe and successful as possible in a global cooperative game. Because population influences most economic cooperation and conflicts in countries' participation, we generalise the results from those inconsistencies so that players can make the right decisions.

To better understand all strategies and to find Nash equilibria, we give one sample "the oil painting oil patron's dilemma" with a tried data set and also use those data to simplify the calculation process (Bratvols et al, 2009). [26] The dynamic forces of this classical game have been cast as the oil painting oil patron's dilemma, where two countries produce oil and each belief to maximize its oilpainting income. These countries are anticipated to give a commanding amount of the world's total consumption, meaning that their manufacturing defines the oil's price. **Fig 3.4** depicts the change in the oil's price relative to the total product. In our illustration, each of the two countries can choose to supply 10 or maybe 20 bbl of the oil barrel. The possible price issues are shown in **Fig 3.5** 



Figure 3.4: Oil price is considered a function of the produced oil's total [25].

Were the two countries to accept to make only 10 bbl each, to keep the oil high price, each nation would have to aim to change the deal by increasing production by 20 bbl. Moreover, these countries see that the other country may break the pledge. Country A knows that if country B properly agrees on its production limit at 10 bbl, then A will get 500 USD by generating 20 more bbl (20 bbl x 75 USD/bbl). If rather, country A does its deal at 10 bbl. However, if country B does not abide by the agreement, country A will only receive 750, *whileitwillearn*800 if it follows the rules. The same meaning applies to country B. Each country has to find the best argument for itself, and no matter how the other country chooses to abide by the agreement or break it - it's up to you. choose or cancel the contract.

		Country B		
		10 bbl	20 bbl	
Country A	10 bbl	USD 1,400 USD 1,400	USD 1,500 USD 750	
	20 bbl	USD 750 USD 1,500	USD 800 USD 800	

Figure 3.5: The dilemma of the oil producer [25].

This creates a dilemma. However, 400 and be better than if both call off the deal, if both countries come to an agreement on cooperation, they would evidently make a practical profit. The problem is that neither one benefits from taking an adventure, understanding that it is always in the other nations' attention to break the agreement. As a result, although the two countries desire each other, neither can anticipate the other to stick to its pledge to limit the product to 10 bbl, without some fresh contracts or executable processes.

# Chapter 4 Calculation functions (models)

In any situation, the activities of two or more decision-makers influence the outcome (players). The strategic decision-makers in this game are the global cooperative countries, and the countries in the WTO (Asian countries, EU, US, ...). The players will negotiate with each other about the purposes, results, causes, contexts, benefits, principles of trade or protectionist principles of countries in the WTO.Countries participating in global economic cooperation will not be able to apply all their laws and policies to other countries but need to have specific decisions or agreements. international legal cooperation treaty (Tang, 2020) [27]. Therefore, all relevant factors need to be considered.

For all countries participating in global cooperation, or more specifically, countries in the WTO, the expansion of this cooperation almost always brings at least one result, one benefit in one area. certain areas or all of them. This can completely include challenges, disadvantages, even risks, and failures. Although the purpose of this game is to exploit the advantages of cooperation to develop, objective or subjective negative factors can also disrupt, lag or even destroy inherent things, deviating from the original purpose.

In the model below, we have studied the aspects that might affect the outcome of collaboration, profits, or the consequences received by many players in the game, combined with research on improvements, and rounds. iteration of game theory applied to global commercial cooperation (Sebastian, Vasclav, Dawid, 2020) [28]. We offer a general formula to help players, in general, maximize benefits, and minimize risks in the game.

	Country A	Country B
	$S^c{}_b$	$S^{d}{}_{b}$
	$P_a = \frac{E_a.M_b - I_a.E_b.M_b}{\sqrt{D_{ab}}} /$	$P_a = \frac{-I_a \cdot E_b \cdot M_b}{\sqrt{D_{ab}}} /$
$S^c{}_a$	$P_b = \frac{E_a.M_b - Ia.E_b.M_b}{\sqrt{D_{ab}}}$	$P_b = \frac{E_b.M_a}{\sqrt{D_{ab}}}$
$S^d{}_a$	$P_a = \frac{E_a . M_b}{\sqrt{D_{ab}}} /$	0/0
	$P_b = -\frac{I_b \cdot E_a \cdot M_a}{\sqrt{D_{ab}}}$	

- $E_a$ : Country A, B export (GDP)
- $E_b$ : Country A, B export (GDP)
- $D_{ab}$ : distance between countries A B cooperate together
- $I_a$ : Degree of the protectionist policy of country A towards exports
- $I_b$ : Degree of the protectionist policy of country B towards exports
- $M_a$ : Market size of country A
- $M_b$ : Market size of country B
- $S^{c}_{a}$ : Country A join cooperation
- $S^{c}_{b}$ : Country B join cooperation
- $S^{d}{}_{a}$ : Country A doesn't join cooperation
- $S^{d}{}_{b}$ : Country B doesn't join cooperation
- $P_a$ : The gained benefit of country A
- $P_b$ : The gained benefit of country B

In the model mentioned above, the reader can see that, for countries participating in the global cooperative game, players must have policies and costs to protect their interests, small business, product, or domestic market (we refer to it as " $i_a$ "), which is closely related to the strength of the industries and products that the rival country exports (we refer to this as is " $e_b$ ") and the size and growth of the rival country's market (referred to as " $M_b$ "). Same in reverse position, this formula has " $i_b$ ", " $e_a$ ", and " $M_a$ ". When these three factors are considered and evaluated, the results show that, as long as the benefits from the cooperation deal, trade liberalization achieves a return that is higher than the cost that the players invest to participate. When participating in the competition (This means  $e_a M_b > I_a e_b M_b$  then countries considering cooperation will be able to go to the test step, calculating based on the above prisoner's dilemma model, and using the method iteratively explores it until the most feasible outcome is achieved, which benefits all players. Regardless of the cooperative situation, players want the best results and so do their opponents. Therefore, when participating in the game, they are likely to be lured by the opponent to break the original rule, take advantage of cooperation to expand their market, invade the environment and overwhelm the opponent's business. That is why domestic businesses or the government need to have policies to protect and invest so that they can take advantage of cooperation, both to protect themselves, to increase benefits, and to increase access to competitor markets, exportability to compete fairly, and sustainably.

According to the natural law of cooperation, especially global cooperation, between a country and an alliance of many countries, the advantages constantly rise or fall in proportion to the size of the participating country's market and vice versa. way. This means the interests of the players will be proportional to the size of their market (called M) and inversely proportional to the distance (called D) from their associated country - the rival country they choose to cooperate with. In this model, we use the square root of the absolute geographical distance between two players ( $\sqrt{D_{ab}}$ ) to calculate the most stable and optimal transportation cost. As a result, the participating country will benefit from international cooperation (modeled by the formula ), while at the expense of its market. This cost is not considered as a method to optimize business benefits, but as one of the characteristics of an economy, an indispensable thing when participating in cooperation.

From the calculation of Marco, Lothar, and Eckart (2004) [29] of loops combined with a fully-proportional sampling strategy by FEMO so that all players, the factors affecting the game can get the same level of investment. This procedure determines the selection of the least number of elements of the following loop, the relationships, and the selected countries are also determined randomly. Use the Psuedo code below to arrive at the NASH equilibrium with the best outcome for each participant.

Algorithm 3: Fair Evolutionary Multiobjective Optimizer

- 1: Select a primary individual x from X evenly
- 2:  $v(x) \leftarrow 0$  {Start counting offspring.}
- 3:  $B \leftarrow \{x\}$
- 4: **loop**
- 5: Pick one element x from  $\{y \in B | v(y) \le v(z) \forall z \in B\}$  evenly
- 6:  $v(x) \leftarrow v(x)+1$  {Increase the number of offspring}
- 7: Create x' offspring by mutating of x.
- 8: **if**  $\exists z \in B$  such that  $(z \succ x' \lor F(z) = F(x'))$  **then**

9: 
$$B \leftarrow (B \setminus \{z \in B | x' \succ z\}) \cup \{x'\}$$

10:  $v(x') \leftarrow 0$ 

{Start counting offspring.}

- 11: **end if**
- 12: end loop

### Chapter 5

### Results

#### 5.1 General results

Looking at the model table based on the game theory's prisoner's dilemma and the repeating prisoner's dilemma, players will draw three possible scenarios when they have considered the factors for participating in cooperation.

#### Case 1

All players participate in cooperation following the rules, contracts, and terms of territorial sovereignty, culture, and benefits will be evenly distributed to players. That is, they all participate in the game of global cooperation to gain benefits for their businesses and countries, foreign currency revenue sources, business networks, and cooperation are consolidated and expanded. In this case, the only difference comes from that country's GDP and market. This means that the higher the export quality, the stronger the consumption level, the more valuable the export market, and the greater the profit of that exporting country and can reach the maximum value  $(P_{max})$ .

#### Case 2

One of the two countries does not participate in cooperation (only imports), meaning that country A does not have exports to the market of country B ( $E_a.M_b$ does not reach). Thus, country A will be subject to country B's protection for its exports, combined with the costs of transporting and exporting the competitor's goods and services, the profits country A earns in the future. This situation is zero, even negative value. For exporting countries, because they do not have competition from rival countries in their market, some policies and costs for investment and protection become unnecessary. The benefit will be the combination of export value and the market they choose to export and consume.

#### Case 3

When all the players in this global cooperative game have no economic connection or any aspect, the profit will be zero. They don't invest costs on any parameters or aspects of the game, so there will be no profit because there are no trades. At the same time, failures, mishaps, or negative effects will not be possible. when participating in cooperation.

#### 5.2 NASH equilibrium point

Nash equilibrium is a theorem in game theory - a branch of applied mathematics. This simple concept also helps economists figure out what determines the prices of companies, explains how governments should design auctions to get the most bang for their buck, and explains both. The reason why a team will sometimes make self-defeating decisions. It is also used to study strategies for optimal selection.

The Nash Equilibrium predicts how firms will react to competitors' prices. If each nation has thousands of rivals, the two big countries that have set out to fight on price will be able to wring away more clients than normal. The Nash equilibrium also assists economists in understanding why a choice made that works for an individual can turn out to be harmful to the group as a whole. People will benefit more if they can autonomously make rational decisions.

From the NASH equilibrium problem in the noncooperative game proposed by H. Nikaido and K. Isoda (1955) [30] the elements of the problem, in general, is the problem: Find  $x' \in H$  such that  $F(x^*, y) \ge 0, \forall y \in H$  where H is a given set and  $F: H \times H \to R$  is a given function with F(x, x) = 0 Nikaido-Isoda function defines NASH equilibrium of conflict problem in project management described by Unified Game-based model follow the form:

$$F(x^*, x) = \sum_{n=1}^{k} F_{n(x)} - F_n(x[y_n]))$$
(5.1)

Where vector  $x[y_n]$  is the vector obtained by replacing the component  $x_n$  with  $y_n$  from the vector x. The notation  $H_n \subset R$  is player *i*'s strategy set. Then the strategy set of the game is  $H = H_1 \times \ldots \times H_n$ . A point  $x^* \in H$  is called the Nash

equilibrium of the game if:

$$F_n x^* = F_n(x \times [y_n]), \forall y_n \in H_n, \forall n$$
(5.2)

Finding the Nash equilibrium using the Nikaido-Isoda dual function is equivalent to finding  $F_n x^*$  such that Equation 5.2 is satisfied.

In the Unified Game-based model, determining the benefits through the convex function  $F_n x^*$  is equivalent to the notation for the payoff function  $u_i$ . The convex function  $F_n(x^*[y_n])$  for the Nash equilibrium  $x^*$  found is equivalent to the definition of  $u_n(t_n^*, t^*_n)$  where the set of strategies  $x^* = T^* = (t_1^*, ..., t_i^*, ..., t_N^*)$  is called the Nash equilibrium when:

$$\forall (t_n^*, t_m^*) \in T^*, (t_n^*, t_m^*) \notin R^c, (1 \le n, m \le N)$$
(5.3)

and:

$$u_n(t_n^*, t_{-n}^*) \ge u_n(t_n, t_{-n}^*), \forall t_n \in T_n$$

From the general results described by the cases and the formulas based on the repetition of the prisoner's dilemma, we deduce the equilibrium for maximum benefit. This is a general model to apply to many cases. This model is derived from the general formula for assessing dilemmas, issues of negotiation or concessions based on the Nikaido Ishoda function. This is an advanced method, derived from being able to find the NASH equilibrium. Because the formula table above is the same formula that repeats until the player finds the highest result they want. After we reduce and evolve, and develop more, this formula has a shorter loop and is easier to calculate.

$$P_{a/b} = P_{max} = \frac{E_a \cdot M_b - I_a \cdot E_b \cdot M_b}{\sqrt{D_{ab}}} / \frac{E_b \cdot M_a - I_b \cdot E_a \cdot M_a}{\sqrt{D_{ab}}}$$

- $P_{iA}$ : all of funds' A from cooperation;
- $P_i$ : cost of A must be paid to partner to get cooperation and profit.

$$\Leftrightarrow P'_{A/B} = \frac{I_a E_b M_b + \sum_{P_{max}}^{\pi}}{a^n} (A/B : CountryAorB)$$

( $\pi$ : economic protection strategies of cooperation countries;

 $a^n$ : levels of changed strategies)

With each of the changes in strategies, people have other new strategies.

- X- the changes in strategies
- $\xi$  changing in the strategies and payoff of country A or B

$$\rightarrow P(\xi^X) = P(\xi)$$

## Chapter 6

## Conclusion

Multinational cooperation between many economies brings great benefits and opportunities for players to participate in the game of cooperation and investment. As mentioned from the beginning of the study, we point out the problems and conflicts that occur between the countries participating in the cooperation, and the conflicts that come from the characteristics and differences of each country. This is not a new topic, but to summarize the general problems, go from causes to possible outcomes and specific strategies to solve them, we think this is a good article. the different studies that we did.

Throughout the research paper, we applied the Fair Evolutionary Multiobjective Optimizer (FEMO [1]) and tested it with several linear regression techniques. This is one of the algorithms published in the MOEA framework, to present an overview of the player's problems, combined with the prisoner's dilemma. By iterating the algorithm, and giving possible cases of a cooperative game, this is a useful method to both be able to show the existential problems of a game that need to be solved. , has just given strategies so that players can evaluate and choose appropriate strategies to achieve the highest results, and bring maximum benefits and minimum losses. The study, together with algorithms and typical problems in economic cooperation, can help countries or corporations, and scholars can research and apply to gain profits in projects. their judgement. Moreover, for further indepth study, this can be considered as a foundation document, to develop broader problems, develop the model, to improve the Unified Game-based model to be more complete.

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