Department of Economics and Finance

Chair of Games and Strategies : Game Theory

United States and China: A Game Theoretical Approach to International Trade

Supervisor:
Prof.
Roberto Lucchetti

Candidate:
Camilla Altieri
230441

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"It is often assumed that an economy of private enterprise has an automatic bias towards innovation, but is not so. It has a bias only toward profit"

- Eric Hobsbawm

0.1 Introduction

International trade is the exchange of goods and services between countries. It has allowed governments to expand their markets and access all sorts of goods and services that otherwise would not have been available domestically. International trade has been vital for the rise in the global economy and has become an economic activity on which most countries rely. As a result, the market is becoming increasingly competitive.

In today's economy, the importance of trade is constantly expanding and the rules aimed at keeping it balanced and equal for all countries involved. Trade conflicts, in the modern economic scenario, are not unusual. Countries try to keep themselves in the most advantageous position they can, even if this implies not respecting fair competition.

Since the 1970s, when global trade started, traded goods, capital, and services has reached a sum close to 20 trillion in US dollars in 2019. The export of traded goods refers to goods that are manufactured, produced and grown in another country. Countries are involved both in the export and import of said assets, and it hugely contributes to the GDP that each country produces annually.

An open economy allows wealthy countries to use their resources more efficiently, allowing nations to specialize in producing specific items and import the ones they cannot produce cheaply. Developing economies also benefit from openness; it makes them grow more rapidly by allowing for technology and skill transfers and fostering the convergence phenomenon. Describing this scenario, trade seems entirely beneficial; nonetheless, it can be manipulated and abused by utilizing unfair trade practices.

The manipulation of trade makes countries benefit from trade at the expenses of other trading partners. Therefore, it is a form of unfair competition and needs to be corrected so that all countries can benefit from a level playing field with equal opportunities. Though what happens if a country is not playing by the rules? There are adjustment mechanisms for this type of behaviour that are far from perfect, and thus, countries may decide to act independently and, as a result, engage in conflicts as trade wars.

This paper will analyze and explain two different work fields, namely game theory and international trade, and explain the interactions between the two. International trade can be seen as a strategic interaction between

nations acting rationally and maximizing their profit. With this in mind, we will explore two of the global trade leaders: the United States and China. Exploring these two economies, we will analyze one of the most poignant moments in contemporary economic history: the trade war between them.

We will first explore the trade history of the two countries and what led them to occupy such an essential place in the economic scenario. Then, successively we will give a complete overview of the trade conflict: what are the causes for its start, the actions taken by the parties and the outcome.

Once we have given a complete framework on the matter, we will model two distinct game models. Representing China and the United States as two players and their actions as strategies to find an equilibrium in the strategic interaction incentivizing them to act fairly. Furthermore, after the games are presented with all the characteristics, we will comment and analyze the found equilibrium. Although the two games are different, they offer two viewpoints for the situation and a better understanding of the topic.

Finally, we will present thoughts and conclusion on the overall analysis carried out and the primary rationale for the conflict.

Thus, this thesis provides the main tools for analyzing and evaluating the interactions between nations and what outcome can be reached if countries are given the right stimulus to act in a fair fashion. In fact, although the models are based on a simple analysis, the work gives insights on how almost every problem in trade can be modeled as a game-theoretical problem and hopefully find an equilibrium that will eventually apply to reality.

Chapter 1

International Trade and Game Theory

1.1 International Trade, Protectionism and Free Trade

International trade allows countries to make economic transactions in exchange for goods and services between them. It has allowed consumers to have a greater choice of goods and services that were not available in their own countries or would have been more costly domestically. Moreover, it has increased the economy's overall efficiency through the selection effect: the exit of unproductive firms from the market. It is conducted to provide a nation with commodities it lacks in exchange for those it produces in abundance. Trade has promoted globalization and the incentives to an open economy; in general, it improves a country's standard of living and enhances growth. International trade has developed thanks to the collaboration between central banks and the private banking system, without which the rise of the global economy would not have been possible.

Countries differ in various economic aspects; for this reason, trade between nations is exceptionally convenient. Countries can differ in natural resources, human and physical capital, education, health, natural resources... the list goes on. It is on these critical differences that Adam smith stressed the importance of specialization. In his book 'The Wealth of Nations' (1776) [1] he emphasizes international trade as an essential source of increased output. However, the theory of comparative advantage has been further developed and attributed mainly to the English economist David Ricardo, which he developed as the principle of comparative advantage. Ac-

cording to the comparative advantage principle, countries that can produce specific products more cheaply tend to specialize in them and import those they cannot produce at low costs or do not have the means to produce them all.

"Specifically, comparative advantage is an economy's ability to produce a particular good or service at a cheaper opportunity cost than its trading partners" [2]. It allows entities to sell goods and services at lower prices concerning competitors and thus realizes higher profits. It rewards the country that is productively efficient in producing a good; this efficiency could result from the training or skills of the workers, on the amount of available capital, or for numerous other reasons. Comparative advantage hints that countries will take part in trade by exporting the goods they have a relative advantage in and discourage those in which they would be competitively inferior if they opened their borders to trade. This is the salient point for the idea that all countries can mutually benefit from cooperation. The greater the diversity, the greater the opportunity of beneficial trade.

On the other hand, a threat to international trade is protectionism. Protectionism refers to government trade policies that aim at helping or domestic industries by imposing tariffs on imports or providing government subsidies. However, trade policies can also be implemented for safety reasons [3].

[1] A tariff is a tax levied on products when they cross the borders of a custom area; they are usually classified as protective or revenue-producing. Protective policies place specific restrictions on international trade to benefit or safeguard domestic industries, whereas revenue tariffs are designed to obtain revenue rather than restrict imports. However, many economists argue that protectionism may slow economic growth and increase inflation level in the long term. In other words, it hurts the very same people it was designed to protect.

When a tariff spiral between two countries takes place, it can be defined as a trade war, the two countries will implement protectionist policies to hurt one another and thus implement trade tariffs against each other. The most common argument for the imposition of tariffs is to protect domestic industries. However, comparative advantage shows that sectors in need of protection may not survive either way, and they may allocate their resources more efficiently in occupations that possess a comparative efficiency.

[1]This section has been majorly taken from [4]

There are four main types of tariffs a government can impose to limit imports or safeguarding a country:

1. Import tariffs

   Import tariffs are one of the top means through which a government can impose tariffs on imports and enact protectionist policies. All types of importing tariffs are charged to the importing countries raising the prices of the goods imported. We can see three main types of import tariffs:

   - Scientific tariffs;
   - Peril point tariffs;
   - Retaliatory tariffs;

   Scientific tariffs are import tariffs imposed on a product-by-product basis. They raise prices for the importer and pass it on to consumers. Peril tariffs are focused on a specific industry and are calculated to cause harm to the overall industry. Lastly, retaliatory tariffs are enacted primarily due to excessive duties being charged by trading partners; we will concentrate mainly on these tariffs later in this work since they are the ones majorly utilized in trade wars.

2. Import quotas

   Import quotas are non-tariff barriers that are put in place to limit the number of specific products entering the domestic market; they impose a limit to the quantities of commodities a country can import over a determined period. This type of tariff does not have such dramatic consequences as the previous ones; they have a negligible effect on prices, although they boost demand for domestic products.
   Quotas may be put in place also to impeding dumping from other countries, which occurs when foreign industries charge prices below production costs to import countries.

3. Product standard

   As we said earlier, tariff barriers can also be put in place for safety reasons, these tariffs are called product standards. Product standard protectionism is a barrier enacted to limit importing products that do not pass an internal control. Since countries may have different

standards for food preparation, intellectual property or used materials, these barriers are implemented to block imports with standards different from the domestic market.
For example, consider the Netherlands production of Marijuana; in this country, its use is legal. It is usually provided by shops all over the national soil. However, in most EU countries, it has yet to be legalized, so product standards are put in place to block this product from entering the country where its use is still prohibited.

4. Government subsidies

   Government subsidies are subsidies the government provides to industries to increase their profitability, and they are usually provided to promote social welfare. Countries can also offer government subsidies to boost their trade balance; these are usually called export subsidies to give countries incentives to expand globally and export internationally.

The different types of tariffs may be imposed in different ways and have very disparate effects on the country's economy. As opposed to tariffs, we could have free trade agreement or simply a trade agreement scenario, which is contractual arrangements between states concerning their trade to reduce or eliminate barriers for import or export between them.

Under free trade governments, countries can sell and buy products without any or little government intervention. Nowadays, free trade is carried out as a formal bilateral or multilateral agreement of the involved nations; however, a free trade policy may also be an absence of trade restrictions without any action or agreement from the parties' governments. The agreement does not grant all imports to occur; for example, a country can allow free trade except for specific commodities that do not meet the product standards or protect home producers.

Moreover, free trade allows economies and businesses to experience faster growth taking advantage of scale economies and better satisfying the population. There are multiple examples in history showing that a poor open economy will grow a lot faster than a poor closed economy. Trade and in particular free trade expands the variety of products available within the country borders while also lowering the prices of the goods already available; it also helps exploit better resources, skills, and knowledge.

While free trade has some beneficial aspects, it also carries its risks; one of the consequences of free trade is the imposition of unfair trade policies by the trading partners. For example, we can think of low labour costs that could incentivize industries to manufacture their goods abroad, lowering the country's employment. For this reason, free trade is not seen as totally beneficial from the population's point of view. On the contrary financial markets view free trade as an incredible opportunity to expand domestic producers' market. A concrete example of free trade area we could think of is the European Union, in which its members have no boundaries to trade between themselves; they form a single entity to trade.

Free trade has both positive and negative aspects. However, it provides a great advantage as it confers economies the ability to become incredibly efficient, allowing countries to specialize in the production they are best in and forcing the market exit of entities that are not as profitable.

1.2 Game theory

Game theory is a branch of applied mathematics that provides the necessary tools for analyzing situations in which agents, called players, apply strategies to maximize their outcome. Game theory presents models of interactive situations between rational players; players' decisions are interdependent, which causes them to consider the other player's possible decisions to formulate a strategy [5]. In other words, one player's payoff is dependent on the strategy choices implemented by the others. A game will point out the players' identities, preferences, and available strategies and how these strategies affect the outcome. The players' preferences are defined as utilities, this refers to the welfare ranking that the players derive from a specific strategy. The solutions of a game represent the player's maximum achievable payoff which maximizes his utility given the game conditions and the player's available actions.

"All situations in which at least one agent, can only act to maximize his utility through anticipating the responses to its actions by one or more other agents, is called a game" [6]. Given this definition, it comes as no surprise that its applications are countless and diverse; each game model applies to different scenarios, it has been employed in economics and psychology, evolutionary biology, and politics to determine optimal political coalitions. A game can be used every time two or more decision-making parties face pay-

outs or consequences depending on their actions.

The applications of game theory are extensive, but they have been firstly applied in economics by its developers John Von Neumann and Oskar Morgenstern [7]. In their book *'The Theory of Games and Economic Behaviour'* (1944), they observed that economics resembles a game; the agents have to anticipate each other's moves and therefore necessitates a new kind of mathematics called game theory. Thanks to game theory, there has been a revolution in economics; it shifted the Steady States equilibrium toward the market process. As in any concept in economics, there are assumptions of rationality and payoff maximization. Therefore, it is assumed that players participating in a game are acting in a rational fashion and will try to maximize their payoffs in any given situation.

Utility maximization is thought, in mathematical terms, as a utility function. Each player has its utility function from which they derive their best response; the utility-maximizing outcome. The players' best responses give us the Nash Equilibrium. Nash equilibrium or equilibria, if there are multiple ones, are the solutions of the game; they are optimal outcomes reached that, once achieved, will not be deviated from. No player can increase payoff by changing decision unilaterally [8]. Its name derives from its inventor, the mathematician John Nash for whom he won the Nobel Prize in 1994.

Games can be classified according to certain distinctive features; the most obvious one is the number of players. A game can be formulated as being a one-person, two-person, or n-person game, and every game has its rules and characteristics. A player does not necessarily need to be an individual; it can be a nation, a firm, or a team, but every person that is part of it has to share the same interests [5].

Games can be described depending on the information available to the players. We have games with perfect information and with imperfect information. Games with perfect information are characterized by the players' complete knowledge about the game at each stage of its develpment; development hand, games with imperfect information are games in which players are not aware of all the opponent's characteristics for instance like in card games. An additional difference between games with perfect information and of imperfect information is related to the ways of representing the games based on order of play. We can distinguish between sequential-move and simultaneous-move games. The difference between this two types of games is not temporal, is not based on the order of events, but rather on whether and

when players know about other players' actions when making a choice [6]. In simultaneous-move, the agents do not know the others' choice when deciding a strategy whereas sequential-move games denote cases where no moves are simultaneous, the agents' c; thes are well known by the player deciding on a strategy. As an example, chess is a perfect information game, while rock scissors paper is not.

Another classification for games is the extent to which the goals of the players coincide or conflict. We have constant-sum games and variable-sum games. In constant-sum games, players are in total conflict; in other words, it takes place a pure competition. Players in this type of game have completely opposed interests. A further distinction for constant-sum games is positive-sum and zero-sum games. In positive-sum games, the total gains and losses are always greater than zero whereas, in zero-sum games, the total wins and losses add up to zero; thus, one party benefits at the expense of another.
On the other hand, all the players may be winners or losers in variable-sum games, depending on the outcome. Variable-sum games can be further distinguished in cooperative and non-cooperative. In cooperative games, players can communicate and also make binding agreements. Whereas, in non-cooperative games, players may communicate, but they cannot form a coalition or an agreement between themselves.

A game can be described in one of three ways: extensive, strategic or characteristic function form. Most common games that develop step by step can be modelled as games in extensive form.
A game tree can conveniently represent an extensive form game because all actions are known and sequential. Each turn is a vertex of the tree, and each branch represents the players' possible successive choices; the payoffs for each action profile are given by the pair at the leaves of the game tree. A method to solve this type of game is backward induction, which is reasoning backwards in time; we start from the end of the problem and regress to determine the sequence of optimal actions. A player in such games will choose her first action while considering each series of responses and counter-responses that will result from each choice available to her. She will then choose the action that starts the chain leading her to the outcome maximizing her utility. It examines the last point where a decision can be made and defines the optimal decision, always remembering that players are rational and always choose the outcome maximizer option.

The game's strategies can be classified as pure and mixed, dominant and dominated. A pure strategy for a player is a combination of moves at any

time that player is called to take a decision. Once the set of the pure strategies of a player is given, she can decide to adopt a mixed strategy rather than a pure one: in this case the utility of the player is calculated in expected sense. Mixed strategies make sense in many games: for instance, it makes no sense to adopt a fixed pure strategy when playing (repeatedly) rock, scissor paper: if the future opponents os the player can observe her, they can take an enormous advantage. This does not happen if the player plays (optimally!) a mixed strategy. Another distinction between possible strategies would be between dominant and dominated strategies. A dominant strategy is a strategy providing the player higher utility than other strategies, regardless the choices of the other players. Thus the rationality assumption made on the players implies that a (strictly) dominated strategy cannot be used in a game among rational players. [2]

1.3 How Game Theory applies to International Trade

Nowadays, all countries, regardless of their economic strength, size or endowment of natural resources, must participate in one form or another in the global economy, as a natural consequence of general economic interdependence between them. The level of economic development of the countries and the degree of specialization of each one will determine each nation's role in the global economy. As previously stated, game theory analyses situations in which each agent's well-being depends not only on her actions but also on the actions of its opponents; all of the agents consider this interdependency when formulating the strategies. Alex & Toma (2012) [9] state that theoretic games are characterized by a number of players or decision-makers who interact with each other forming coalitions and, in some cases, get into conflict with each other to maximize their payoffs. Thus, we can find numerous similarities in economics since economics is a competitive system in which entities try to maximize their profit anticipating the opponent's moves, and their outcomes will be strictly dependant on the opponent's choices. In economics, entities utilize strategies to be better off than their counterparts while also maximizing their payoffs. More specifically, international economics has a game-theoretic character: each country faces decisions on which products to

[2]This shows the tragedy to take selfish decisions in an interactive setting: the prisoner's dilemma, the most famous example of the whole theory, shows that the combination of the use of strictly dominant strategies can produce very adverse outcomes for the players.

import based on which product will bring more satisfaction to the population and afterwards negotiates over mutual reductions of tariffs or under a trade agreement deal. Trade and competitiveness are intimately connected; competitiveness can be described as the set of factors that determine the level of sustainable productivity of an economy, and trade utilizes the factors that define competitiveness to make a country better off. Competitivity has its centre on productivity: the efficiency with which an economy uses available inputs to produce outputs. The openness of a country changes its competitiveness landscape by broadening the scope of cross-border flows. Not only goods cross borders but also entities, manufacturing processes, labour, capital and so on. As a consequence of international trade, the market increased its competitiveness, which brought inexpensive labour and manufacturing costs, thus lowering the prices for home products. It is not possible to choose a permanent trade policy since trade increases, countries may change production structures, and the population's needs develop over time; also, the country's strategies have to change together with the other factors to keep safeguarding the nation's interests and needs.

To achieve the above-mentioned goals, a country has to act in self-interest, rational way as players in a game do. Thus, we can model trade interactions as a game, in different ways, according to the scenario we are analyzing. We can figure trade as a market with imperfect competition, and all of the trade interventions are rational since public agencies have market power in trade. The framework of a two-level game, which is a game in two levels to solve international conflicts using game theory, was first presented by Putnam (1988). He stated that the set of economic interactions between two governments is determined first by political-economic interactions between each country's government and its interest group [10]. After Putnam Rossman and Helpman (1995), [11] proposed a two-level game in the context of trade protection. They modelled the strategic interactions between two large open economies, each with its own political and economic structure and the relevant market power.

Policymakers make clear the importance of strategic interaction in trade. For example, in the paper published by Abbott & Kallio (1996), [12] a model based on a theoretical game approach with the European Union and United States as players which independently maximize their payoff is proposed; in this model, multiple equilibria were found. Moreover, game theory has been used as an argument in favour of trade liberalization. They concluded that the profit-maximizing outcome would be the one without custom unions, tariffs or protectionism. The countries engaging in these unproductive activities

will thus realize a lower payoff.

The primary rationale behind this argument is that free trade is always a win-win situation for all the parties involved. Even if the counterpart decides to implement protectionism, the other would still be better off sticking with free trade.
In the paper *'Trade Wars, Trade Negotiations and Applied Game Theory* Harrison and Ruström [13] use a trilateral Free Trade framework between the United States and Canada to analyze the best outcome. They find that both United States and Canada will lose from a trade war and that they would have been better off maintaining the status quo, seen as trade negotiations under GATT. Additionally, they point out that the world as a whole loses significantly from the said trade war. On the other hand, they also point out that in multilateral negotiations between the EC, the United States and Japan, the United States and the EC do gain significantly compared to the status quo by having trade negotiations with the threat of retaliatory tariffs.

The extensive literature on game theory applications to international trade emphasizes how trade policy strategies can be converted into strategies of a game. Behind all the related articles is the argument that economic interactions rely on the same assumptions that game theory relies on: rationality, strategic interactions and maximizing the payoff.

As we just explained, trade is based on interdependency. Each country is dependent on the others since it necessitates them to satisfy its proper citizens' consumption needs and interests. However, each country acts in a rational selfish manner. With this framework in mind, when protectionism tariffs are involved, which is the best outcome? Sticking with free trade or retaliatory tariffs? We try to answer the questions in the next chapter taking U.S.- China case as an example.

Chapter 2

U.S. and China

2.1 U.S. and China as global trade leaders

2.1.1 United States

The United States, form less than 5% of the world population and account for almost 20% of the world's total income. The U.S. is the world's largest economy and leader in global trade [14] and has led the world to an unprecedented reduction of barriers in the past seventy years. The United States started to open-world market in 1934 with the reciprocal trade agreement act. The turning point in trade came after World War II; America's leaders thought it was critical to engage economically through trade policies to foster economic prosperity. To pursue this goal, the U.S. created the General Agreement on Tariffs and Trade (GATT) in 1947. Under the GATT, the major world trading nations concluded a series of negotiating rounds to lower the trade barriers and implement international trade rules, including intellectual property, goods, and binding dispute settlement procedures [15]. As a result of these rounds, tariffs were lowered by more than 50% and trade agreements with multiple nations started forming. This brought a revolution, with the huge rise in world trade exploded and U.S.'s trade policy opened domestic and foreign markets to an unprecedented level.

Following this, in 1994 it was held the Uruguay Round, which did not only substantially reduce trade barriers but also transformed the GATT into a more complete and structured regulatory environment for international trade the World Trade Organization (WTO): *a global international organization dealing with trade rules between nations* [16]. The newly formed WTO provides an international dispute settlement mechanism as well as restraints on the use of some non-tariff barriers. In addition to the Uruguay round, the

United States negotiated the North Free Trade Agreement (NAFTA) during the same period. This agreement eliminated all trade barriers between Canada, Mexico and the U.S. thus creating a duty free market for 450 million people.

Though the road to globalization was not always smooth, the WTO and NAFTA raised concerns over trade liberalization for various reasons such us unfair competition, environmental concerns and labor reallocation, the situation peaked in 1999 with the explosion of massive protests against the WTO and trade agreements. Despite this, two years later in 2001 after the terrorist attack to the twin towers, the WTO was able to launch another round of negotiations [17]. Following the new round, the U.S. started multilateral negotiations for several trade agreements, as the Trans-Pacific Partnership (TPP), which was designed to include 40% of the global economy and become the world's largest free trade deal, and the Free Trade Area of Americas that would include all nations in South, Central and North America.

Thanks to this new system of multilateral trade agreements trade expanded the production and competitiveness of the nation's most competitive industries and thus the export of goods, which increased the nation's wealth and aggregate productivity. The possibility of serving the global market firms expanded their scope and increased investments in the export sector, which helped benefit from scale economies and reduce production costs. All these factors increased the United States' output growth rate and productivity. Moreover, with the expansion of exports we have also increased imports, which can provide high-quality production inputs helping to keep the U.S. companies highly competitive in domestic and foreign markets.

Economic interaction with the rest of the world has played a crucial role in making America the economic leader we now know. The United States has had relatively open borders, with some exceptions, which allowed most products to cross with a zero or low tariff; this has allowed the country to maintain levels of inflation at its target and allowed the Federal Reserve to keep low-interest rates. During the 1990s, exports accounted for approximately 25% of output growth [18]. Unfortunately, trade barriers and distortions not compliant with international trade rules have undermined this multilateral trading system. The GATT and WTO systems are based on the expectations that there will fair competition and equal possibilities in the trade arena. However, some countries pursued unfair trade policies or have allegedly unfavourable agreements to the U.S. economy.

In 2019, U.S exports were 2.5$ trillion, which contributed by 11.7% to the American Gross Domestic Product (GDP). Despite everything it produces, the United States imports more than it exports, which produces a trade deficit that has steadily grown over the past decade [19].

Given the assumed unfair trade positions taken by the other nations when Donald J. Trump became president, he implemented some significant policy changes for the United States. The newly elected president thought that a negative bilateral trade balance indicated that the trading partners were not respecting trade rules. He withdrew the U.S. from the TPP; agreements with Mexico and Canada, NAFTA and USMCA, respectively, and the South Korea KORUS were renegotiated. Trump administration began with tariffs on steel and aluminium, solar panels and set off a tariff spiral with China in multiple sectors.

The trade policy plan was based on four pillars:

1. Rebalance the trade relationship by giving support also to national security.
2. Renegotiate outdated and imbalanced trade agreements for the benefit of the citizens and the country
3. Foster the enforcement of international and national trade laws
4. Defending the United States interests at the WTO. [20]

Despite this initiative, the trade deficit has continued to grow. Moreover, countries like China, EU, Mexico and Canada announced retaliatory tariffs further hurting U.S. exports. Given this scenario, Canadian and Mexican tariffs were eventually removed in May 2019, but this was not the case for China, as we will explain later. Additionally, tariffs depressed the stock market and reduced the growth of investments. The long-term effect of the imposed tariffs is yet to be determined as the newly elected president trade policy comes into force.

2.1.2 China

China's history trade had rich records of it being an integral part of international trade. Despite this, its position in the global market drastically changed in the 15th century. From the 15th century until the 20th century

China has reclined itself from trade and became uninterested in what the world had to offer [21]. This change in approach stalled China's growth; its GDP went from being 30% higher than western Europe in the 18th century to being 1/12th by the middle 1900s. Given this general situation, China's economy was stagnant, centrally controlled, inefficient and highly isolated from the global economy.
In the pre-reform era Chinese trading system had three main features:

1. The system of foreign trade was completely monopolized by the central government

2. The strategy for trade was one of import substitution and trade planning; meaning that the purpose of importing more was to lay foundations to industrial independence

3. The exchange rate and relative prices, that usually are at the heart of the foreign trade system, were unimportant; prices of domestic goods were fixed and not determined on international prices basis and domestic prices of imported goods were determined according to those of domestic goods. [22]

The 1960s was a period of isolation and emerging of pragmatism in China's international economic relations. China ceased ties with the Soviet Union, and in 1958, the communist party chairman, Mao Zedong, took initiatives to turn the country economically inward and maintaining a long period of autarky in the subsequent 12 years. Mao implemented a strategy called the 'great leap forward' based on self-reliance, where foreign trade was assigned a minor role. This damaged the Chinese economy, not permitting the country to prosper.

A different approach to trade was later employed by China's tenth prime minister, Deng Hsiao Ping, which realized that China's economic potential could not be achieved without engaging economically with the rest of the world. To regain economic relevance in international markets, he started allowing trade with Japan and Europe; this eased relations with the West and internationalism grew. As political conditions eased, relations with numerous states normalized, and trade expanded dramatically. [23]

After Mao's death, the new chairman Deng Xiaoping ended the country's isolation and abandoned most economic policies and measures which opposed openness. The Chinese Communist Party Congress in December 1978

marked the start of reforms and policies aimed at making the country an active participant in global markets. Free-market reforms were implemented in 1979 to open the country to foreign trade and investments, shifting governance from administrative to legal by creating a variety of legal tools to regulate foreign trade.[24] During the 1980s and 1990s, thanks to market reforms and new trade policies, trade came complete cycle.

In 1986, to enhance and secure access to foreign markets, China applied to join the GATT. However, the accession was delayed, and 15 years passed before China could formally participate in the multilateral trading system [23]. China officially joined the now renamed WTO in 2001, demonstrating its propensity to become a key player in the global arena again. The obligations applied by WTO on China were much stricter than those applied to other members. The reasons for these unfair conditions appear to be in the political and commercial implications of China's access to global markets. Nevertheless, China accepted the conditions and agreed to implement WTO conditions effectively.

From there on, China has transformed. It went from being a poor developing economy to one of the global trade leaders in the contemporary economic scenario, with trade being a crucial tool for its economic modernization. Since the country decided to open its borders, it has been one of the world's fastest-growing economies with real GDP growing annually by 9.5%; such growth has permitted it to double its GDP every eight years and helped raise approximately 800 million people out of poverty. [25]

With such growth and openness, China became the world's largest manufacturer, merchandise trader, holder of foreign exchange reserves, and leading commercial partners for the United States and the European Union. China was essential to the U.S. economy as it being its biggest merchandise trading partner, the most significant source of imports, 3rd U.S. export market, and the largest foreign holder of United States Treasury security.

By 2010 China was already the world's largest exporter. The country's path to becoming a manufacturing powerhouse was probably due to the access to the World Trade Organization and the emergence of global value chains (GVCs). The great bulk of Chinese exports consist of manufactured goods of which electronic machinery and equipment and clothing and footwear are the most substantial part.

As the Chinese economy matured, its GDP growth has slowed down; the

government has embraced this slow economic growth relying less on fixed investment and exports and more on consumption, services and innovation to drive economic growth. The country has made innovation a top priority in its new financial planning through several initiatives, such as 'Made in China 2025', a plan to modernize China's manufacturing in key sectors through government subsidies. [26]

The quick rise of the Chinese economy has both been questioned and admired. The U.S. and other industrialized countries accused China of unfair trade practices, intellectual property rights violation and manipulating its currency to manage its exchange rate. The 'Made in China 2025 'and the concerns over trade policies breach have raised concerns in the international market. It is thought that China is using industrial policies to decrease the country's reliance on foreign technology and eventually dominate the global markets.

Despite the continuing accusations and the many complaints brought by member states to the WTO, China's importance in global production in most sectors has consistently increased, demonstrating its export resilience and the gained market power.

2.2 An overview of the trade war

In recent decades, China's increased economic power combined with the decline of the United States grip in the global value chains and international trade has led to a change in the geopolitical landscape. China became a leader in commodity export in 2015 with an absolute GDP of 14,092 million USD, second only to the United States. Thanks to the pace of its economic growth China became the world's largest exporter with an annual export volume of 2,263.33$ million compared to U.S. exports of 1,546.72$ million. It is thought that China's economic power has surpassed the one of the U.S. in recent years, with it becoming the low-cost manufacturing centre for global production. Even with this advantageous position on China's side, America still holds the leading position in stock, credit, energy and commodity markets.

Tensions between the two economies began to arise when the WTO granted China the market economy status; this status limited protectionism opportunities against Chinese companies. Trump's confrontation policy

was reflected in the National Security Strategy adopted in December 2017. It introduced restrictions on China's investments in American technology, tightened exports control and refused to recognize China as a market economy.

Given this general framework in mind, the United States, under Trump's administration, launched an investigation under Section 301 of China's technology transfer, innovation, and intellectual property policies deemed harmful to U.S. economic interests. The U.S. officials later stated that China has been pursuing unfair trade policies under section 301 and 201 of the 1974 trade act, exploiting trade liberalization and WTO membership while at the same time trying to keep its domestic market safeguarded against foreign competition by providing government subsidies and facilitating exports through currency devaluation. Thus, the United States accused China of stealing knowledge and technology from American companies. The U.S. is not the only country worried about the rapidly growing Chinese economy. Several others, such as but not limited to the European Union, have raised concerns over the 'Made in China 2025' plan.

At the same time, researchers point out that, in the attempt to restore a positive trade balance Trump violated international law and multilateral agreements; the United States has abandoned the concept of free trade, trying to preserve its status as a global leader.

[1]There are four main explanations from the United States perspective for the trade conflict:

1. The concern that China's trade surplus is depressing job creation in the U.S. and reducing of trade deficit
2. To limit the access of Chinese companies to American technologies and prevent Chinese modernization
3. Prevent China's growth in military strength
4. The reduction of federal budget deficit

As pointed out before, trade wars have no winners or losers, both sides will suffer losses, and at the same time, the global economic growth will face a slowdown. The United States has a long record of winning negotiations,

[1]This section has been majorly taken from [27] .

resolving trade conflicts and forcing other countries to step back. However, China was resilient to United States tariffs and tariffs threats and frequently responded accordingly, leading to the trade war.
The trade war took place in different sectors in which it was thought that China was acting in an unfair matter. These are the three main ones:

- Solar panels and washing machines

On October 31^{st} the U.S. International Trade Commission finds that imports of solar panels and washing machines have caused harm to the related industries and recommend to president Trump to impose global safeguard restrictions. On January 22^{nd} of 2018 president Trump approves global safeguard restrictions on 8.5 billion in imports of solar panels and 1.8 billions of washing machines.

As a consequence the Chinese government self-initiates anti dumping and countervailing duty investigations on roughly 1 billion of U.S. exports of sorghum which come to life on April 17^{th} with a 178.6% antidumping duties.

- Steel and aluminium

On the 16^{th} of February 2018 the department of commerce release a report stating that imports on steel an aluminium products threaten the U.S. national security.

On the $1^{st}$of March 2018 Trump announces tariffs of 25% on steel and 10% on aluminium on all trading partners on national security grounds, which covered Chinese exports worth approximately 2.8 billion.

On April 2^{nd} 2018 China retaliates imposing tariffs on aluminium waste, pork and fruits and other U.S. products worth approximately 2.4 billion.

As a response, in July Trump files a WTO case against China and other countries which challenged retaliatory tariffs as a response on steel and aluminium trade actions that were implemented to safeguard the United States national security. Moreover, president Trump also provides government subsidies to American farmers for the lost export sales resulting from tariffs actions.

On January 2020 Trump imposes new tariffs on almost 450 millions of steel and aluminium products to help industries suffering from previous tar-

iffs.

- Technology, Intellectual property and innovation

On 22^{nd} of March 2018 the Trump administration releases its report 'Findings of the investigation into china's acts, policies, and practices related to technology transfer, intellectual property, and innovation under section 301 of the trade act of 1974' which concludes that China is conducting unfair trade practices related to technology transfer, intellectual property and innovation.

On the 23^{rd} of March 2018 president Trump signs the 'Presidential Memorandum targeting China's economic aggression' on unfair trade practices. Trump releases a list of 1,333 Chinese products under consideration for 25% tariffs covering 46.2$ billions of U.S. imports. The sectors majorly hit are machinery, mechanical appliances and electrical equipment. On the 4^{th} of April 2018 China publishes its list of 106 products subject to 25% tariffs as a retaliation for Trump's actions, covering roughly 50$ billions of China's imports from the United States.

On the 15^{th} of June 2018 the U.S. state representative publishes a revised list of products worth 50$ billions, in which targets more intermediate products used largely by American based companies. On the same date China also publishes a revised list targeting 45 billion of U.S. exports including agricultural and food products.

On the 6^{th} of July 2018 U.S. tariffs on the first 34$ billions out of 50$ billions go into effect, and on parallel China applies the first tariffs on 34$ billion worth of imports.

On the 10^{th} of July 2018 the U.S. trade representative publishes a list of additional 200$ billions of Chinese imports with a 10% tariff. This list is combined with the previous 50$ billions of imports for a total of 250$ billions out of the total of 504$ billions of goods imported from China.

On the 1^{st} of August 2018 Trump considers a 25% tariff on the list of products worth 200$ billions imports. As a response on the 3^{rd} of August 2018 China warns that it could add duties from 5% to 25% on 60 billions of U.S. goods following on Trump threat to raise tariffs.

On the $23^{rd}$of August 2018 Trump administration imposed tariffs on the remaining 16$ billions of imports from the 50$ billion items list and China retaliates immediately with its own remaining list worth 16$ billions. This completes the first 50$ billion on tariffs announced back in April.

On the $24^{th}$of September 2018 U.S. tariffs on 200$ billions of Chinese imports come into effect accompanied by China with applied tariffs on 60$ billion tariffs of U.S. imports.

On the 1^{st} of December 2018 after the G-20 summit Presidents Trump and Xi announce a deal to stale for 90 days tariff escalation that was expected in January.

The U.S. announces that the new list of tariffs on the 200 $ billions of goods will be delayed and China lowers tariffs from 25% to 15% on auto products.
On the 24^{th} of February 2019 Trump announces a delay on tariff increase expected on the 1^{st} of March on the 20$ billions product list. The 10% tariff would have been increased to 25%.

Between the 30^{th} of April and the 1^{st} of March 2019 there are ongoing negotiations before the new G20 summit. U.S. and China negotiations fail, and on the 5^{th} of May 2019 Trump renews the threat of a tariff increase up to 25% on the 200$ billions goods imported from China that will come into effect on May 10th.

On the 10^{th} of May 2019 Trump keeps his word and goods previously subject to a 10% tariff are now subject to a 25%. On the 1^{st} of June 2019 China retaliates and increases the tariff on 36$ billions of the 60$ billions list.
On the 1^{th} of August 2019 after a round of trade talks with no results between the two countries, president Trump states that it would impose a 10% tariff on an additional 300$ billions of imports from China.

On the $23^{rd}$of August 2019 China plans to retaliate on 75$ billions of US exports in response to Trumps coming tariffs on 300$ billions of Chinese imports. Later the same day, Trump stated that he would apply a 15% tariff, not anymore 10% percent, on the 112$ billion list on September 1st, and on the 160$ billions list on December 15th. He also said that the 25% tariff on 250$ billions of Chinese goods will increase to 30%, starting October 1st.

On the 11^{th} of September 2019 China announces it will exclude some products from the retaliatory tariff imposed in 2018 and Trump delays tariff increase on the 250$ billions of Chinese imports. After a two-day meeting of U.S. and Chinese deputies, USTR issues tariff exclusions on about 400 Chinese products.

After two days of high-level talks, Trump announces a Phase one trade deal that includes suspension of planned tariffs and a Chinese pledge to buy more farm goods, but few details.

On the 11^{th} of October 2019 US delays tariffs scheduled for the 15th of December and cuts tariffs from 15% to 7.5% on the ones enacted on 1st September. China following U.S. steps delays the tariffs increase scheduled for the 15^{th} of December and extends tariffs exemptions for some agricultural and machinery products.

Finally on the 15^{th} of January 2020 President Trump and Chinese vice premier Liu He sign the 'Phase One Trade Deal' in which U.S. will Relax some tariffs from Chinese imports from 15% to 7.5% effective 14^{th} February and China agrees to purchase an extraordinary amount of an additional 200$ billion worth of U.S. exports over 2 years. China also pledges to enforce intellectual property and to lower tariffs on 75$ billions of US goods from 10% to 5% and from 5% to 2.5% effective 14^{th} of February.

Officially on the 14th of February the Phase One Trade Deal enters into force.

2.3 A simple theoretical game analysis of the situation

In this section I will present two simple game models based on the trade war between China and the United States. The models are a great simplification of reality based on my competencies and knowledge of the topic. In this study, the trade dispute is constructed on the two players U.S. and China, in a non-cooperative game theoretical framework. The trade dispute evolved in a trade war between the two countries. Still, in our example, we try to find an equilibrium other than the trade war outcome by introducing a (reasonable) deputational loss in case of high tariffs.

2.3.1 Extensive form game

The first model is constructed as an extensive form game with perfect information. Perfect information game: a game where all the players know everything that has happened previously and what will happen in the game. Assumptions of the game:

a) Players are rational;

b) Players are utility maximizers;

c) All the players have the same perceptions of what the game is;

d) Complete information: each player knows the characteristics of the other players' preferences and strategy spaces;

e) Perfect recall: each player knows and remembers his previous behaviour in the game.

Characteristics of the game:

i) A set of players $N = \{US, China\}$, where US is Player 1 and China is Player 2

ii) For each i = 1,2, a set of actions S_i that is, a set of actions, which are for Player 1 (US) is $A_{us} = \{x_1, x_2, x_3; z_1, z_2, z_3, z_4\}$ and for of Player 2 (China) is $S_c = \{y_1, y_2, y_3\}$

iii) A time period equal to $t = 3$.

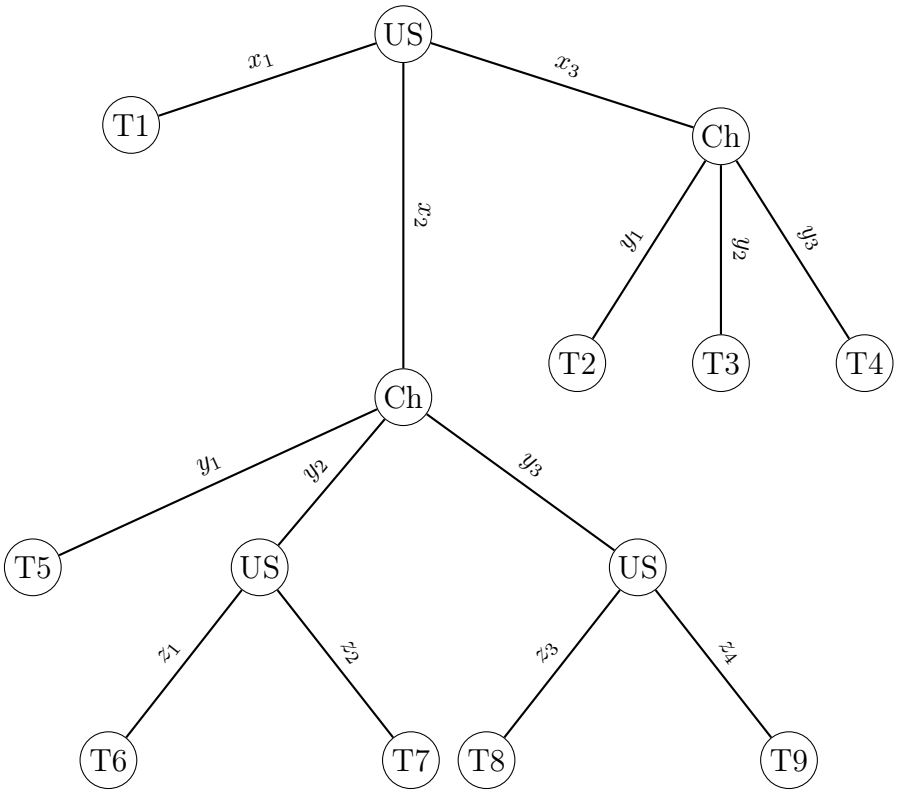
In assigning utilities, we introduce a reputational loss coefficient $c \in (0, 1)$ for the country that imposes a high tariff, meaning that the country that imposes a high tariff will lose in reputation with respect to the other countries. This should prevent the countries to adopt (too) high tariffs.

The game has the following structure:

1. One side makes an offer
2. The other side either accepts or reject
3. If they reject the game either the game ends or they can make a counteroffer

The structure of the first game is as follows: at the first stage Player 1, which is the first mover, has three possible choices x_i with $i = 1, 2, 3$ where x_1 represents no tariff, x_2 represents low tariffs, and x_3 high tariffs. Subsequently, in case of choice x_2, x_3, Player 2 will choose a move selected in the set (y_1, y_2, y_3), where again the meaning is the same (different letters are used to distinguish between players). The game ends in any case after the choice of Player 2, if at the first stage Player 1 chooses high tariffs x_3. In the other cases, the game ends if Player 2 chooses y_1 (no tariffs), or it continues, and now is again Player 1's turn. Player 1 finally selects one more time between low tariff increment z_1, z_3 or high tariff increment z_2, z_4.

The game is structured as a game tree and is the following:



The payoffs are the percentage tariffs applied to total imports, which signifies that the tariffs are revenue for the country that imposes them. The total payoff of a player is the percentage tariff applied multiplied by total imports minus the percentage tariff used by the other player on your total exports.

The utilities of the players are calculated in the following manner if they decide to apply low tariffs:

$$US(x, y) = (x + z)(1 - c) - y(1 - c)$$

$$China(x, y) = y(1 - c) - (x + z)(1 - c)$$

The results we obtain from the tree diagram are the following:

- T1 = $(0, 0)$ which is $(x1; -x1)$ because Player 1 chooses to not apply tariffs;
- T2 = $(0.1; -0.1)$ which is $(x_3(1-c); -x_3(1-c))$ because Player 1 chooses to apply high tariffs and Player 2 to not apply tariffs;
- T3 = $(-0.05; 0.05)$ which is $(x_3(1-c)-y_2; y_2-x_3(1-c))$because Player 1 chooses to apply high tariffs and Player 2 low tariffs;
- T4 = $(-0.025 : 0.025)$ which is $(x_3(1-c)-y_3(1-c); y_3(1-c)-x_3(1-c))$ because both Players (1,2) decide to apply high tariffs;
- T5 = $(0.15; -0.15)$ which is $(x_2; -x_2)$because Player 1 chooses to apply low tariffs and Player 2 chooses to not apply tariffs;
- T6 = $(0.1; -0.1)$ which is $((x_2 + z_1) - y_2; y_2 - (x_2 + z_1))$ because Player 1 chooses to always apply low tariffs and Player 2 chooses to apply low tariff;
- T7 = (0.05; -0.05) which is $(x_2 + z_2)(1 - c) - y_2; y_2 - (x_2 + z_2)(1 - c))$ because Player 1 decides to apply a low tariff and a high tariff and Player 2 a low tariff;
- T8 =$(0.125; -0.125)$ which is $((x_2 + z_3) - y_3(1 - c); y_3(1 - c)(x_2 + z_3))$ because Player 1 chooses to always apply low tariffs and Player 2 chooses a high tariff;
- T9 = $(0.015; -0.015)$ which is $((x_2 + z_4)(1 - c) - y_3(1 - c); y_3(1 - c) - (x_2 + z_4)(1 - c))$ because Player 1 chooses a low tariff and a high tariff and Player 2 chooses a high tariff;

Where the variables represent the following applicable tariffs and repuational loss:

- $x_1 = y_1 = 0$
- $x_2 = y_2 = 0.15$

- $x_3 = 0.20$
- $y_3 = 0.25$
- $z_1 = z_3 = 0.10$
- $z_2 = z_4 = 0.25$
- $c = 0.5$

The payoffs are structured to resemble reality. Therefore tariffs applied are similar to those used in the trade conflict, where high tariffs were between 20%-30% and low tariffs between 5% - 15%. We further applied a high reputational loss for the countries, equal to 50%; this was decided given the fact that both countries are members of the WTO. If they proceed with the application of excessive-high tariffs, this will signal to all trading partners that they are acting as unfair competitors, therefore giving a significant disincentive to countries to trade with them. We reasoned that there would have been a trade-off between costs and fairness in trading partners' minds.

In almost every case, China has a negative payoff both because the US has the first-mover advantage and because China is not yet a self-sufficient economy; its primary source of revenue are external partners. China would have never started the trade conflict since its economy is too reliant on the United States. Therefore, if the trade between China and United States would have ceased, the economy would have lost one of its main customers, which would have harsh economic consequences, putting it in a precarious position.

Having described the rationale behind payoffs construction, we proceed to find the equilibrium by backward induction. The first player wants to maximize its payoff he will thus choose the strategy leading to the outcome $(x_2; y_2; z_1)$ knowing Player 2 possible action set. Given this, we proceed backwards to find the path that will lead to this outcome.

The United States, between the first three available moves, the one who could give a higher payoff is the imposition of low tariffs and thus $x = x_2$. If on the contrary chooses a high tariff, China will choose a low one resulting for the United States in a negative payoff, and if it chooses not to apply tariff it will make no payoff, and more is always better.

At this point, China has the choice between other three possible choices. The rational decision for China is to apply a low tariff y_2 , if he chooses a tariff $y \neq y_2$ it will obtain a lower payoff given Player 1 possible action set. Now again is the US's turn, and he will choose the option which gives him a higher payoff, which is $z = z_1$, a low increment of tariff.

The equilibrium payoff that we find is $(x_2; y_2; z_1) = (0.1; -0.1)$. Thus, the equilibrium shows that the best response of the US to China's available strategies and the best response of China to US strategy choices is a low tariff imposition. This means that if the countries are given the reputational loss incentive, it is better to stick with a low tariff imposition. This would be the rational choice for both countries, making them not incur in excessive revenue loss.

2.3.2 Continuous Form

In the second model we assume that there are only two stages and the players select $x \in [0, 1]$: $x = 0.1$, for instance, means that a 10% tariff on the global import is imposed. The characteristics of the game:

i) A set of players $N = US, China$

ii) Each players strategy set is $[0, 1]$

The two utility functions :

$$US(x, y) = x(1 - x + cy)$$

$$China(x, y) = y(1 - y + cx)$$

Also, in this case, we added a reputational loss with $c \in (0, 1)$ such and we assume that the overall reputational loss of a player is given by his choice, mitigated by the choice of the opponent. The factor c is introduced since the effect of the tariffs applied is direct, while the effect of the tariffs applied by the opponent are indirect.

To find the outcome of the game, since it is a perfect information game, we apply backward induction. In this context , the first player (US) is called the leader, the other one (China) the follower. For each $x \in [0, 1]$ The follower choice is that one that maximizes his utility. This creates a function $f(x)$ which is known to the leader, which thus maximizes $u(x, f(x))$. The leader or first mover has the advantage of being the first to make a choice,

and thus he will realize a higher payoff in respect to the follower.

In this game, to find the NE, we have to compute the BR of the players for the other player action. We start off performing the equation and then calculate the first derivative and equalizing it to 0. We find that the best responses of the two players are:

The best response of player 1 if player 2 chooses y is:

$$BR_1 y : x = \frac{1 + cy}{2}$$

The best response of player 2 if player 1 chooses x is:

$$f(x) = BR_2 x : y = \frac{1 + cx}{2}$$

Solving

$$x = \frac{1 + cf(x)}{2}$$

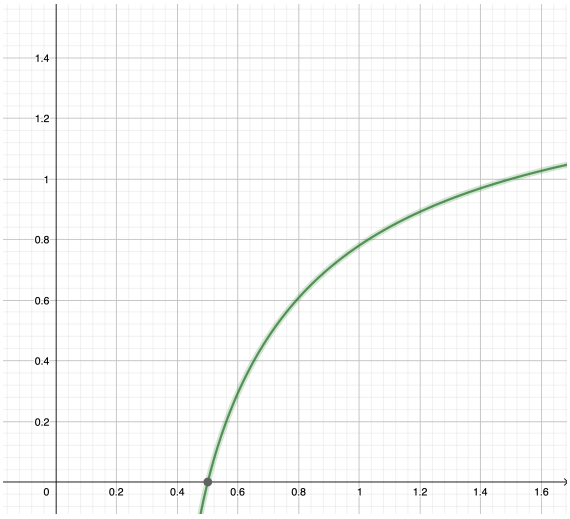
we get:

$$x = \frac{2 + c}{2(2 - c^2)}$$

$$y = \frac{c(2 + c)}{4(2 - c)} + \frac{1}{2}$$

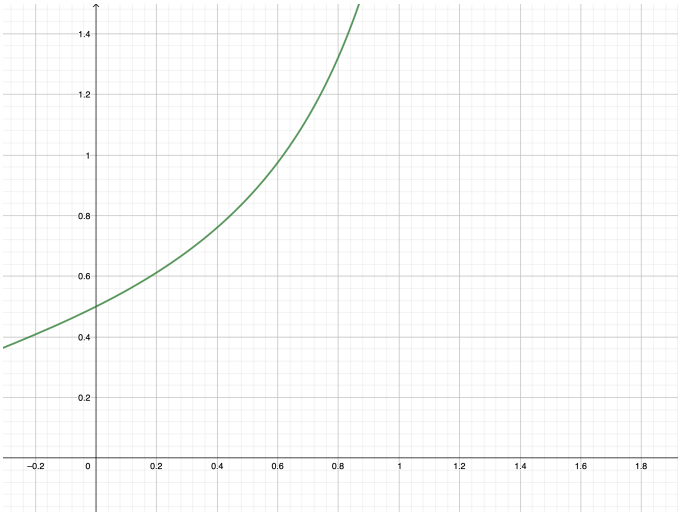
Here are the graphs of x, y as functions of the variable c, with $0 < c \leq 1$.

$$x = \frac{2 + c}{2(2 - c^2)}$$



The graph represents x as a function of c. C is represented on the y-axis, while x is represented on the x-axis. The function has a minimum in $c = 0$ and $x = \frac{1}{2}$. While as the c starts increasing, the function slowly reaches its maximum, which is found at the point $c = 1$ and $x = \frac{3}{2}$.

$$y = \frac{c(2+c)}{4(2-c)} + \frac{1}{2}$$

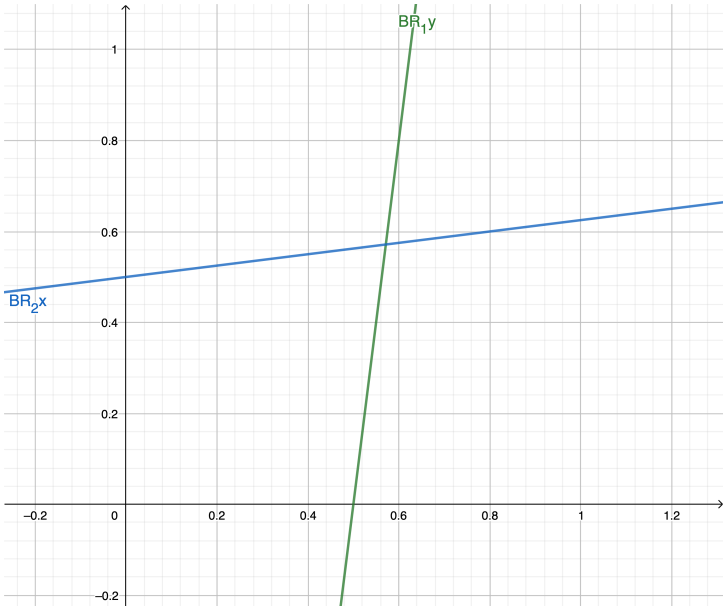


The graph represents y as a function of c. C is represented on the x-axis, while y is represented on the y-axis. Here we can observe the same trend as the one in the previous graph. The function has its minimum in the point

$c = 0$ and $y = \frac{1}{2}$, and as c increases the function slowly increases and reaches its maximum in the point $c = 1$ and $y = \frac{1}{2}$.

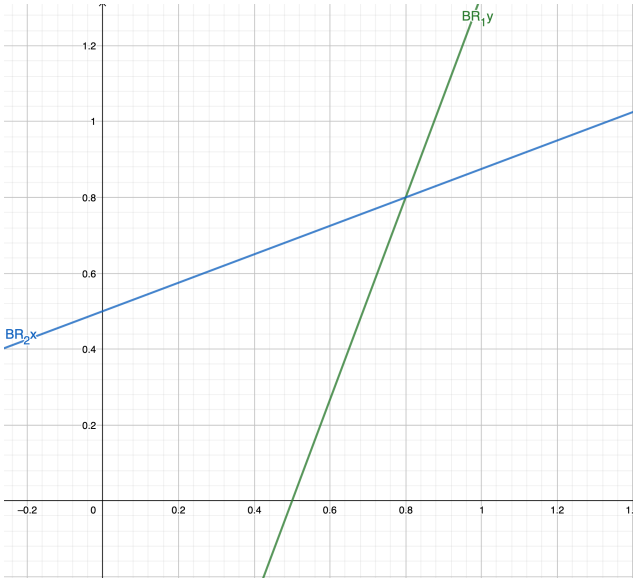
We now present three possible scenarios with three different levels of reputational loss.

- First case with a low reputational loss, $c = 0.25$



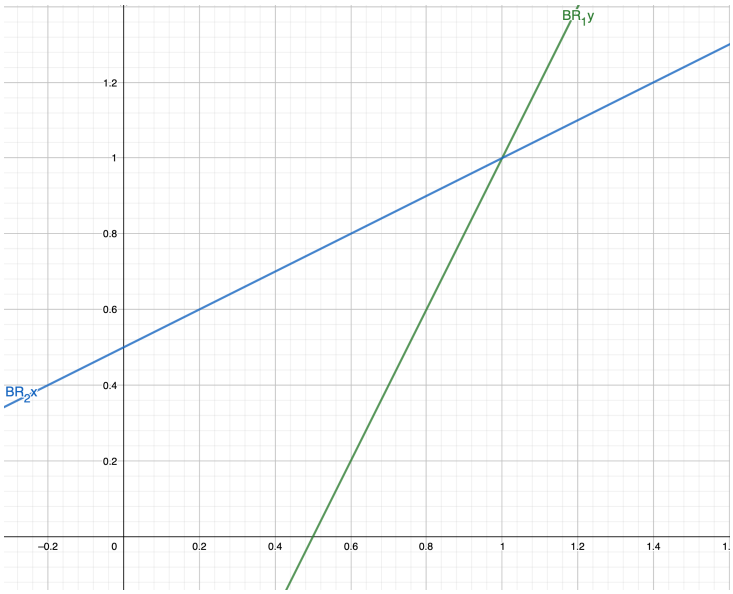
Given the results, you can see that if the reputational loss is sufficiently low, the two countries will not engage in high tariffs. The United States and China, to obtain the utility-maximizing payoff, have to charge lower tariffs. This is because their equilibrium tariff level is tied to the reputational loss of the counterpart; if the loss is minimal is better to apply lower tariffs.

- Second case with a medium reputational loss, $c = 0.75$



As you can see in this second case, as the reputational loss gets bigger, the two players obtain a higher payoff charging higher tariffs. Therefore, to obtain the maximum payoff, both players have to increase the tariffs applied to each other.

- Third case with the maximum possible reputational loss, $c = 1$



This last result shows us that the equilibrium, in this case, is the trade war. If the players are losing the maximum possible reputation, the best re-

sponse and strategy is to start a trade conflict . Given this, we can see that the two players will always use excessive-high tariffs because they want to maximize their revenue. The higher the tariffs, the higher the payoff. Therefore given the rationality of the players, they will engage in the conflict.

We can further point out that the game's outcome will be majorly dependent on the degree of reputation that the two players lose. If the loss is high, the players will prefer to engage in a trade war. Whereas, if it is sufficiently low, their preference will be to maintain low tariffs.

Chapter 3

Remarks and Conclusions

In the previous sections, we have presented two-game models based on the trade conflict between China and the United States. This conflict is interesting, not only because the nations involved are two of the most potent economic leaders in contemporary history, but also for the dynamics that played in its evolution. In both games, the United States is the advantaged player; it was the one to apply the initial tariffs and therefore it has had the decisional power on the trade conflict. China, in every case, has to counteract decisions taken by the United States; the United States always had an advantageous position in respect to China.

Despite this, the U.S. was not indifferent to Chinese countermeasures; many critics were raised from Trump's initiative since the United States' firms rely on China almost as much as China relies on the United States. As of now, the countries are mutually dependent. On the one hand, numerous firms in the United States depend on the Chinese manufacturing process and inputs provided. On the other hand, the Chinese economy relies on products and the numerous businesses provided by the United States on which the country's richness is fostered. Therefore a deal was the inevitable end of the argument.

China has been long pursuing an unfair behaviour toward general trade; it has been polluting excessively, charging low prices and using PR protected goods to gain the technical knowledge to modernize. It is clear that China has not been compliant with WTO trade rules and has carried out an unfair competition. Nevertheless, countries like the United States, European Union and several others have benefitted from its meagre prices taking advantage of its poor economy to keep themselves highly profitable. China has seized the opportunity to enrich itself; it went from being an exploitable country to

a global powerhouse thanks to the same nations now condemning its unfair market position. As we already said, the United States abandoned the concept of free trade to regain and affirm its position undiscussed trade leader. This is precisely why the conflict insured. The United States wanted to prevent China from surpassing it with unfair methods as a global leader.

The reputational loss that we have applied in the game does not serve with the sole purpose of disincentivizing countries to apply low tariffs, but also to allow us to connect to the reality of global dynamics. For example, if one of the countries is acting too aggressively toward another with it being a WTO member, the loss of reputation is justified because it is not using generally accepted mechanisms like the WTO dispute settlement body to rebalance the market. Instead, it is trying to force competitive correctness using unfair and aggressive means.

The games we presented though simplifies reality; we tried to model the games to find an equilibrium different from the trade war or the maintenance of the status quo. Therefore, we found a solution that would have been rationally convenient for both countries, keep applying low tariffs until an agreement is reached. The tariffs would have incentivized the countries to search for a deal and would not have produced excessive losses. Given their mutual reliance, the conflict between the two economies was neither sustainable nor feasible in the long run. Furthermore, the approach implemented by the United States was too aggressive and shifted the focus of the Chinese government from the existing problems toward self-preservation.

The situation has now been partially solved but Chinese economy is not yet out of the woods. Even if the conflict seems to have ceased, the United States is not the only country bothered by China's behaviour in trade, and a significant part of trading partners still accuses China of unfair competition. Moreover, China has long raised doubts on the sustainability and fairness of the supply and manufacturing process that is carrying out.

Moreover, with the global pandemic outbreak, which originated in China, the suspicions are getting stronger and more resilient. Therefore, for the Chinese economy to continue to be part of the global environment, it has to apply serious policy changes and implement a different approach to competition. Even if the United States approach was undoubtedly too hostile, the reasons for the rise of the conflict are widely shared by numerous nations. As in every global issue, this conflict results from a market failure, namely lack of coordination, and in doing so, the failure to find a better resolution of the

issue. In addition, Biden seems to be wanting to apply the same though economic policy as his predecessor.

What path the Chinese economy will take is not yet clear. Among researchers is widespread the thought for which China will face a downturn in economic performance. However, it seems that China is getting richer and richer day by day.

If the made in China 2025 plan will materialize is not yet known, but it appears evident that China is walking toward self-sufficiency. In a recent speech, Chinese President Xi Jinping stressed the need for China to 'enhance international supply chains and develop powerful retaliation and deterrence capabilities against supply cut-offs from trading parties'. In other words, China has to develop in such a manner to impede trading partners, like the United States, to have an advantaged position in a future conflict.

In the case in which the plan where to be successful, WTO countries will no longer have the means to impede China from using unfair competition and market exploitation. If Chinese behaviour were to be corrected, it has to be done promptly and with the implementation of stricter rules to the trading system to prevent such occurrence to take place.

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