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"Game Theory and international competition: Italy – Turkey, analysis of a relationship"

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Firma (signature) …Leonardo Damiano……………………

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Abstract

Employing the lens of game theory, this thesis explores the issue of international competition within the context of the intricate relationship between Italy and Turkey.
Through a comprehensive literature review, various game theory models are examined and applied to the case study in order to gain a better understanding of the strategic decision-making processes of the two countries.
Trade behaviour, historical interactions, political manoeuvres, and diplomatic exchanges are considered to provide concrete examples to support the theoretical arguments.
The final aim of this thesis is to analyse the strategic actions of both countries and their implications, offering insights into strategies and potential pathways for navigating this international relationship between Italy and Turkey more effectively.

Abstract in italiano:

Applicando il quadro teorico della teoria dei giochi, questa tesi esplora il tema della competizione internazionale nel contesto dell'intricata relazione tra Italia e Turchia.
Attraverso un'accurata ricerca bibliografica, diversi modelli teorici saranno presi in esame e applicati al caso di studio con lo scopo di ottenere una migliore comprensione di come queste due nazioni prendano le loro decisioni strategiche.
Le pratiche commerciali e le interazioni storiche dei due Paesi, contestualizzate dalle manovre politiche e dai rapporti diplomatici, vengono esaminate per fornire esempi concreti a sostegno della dissertazione teorica.
Fine ultimo di questa ricerca è quello di esaminare le azioni strategiche delle due nazioni e le loro implicazioni, fornendo uno spunto sulle possibili strategie per condurre la relazione internazionale tra Italia e Turchia in modo più efficiente ed efficace.

Keywords:
international trade, customs union, bilateral agreements, applied economics, diplomacy.

Chapter 1 - Game Theory: a brief introduction

This thesis aims to describe with some game theoretical concepts the international economic relationship between Italy and Turkey.
Game Theory is a formal modelling approach that helps in the analysis of interactions and “problematic social situations” (Diez, 2011) that occur among agents, e.g. people and/or organizations. Typically, it is assumed that each party involved in the interaction aims to maximize his or her reward, by following convenient strategies under common rules. These rewards are also known as payoffs and may not always be easy to define as, generally, they represent some kind of convenience or utility (a brief yet comprehensive definition of this fundamental economic concept can be found in Geçkil, 2009, pp. 12-14).
To describe a situation using the Game Theory means to list all the relevant variables/aspects that characterize the interaction in question, i.e. the rules of the game, who are the agents (also known as players) involved, the available strategies to each player, and the desired outcomes. The most interesting aspect of Game Theory approach is that it helps determining which is the “best strategy” that allows the agent to achieve the highest payoff in the specific situation (or game).

1.1 Historical background and key concepts

Game Theory originated in mathematics as an attempt to better understand real games such as strategy games, card games, and especially gambling; it is clearly according to this original purpose that this theoretical framework has been named. The expression "game theory" is attributed to the French mathematician Emil Borel, who in the 1920s first used it talking about "Théorie des jeux” (as stated by Fréchet 1953) while trying to determine an equilibrium solution to zero-sum games between two players, in which one’s gain is other’s loss.
Borel’s contributions were followed by the efforts of the Hungarian mathematician John von Neumann, who, in 1928, with his article "On the Theory of Games of Strategy," sanctioned the birth of this new discipline, demonstrating the existence of the equilibrium solutions theorized by his predecessor and introducing a schematic way to brilliantly describe the variables of a game (Geçkil, 2009).
However, as reported by Leonard (2016) everything most relevant started in 1941, when John von Neumann began his collaboration with the Austrian economist Oskar Morgenstern, and they started working together on their major work "Theory of Games and Economic Behaviour", finally published in 1944. The contribution by “the two émigrés at Princeton” (Leonard, 2016 p. 222) is a text of proven influence in mathematical social science which is

considered the introductory book to Game Theory as a new approach to science that set new standards for mathematical rigour in the field of economic theory (Leonard, 2016).
However, the concrete influence of the “Theory of Games and Economic Behaviour” was initially felt not in social theory but in the domain of military strategy. During the 1940s, game theory became an element in mathematical models of military engagements, resulting in the great success of operations research during World War II. This led the US Army Air Corp to establish in 1948 the RAND Corporation, a think tank where models of this kind continued to be developed, and game theory was given strong institutional support (Leonard 2016).
As recognized by Leonard (2016, p. 232), it is precisely “in the post-war military-academic milieu that a new generation of game theorists came of age". Alternating between Princeton University and the RAND Corporation, young mathematician John Nash developed new lines of analysis. Nash introduced the conceptual division of games into cooperative, in which coalitions are permitted, and non-cooperative, in which players act in isolation. Moreover, in 1950, for his Ph.D. thesis, he described the famous Nash equilibrium, proving that, under specific conditions, also in non-cooperative games can emerge an “equilibrium point” (Nash, 1950), where each player’s strategy maximizes his payoff assuming that the other players are doing the same (Gibbons, 1992).
After first formalisations in the 1920s, a fast development in 1940s and great contributions in the 1950s, game theory prosperously developed over the last six decades, providing brilliant results (honoured 11 times with Nobel Prizes as reported by Pinkasovitch, 2022) and representing one of the most prosperous fields of academic research in economics. As a result of this success, game theory consolidated its importance in analysing real-world environments and is now recognized as a useful tool in business and diplomacy (Geçkil, 2009).
Nevertheless, game theory provides big help in addressing international relations by providing a formal and strategic framework for understanding the interactions among countries and other actors on the global stage (Diez, 2011).
After this introductory historical overview of the development of game theory to the present day, a more formal approach to its relevant principles will follow.

1.2 Definition and principles of game theory

In game theory, reality is represented through stylised models which allow understanding economic interactions better. This section aims to provide an overview of selected concepts and models that will be used later in the analysis.

As said at the beginning, a game is characterised by some recurrent elements that represent the binding structure of the interaction: the players, their strategies, the rules of the game and the payoffs.
The players of a game are the agents involved in the interaction that it represents. To allow this representation, there are two fundamental assumptions about players' behaviour.
First, as for consumers in microeconomics, it is assumed that players are rational according to utility theory, which means they are constantly trying to maximize their final payoff (Colman, 1982 p.18). However, their utility maximizing preferences, which translate into strategy and drive strategical behaviours, are directly influenced by the grade of knowledge players have about the game (Geçkil, 2009 p.18).
Two scenarios can be distinguished based on the knowledge possessed by the actors: games of incomplete and complete information. In the first case, players have only partial information about the variables of the game. Nevertheless, this thesis focuses on games of complete information in which players not only know the rules of the game and all possible reciprocal payoffs, but most importantly, they know each other's strategies, they are aware of each other's rationality in pursuing the best payoff possible, and they are conscious of the fact that they both have all these information.
Under the assumption of complete information, players play their utility-maximizing strategies according to the rules of the game and its nature.
The rules of the game address the timing of the player's actions and the duration of the game. There can be one-shot games, in which players play only once, like in close bid auctions, and repeated games, in which players interact multiple times, like in bridge. Moreover, there can be simultaneous games in which players play at the same moment (or they think they are playing at the same time), choosing their actions, like in rock-paper-scissors, and sequential games in which players take turns, like in chess.
Instead, when talking about the nature of the game, three main typologies of games can be distinguished according to the way in which players interact and compete.
The simplest form is strictly competitive zero-sum games, which signifies that the total payoff remains constant, rendering any individual's advantage contingent upon the loss of others (von Neumann & Morgenstern, 1953). This category is well represented by games such as poker, where players compete for a fixed amount of chips, which remains constant throughout the game. The sum of chips won by all players at the end of a hand or a game is always zero, as any gain by one player is offset by an equal loss incurred by another. The ultimate solution to these games consists in the minimax theorem proposed by von Neumann which demonstrates how a player constantly tries to minimize his loss while the other tries to maximize his gain.

This process leads players to the choice of strategies that, in von Neumann's words, are "well balanced" and drive game in a way that "result is always the same", as reported by Leonard (2016 pp. 222-225).

Moving on, we encounter non-cooperative games, where each player seeks to maximize their utility independently, emphasizing the pursuit of self-interest as the driving force behind strategic choices (Nash, 1950). In contrast, cooperative games constitute the third typology, characterized by a paradigm where players collaborate to achieve mutually beneficial outcomes since the best individual outcome coincides with the overall optimal solution (Colman, 1982).

Whether the rules and the nature of the game are, the universally traditional way of representing a game assumes that only two players play it with a finite set of possible strategies and few consequent outcomes. This simplification happens for two practical reasons: firstly, it allows to focus more on the strategic aspects of the interaction; secondly, it simplifies the analysis as bringing in more than two players would necessitate the usage of advanced mathematical models (Diez, 2011 p. 72). Despite this necessary simplification, when representing a game, it is fundamental to properly capture all these structural elements seen above in a brief scheme that grants a correct overview of the situation.

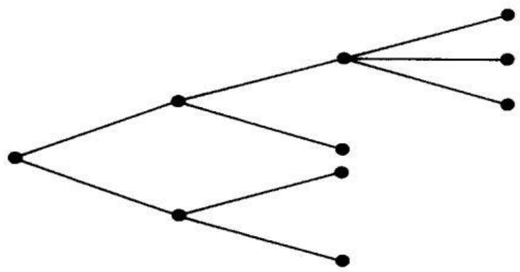

Fig. 1.2.1: *Extensive form of a game (Colman, 1982).*

At this scope, in 1928 von Neumann formalised the extensive form of a game, also known as a tree form or game tree. As explained by Colman (1982), it consists of a graphical representation that captures all the elements presented above through a "tree" scheme in which nodes represent decision points or events in the game and every edge (the "branches" of the tree) connecting nodes corresponds to a possible move or action available at a given decision point.

At the end of the game, payoffs are assigned to each player by so-called terminal nodes.

One common method of solving extensive-form games is *backward induction*. This involves starting from the terminal nodes and working backward to the initial decision nodes, determining optimal strategies at each stage.

The extensive form is particularly useful for modelling games with a sequential structure, such as chess, since it allows a detailed analysis of strategic interactions by considering the decisions made at each step and their consequences on the overall outcome of the game (Geçkil, 2009).
More useful for the purposes of this thesis is the *Normal or matrix form of a game* introduced by game theory pioneers to help the decision maker realize that no outcome results from an isolated decision as other players in the game are also making decisions (Geçkil, 2009).

		Player 2 (column)	
		X	**Y**
Player 1 (row)	**A**	8,5	4,2
	B	3,6	2,1

Fig. 1.2.2: *Normal or matrix form of a game.*

In the matrix form of a game, an arbitrary number of rows and columns is set to indicate the number of possible strategies respectively for the player "row" and the player "column." The payoffs from each strategy of each player are written in the matrix, creating intersections that represent all the possible outcomes of the game. In each of these bundles, the payoff presented on the left refers to the player "row", while on the right is indicated the one of player "column".
Even though only simplified 2 players games will be considered in this thesis, here is a formalization of the concept for an *n*-players game following Gibbons' example (1992).
In the normal form representation of an *n*-players game, players are numbered from 1 to *n* and for an arbitrary player *i*, S_i denotes his available set of strategies (called *i*'s *strategy space*), while s_i denotes one of the strategies of this set, so that $s_i \in S_i$. When each player chooses a strategy, this choice results in the combination of strategies $(s_1, \ldots, s_n)$, which defines $u_i(s_1, \ldots, s_n)$ as player *i*'s payoff according to his *payoff function* u_i. According to players' strategy space $S_1, \ldots, S_n$ and their payoff functions $u_1, \ldots, u_n$, we denote this game by $G = \{S_1, \ldots, S_n; u_1, \ldots, u_n\}$.
This means that each player simultaneously chooses a strategy, and the combination of strategies chosen by the players determines a payoff for each player. Although in normal-form game players choose their strategy simultaneously, this does not imply that the parties necessarily act simultaneously: it is sufficient that each player choose his action without knowledge of other's choices.

In such a normal form game $G = \{S_1, \ldots, S_n; u_1, \ldots, u_n\}$ where s_i' and s_i'' are feasible strategies for player i (in other words, s_i' and s_i'' are members of S_i), s_i' is *strictly dominated* by s_i'' if for each feasible combination of the other player's strategies $(s_1, \ldots, s_n)$, i's payoff from playing s_i' is strictly less than i's payoff from playing s_i'': $u_i(s_1, \ldots, s_i', \ldots, s_n) < u_i(s_1, \ldots, s_i'', \ldots, s_n)$ for each $(S_1, \ldots, S_i, \ldots, S_n)$ that can be constructed from other player's strategies spaces $S_1, \ldots, S_i, \ldots, S_n$.

Rational players do not play strictly dominated strategies, because there is no belief that a player could hold (about the strategies the other players will choose) such that it would be optimal (in the meaning of individually maximizing) to play such a strategy (Gibbons, 1992).

Moreover, a good method to identify a player's optimal strategy is exploiting this bi-matrix representation to identify the so-called dominated strategies.

		Player 2	
		Left	Right
Player 1	Up	1,0	1,2
	Down	0,3	0,1

Fig. 1.2.3: *Example of strictly dominated strategy (Gibbons, 1992).*

In the game represented in figure 1.2.3, both player 1 and player 2 have two strategies: $S_1 = \{Up, Down\}$ and $S_2 = \{Left, Right\}$. It is immediately evident how for player 1 *Down* is strictly dominated by *Up* (because 0 < 1), while for player 2 *Right* is better than *Left* if player 1 plays *Up* and vice versa if player 1 plays *Down* (because 0 < 2 and 1 < 3). So how to proceed? As explained, a rational player 1 would not play *Down*. Thus, if player 2 is rational and knows that players 1 is rational, *and* player 2 is rational and knows about player 1's rationality, then player 2 can eliminate *Down* from player 1's strategy space, leaving the game as in Figure 1.2.4.

		Player 2	
		Left	Right
Player 1	Up	1,0	1,2

Fig. 1.2.4: *Example of iterated elimination of strictly dominated strategies (Gibbons, 1992).*

Now *Left* is strictly dominated by *Right* for player 2 (because 0 < 2), leaving *(Up, Right)* as the combination of strategies that determines *(1,2)* as outcome of the game.

This process is called *iterated elimination of strictly dominated strategies* and it works perfectly when dominant strategies occur and the game is always oriented toward the dominant outcome.

However, when in a game there are not strictly dominated strategies and all the strategies survive iterated elimination, the process produces a very imprecise prediction about the outcome of the game.

		Player 2		
		L	*C*	*R*
	T	0, 4	4, 0	5, 3
Player 1	*M*	4, 0	0, 4	5, 3
	B	3, 5	3, 5	6, 6

Fig. 1.2.5: *Example of the absence of strictly dominated strategies (Gibbons, 1992).*

In such situations like the one in Figure 1.2.5, the solution concept of Nash equilibrium produces "much tighter predictions" (Gibbons, 1992) since each player's predicted strategy coincides with the player's best response to the predicted strategies for the other players.

Formally: the strategies $(s_1^*, \dots, s_n^*)$ are a *Nash equilibrium* in the n-players normal form game $G = \{S_1, \dots, S_n; u_1, \dots, u_n\}$ if, for each player i, s_i^* is (at least tied for) player i's best response to the strategies specified for the n-1 other players, $(S_1^*, \dots, S_{i-1}^*, S_{i+1}^*, \dots, S_n^*)$: $u_i(S_1^*, \dots, S_{i-1}^*, S_i^*, S_{i+1}^*, \dots, S_n^*) > u_i(S_1^*, \dots, S_{i-1}^*, S_i, S_{i+1}^*, \dots, S_n^*)$ for every feasible strategy s_i in S_i; that is S_i^* solves: $\max_{s_i \in S_i} u_i(S_1^*, \dots, S_{i-1}^*, S_i, S_{i+1}^*, \dots, S_n^*)$.

A brute force approach to finding a game's Nash equilibrium is simply to check whether each possible combination of strategies satisfies condition in the definition representing each player's best response to the others'.

		Player 2		
		L	*C*	*R*
	T	0, $\underline{4}$	$\underline{4}$, 0	5, 3
Player 1	*M*	$\underline{4}$, 0	0, $\underline{4}$	5, 3
	B	3, 5	3, 5	$\underline{6}$, $\underline{6}$

Fig. 1.2.6: *Solution through application of Nash equilibrium (Gibbons, 1992).*

In Figure 1.2.6, the only strategy pair that satisfies this condition is (B, R) which represents the Nash equilibrium of the game associated to the payoffs pair (6, 6).

We could say that a Nash equilibrium represents a strategic encounter that cannot be adjusted by players without disadvantaging themselves. To rephrase, it is an equilibrium because nobody can change their strategy without, in some way, reducing their payoff. This brings us to the concept of Pareto efficiency: a pair of payoffs is Pareto efficient if does not exist another possible combination in which one player is better off and no player is worse off.

In 1950, Nash showed that in any finite game (i.e., number of players n and the strategy set $S_1, \dots, S_i, \dots, S_n$ are all finite), at least one Nash equilibrium exists. In many cases, such as in the game presented in Figure 1.2.6, this equilibrium represents a *Pareto optimum* (a Pareto efficient pair of strategies) and also coincides with the best possible total outcome. Unfortunately, this excellent coincidence does not always verify and frequently the Nash equilibrium of a game does not coincide with a Pareto optimal solution, which means that players' situation could possibly be improved.

One of the most famous and broadly used examples of such a situation is the so-called "*Prisoner's Dilemma*", which was initially developed by Melvin Dresher and Merrill Flood of the RAND Corporation, and was later formalised using prisoners, sentences and payoffs by mathematician Albert Tucker who famously named it (Geçkil, 2009).

		Prisoner 2	
		Silence	**Squeal**
Prisoner 1	**Silence**	**-1,-1**	**-9,0**
	Squeal	**0,-9**	**-6,-6**

Fig. 1.2.7: *Classical formulation of Prisoner's Dilemma. In yellow is highlighted the Nash equilibrium solution of the game, and in green is the Pareto optimum of this game.*

Figure 1.2.7 shows the classical formulation for this game: two criminals are caught by police and now held as prisoners in different cells so that they cannot communicate. Prisoners have two options: stay silent or squeal on the other. During the interrogation, they are told that if both stay silent and do not confess, they will both spend 1 year in prison, but if one squeals on the other while the other stays silent, then the informer will be free and the other will spend 9 years in jail. However, if they both squeal on each other, then both will spend 6 years in jail.

As explained before, players constantly try to maximize their own outcome, and in this game it means that the two prisoners have the highest incentive on squealing on each other. The strategy *Squeal* not only represents the payoff-maximizing option for one prisoner, but it is also the best possible response to other prisoner's strategy. So, it is obvious how the pair of strategies *(Squeal,*

Squeal) represents the Nash equilibrium of the game, leading to the outcome *(-6, -6)*. However, the Pareto optimal solution is *(Silence, Silence)* as it would improve payoffs to *(-1, -1)*, leaving both prisoners better off and nobody worse off. Nevertheless, this Pareto efficient scenario could only verify if the prisoners had the opportunity to communicate and cooperate remaining both silent.

At this point, it is clear how, in the absence of cooperation, Nash equilibrium of Prisoner's Dilemma situations remains far from the Pareto efficient solution of the game, which coincides with the social optimum, i.e., a situation where the total welfare of the society is maximized.

As imaginable, in the case of international competition, the search is not only for Pareto efficiency, but also for the social optimum.

Based on the concepts defined so far, this theoretical framework will be applied in the next chapter to focus on the applications of game theory to international relations in search of this efficiency.

Chapter 2 - Game Theory applications in International Relations

From coal mining to fisheries management, from production clusters to international competition, game theory has proven to be a powerful tool to describe and also predict economic outcomes from the interactions of a few actors, such as oligopolies and duopolies. This chapter presents some of the theoretical tools proposed to describe the strategic international interaction between two countries with open economies (and make predictions about the likely economic outcomes).

2.1 Relevance of Game Theory in understanding international competition

As emphasized by Lake and Powell (see Correa, 2001, p. 188), when approaching international relations from an economic perspective, the focus should be simply on the interactions themselves and on their economic implications. In this regard, game theory can provide an appropriate point of view to address these strategic interactions.

As reported by Correa (2001, p. 187) game theory and international relations have influenced each other almost since the first formulations by von Neumann and Morgenstern (1953). And this mutual influence is pretty natural given that, according to Evans and Newnham and Hollis and Smith (for all of them see Correa, 2001, p. 189), one of the basic assumptions of international relations is that nations are motivated only by their own interests, considering other countries needs only when these have the capability to exercise a strong direct influence. In this perspective, indeed, nations represent one of the closest real-life examples of game theory abstract constructs (Correa, 2001, p. 190) described in the previous chapter (i.e., the assumptions made on players' behaviour in game theory match those made on nations in international relations).

Despite this convergence, the game theory approach to international relations suffered bitter criticism over the past six decades. As described by Brams (2000) and Bennet (1995, pp. 27 - 39), frequent accusations have regarded rationality of players and the assumptions on the information they hold; the hypothesis that "*all the players see the same game*" and that its dynamics are common knowledge (as well as the resulting payoffs); oversimplification of the real-world scenarios with consequent disregard of some factors that are not captured by the model (i.e., cultural aspects, political preferences, etc.).

However, as concluded by Kuhn (1962) and Correa (2001), the stylization provided by game theory doesn't have the ambition to explain all the possible aspects of the multifaceted international relations occurring among countries, instead the true aim of this discipline is to schematise with mathematical rigour an interaction to empower a precise analysis focused on the variables of interest within the interaction. Further, according to Kuhn himself and to Stone (2001), game theory provides "a powerful language for translating strategic situations into formal notation" (Stone, 2001, p. 243).

From this brief analysis, it can be concluded that game theory is the ideal tool to schematically represent interactions among countries, as long as the study is limited to the analytical aspects of a relationship. The main advantage of this approach is that it allows to focus on the strategic sides of these interactions to determine the optimal strategies for each party.

2.2 Overview of relevant Game Theory models and rationale behind the chosen model

When studying international relations, it emerges how countries, moved by "opportunism" (Reardon and Hasty, 1996) are often competing on several aspects of these relationships. Real-world evidence offers many examples of such competition: countries compete in sports, culture, arm force and, most importantly, economy. Considering the economic interaction between countries, particularly relevant is the issue of international trade, which addresses the exchange of capital, goods or services across international borders or territories.

To describe competition in international trade through game theory, it is useful to simplify the interaction in a two-player game in which two countries, the players, compete in each other markets choosing profit maximizing strategies (Schernikau, 2010). As defined in microeconomics, a market in which there are only a few competitors with market power (i.e., the power to influence prices) is an oligopoly: a form of competition in between perfect competition, where each player has no market power and cannot influence the price, and monopoly, where one player has full market power and thus full control of market price (Schernikau, 2010). An oligopoly ruled by only two competitors with market power is a duopoly and there are three main models to describe the interactions in a duopoly: Cournot and Bertrand, which refer to a static game, and Stackleberg, which consists in a dynamic extension of the simultaneous Cournot game. Following, is reported a brief description of the three models according to Schernikau (2010) and Gibbons (1992).

In a standard Cournot model, the two companies act simultaneously and compete over quantity: to maximise profit, they must produce the optimal quantity reacting to every possible quantity of the other players. The search for the optimal strategy involves defining reaction functions that provide one firm's best response to the competitor's best strategy, leading to the concept of Nash equilibrium.

In Stackelberg happens something very similar with the companies competing over quantity, but the difference is that in this model the game is sequential. The two firms competing in the duopoly are addressed as Leader and Follower: the Leader plays first according to the expected strategies of the Follower, which reacts to the choices made by the Leader.

Finally, in Bertrand, unlimited production capacity is assumed and companies compete on price, leading to a price war in which boundaries are the marginal costs of the two firms: the price charged by firm i cannot be lower than i's marginal cost. In this model, the factor of success is the firms' efficiency as a lower marginal cost of production constitutes a comparative advantage to the rival. Bertrand's formalisation does not provide an explicit definition of reaction functions and the Nash equilibrium of this model is that the price equals the marginal cost. This leads to the so-called Bertrand paradox, where price war within the duopoly results in the same outcome as under perfect competition, rather than keeping the price above the marginal cost.

Furthermore, when analysing international trade, it is realistic to imagine how countries exchange heterogeneous goods produced in different sectors by companies with finite production capacity, characterised by distinct production functions. This makes it feasible that countries, at the aggregate level, are more likely to influence markets by competing over quantity, rather than through price wars.

For this reason, the Cournot duopoly model is generally preferred (Schernikau, 2010, Correa, 2001, Morrison, 1998), to describe international competition dynamics. Moreover, the main feature of the approach developed by Antoine Augustin Cournot during the 19th century is that it implies the strategic behaviour of firms, describing how they optimally respond to each other's actions and leading to the establishment of a unique Nash equilibrium, as demonstrated by Collie (1992).

These characteristics are particularly appealing when approaching international competition through game theory as they help to determine when countries, in choosing their optimal strategies, become trapped in a Prisoners' Dilemma (Gibbons, 1992).

For these reasons, following the trend in literature, Cournot will be the model used in this thesis.

2.3 Application of Cournot duopoly model to international competition

According to Schernikau (2010) and to Gabszewicz and Shitovitz (1992), imperfect competition occurs whenever the economic agents operating in a market have some power to influence market prices. In the case of a duopoly, this condition is met if there is some sort of asymmetry between the two agents involved, which may give some sort of comparative advantage to one at the expense of the other.

To explain this typology of situations, in this paragraph the Cournot model in imperfect international competition will be formalised after Gibbons (1992).

Consider two countries denoted by $i = 1, 2$. Each country has a government that chooses a tariff rate, a firm that produces output for both home consumption and export, and consumers who buy on the home market from either the domestic firm or the foreign one. If the total quantity available in country i is Q_i, then the market clearing price is $P_i(Q_i) = a - Q_i$. The firm i (domestic firm in country i) produces h_i for home consumption and e_i for export, which can be formalised in $Q_i = h_i + e_i$.

In both countries, the firms have a constant marginal cost c and no fixed costs, which means that the total cost of production for firm i is $C_i(h_i, e_i) = c(h_i + e_i)$. However, the firms also incur tariff costs on exports: if government j has set the tariff rate t_j and firm i exports e_i to country j, then firm i must pay $t_j e_i$ to government j.

The timing of the game can be decomposed into two sequential sub-games that concur in defining the payoffs. In the first step, the governments simultaneously choose tariff rates, t_1 and t_2. In the second step, firms observe the tariff rates and simultaneously choose quantities for home consumption and for export: (h_1, e_1) and (h_2, e_2).

In the end, payoffs are profit to firm i and total welfare to country i, where total welfare to country i is the sum of consumers' surplus (defined as $(1/2)/Q_i^2$, given the inverse demand curve $P_i(Q_i) = a - Q_i$ and the quantity Q_i sold on market i) enjoyed by consumers in country i, the profit earned by firm i, and the tariff revenue collected by government i from firm j:

$\pi_i(t_i, t_j, h_i, e_i, h_j, e_j) = [a - (h_i + e_i)]h_i + [a - (e_i + h_i)]e_i - c(h_i + e_i) - t_j e_i$,

$W_i(t_i, t_j, h_i, e_i, h_j, e_j) = \frac{1}{2}Q_i^2 + \pi_i(t_i, t_j, h_i, e_i, h_j, e_j) + t_i e_j$.

Suppose the governments have chosen the tariffs t_1 and t_2. If $(h_1^*, e_1^*, h_2^*, e_2^*)$ is a Nash equilibrium in the resulting (from governments tariff choices) two-market game between firms 1 and 2 then, for each i, (h_i^*, e_i^*) must solve $\max_{h_i, e_i \geq 0} \pi_i(t_i, t_j, h_i, e_i, h_j^*, e_j^*)$.

Since $\pi_i(t_i, t_j, h_i, e_i, h_j^*, e_j^*)$ can be written as the sum of firm i's profits on market i (which is a function of h_i and e_j^* alone) and firm i's profits on market j (which is a function of e_i, h_j^* and t_j alone), firm i's two-market optimization problem simplifies into a pair of equations, one for each market: h_i^* must solve $\max_{h_i \geq 0} h_i[a - (h_i + e_j^*) - c]$, and e_i^* must solve $\max_{e_i \geq 0} e_i[a - (e_i + h_j^*) - c] - t_j e_i$.

Assuming $e_j^* \leq a - c$, we have $h_i^* = \frac{1}{2}(a - e_j^* - c)$, and assuming $h_j^* \leq a - c - t_j$, we have $e_i^* = \frac{1}{2}(a - h_j^* - c - t_j)$ which, for every $i = 1,2$, represent the best response function of firm i to the exported quantity e_j chosen by firm j and to the tariff rate t_j chosen by government j.

At this point, there are four equations in four unknowns (h_1^*, e_1^*, h_2^*, e_2^*) and luckily these four equations simplify into two sets of two equations in two unknowns.

The solutions are: $h_i^* = \frac{a - c + t_i}{3}$ and $e_i^* = \frac{a - c - 2t_j}{3}$, which represents the Nash equilibrium of this second-stage game among firms *1* and *2*.

In the formulation of the Cournot model without tariffs, firms *1* and *2* experience symmetric marginal costs which leads both to choose the equilibrium quantity $(a - c)/3$.

Differently, the choice of tariffs by governments makes marginal costs asymmetric: on market i, for instance, firm i's marginal cost is c, but firm j's is $c + t_i$. Since firm j's cost is higher, firm j wants to produce less. But if firm j produces less, then the market-clearing price $P_i(Q_i) = a - Q_i$ will be higher, so firm i has an incentive to produce more, in which case firm j would produce even less. To formalise, in equilibrium h_i^* increases in t_i, while e_j^* decreases (at a faster rate) in t_i, as shown in the solutions derived above.

Explained the dynamics in the second-stage game between the two firms, the focus is now on the first-stage interaction between the two governments where tariff t_1 and t_2 are simultaneously chosen and concur in defining governments' payoffs as $W_i(t_i, t_j, h_1^*, e_1^*, h_2^*, e_2^*)$ (where h_i^* and e_i^* are functions of t_i and t_j as described above).

For completeness, $W_i(t_i, t_j, h_1^*, e_1^*, h_2^*, e_2^*)$ represents governments i's payoff when they chose the tariff rate t_i, government j chooses t_j, and firms i and j play the Nash equilibrium described in the previous paragraph.

To simplify the notation, from now on $W_i(t_i, t_j, h_1^*, e_1^*, h_2^*, e_2^*)$ will be denoted by $W_i^*(t_i, t_j^*)$, since the focus is now on the tariff choices of the two governments.

If (t_1^*, t_2^*) is a Nash equilibrium of this game between the governments then, for each i, t_i^* must solve: $\max_{t_i \geq 0} W_i^*(t_i, t_j^*)$.

But $W_i^*(t_i, t_j^*)$ equals $\frac{(2(a-c) - t_i)^2}{18} + \frac{(a-c+t_i)^2}{9} + \frac{(a-c+2t_j^*)^2}{9} + \frac{t_i(a-c-2t_i)}{3}$,

so $t_i^* = (a - c)/3$ for each i, independent of t_j^*. And this means that, in this model, choosing a tariff rate of $(a - c)/3$ is a dominant strategy for each government.

Substituting $t_i^* = t_j^* = (a - c)/3$ into $h_i^* = \frac{a - c + t_i}{3}$ and $e_i^* = \frac{a - c - 2t_j}{3}$ gives $h_i^* = \frac{4(a - c)}{9}$ and $e_i^* = \frac{a - c}{9}$ as the firms' quantity choices in the second stage.

Therefore, we can conclude that the subgame perfect outcome of this tariff game is $(t_1{}^* = t_2{}^* = \frac{(a-c)}{3}, h_1{}^* = h_2{}^* = \frac{4(a-c)}{9}, e_1{}^* = e_2{}^* = \frac{(a-c)}{9})$, which means that the aggregate quantity available in each market is $5(a-c)/9$.

If the governments had chosen tariff rates equal to zero, however, then the aggregate quantity on each market would have been $2(a-c)/3$, just as in the Cournot model with symmetric marginal costs.

The aggregate consumers' surplus on market *i,* given the inverse demand curve $P_i(Q_i) = a - Q_i$ and if the quantity sold on market *i* is Q_i can be shown to be $(1/2)/Q_i^2$. So, as the aggregate available quantity on market *i* is lower when tariffs occur, it can be concluded that consumers' surplus on market *i* is lower when the governments choose their dominant-strategy tariffs than it would be if they choose zero tariffs. In fact, zero tariffs are socially optimal, in the sense that $t_1 = t_2 = 0$ is the solution to $\max_{t_1, t_2 \geq 0} W_1{}^*(t_1, t_2) + W_2{}^*(t_2, t_1)$, so there is an incentive for the governments to sign a treaty in which they commit to zero tariffs (i.e., free trade).

		Country 2	
		Free trade	**Tariff**
Country 1	**Free trade**	**t=0, t=0**	**t=0, t=t_2**
	Tariff	**t=t_1, t=0**	**t=$t_1{}^*$, t=$t_2{}^*$**

Fig. 2.2.1: *Normal form representation of the Prisoners' Dilemma resulting from Nash equilibrium of Cournot application to international competition.*

As firms *i* and *j* play only in the second stage of the game according to governments' decisions on tariffs, the first-stage interaction between the governments determines the final payoffs: the unique Nash equilibrium of the game is in dominant strategies and is socially inefficient, making the two countries stuck in a Prisoner's Dilemma, as shown in Figure 2.2.1.

The pareto efficient and socially optimal solution of the game would be free trade, but the only way to reach it is through diplomacy: just as prisoners in its original formulation, countries need to cooperate and find an agreement (in this case about free trade) to solve this Prisoners' Dilemma.

Unfortunately, even when a free-trade agreement is signed, the parties often fail to adhere to it, as reported by Reardon and Hasty (1996). In fact, countries should be “patient enough to prefer long-term gains over short-term temptations” (Stone, 2001, p. 243) but opportunism and conflict often push them to seek short-term gains by "defecting" agreements and "taking advantage of the other party" (Reardon and Hasty, 1996, p. 15).
The next chapter will investigate, through the study of the relationship between Italy and Turkey, whether or not free trade is a concrete option in the real world.

Chapter 3 - Case Study: Italy and Turkey's complex relationship

According to Bennet (1995), cooperation in an international relationship is not always easy. Especially when countries' social, cultural, and historical backgrounds are deeply different: it's the case of Italy and Turkey, two of the largest economies in the Mediterranean region with a strategic relationship suspended between Europe and Asia.
The goal of this chapter is to gather an understanding of the economic relationship between Italy and Turkey to verify if the social optimum is achieved through free trade, or if, according to the Cournot model of international imperfect competition discussed above, the Nash equilibrium in Italy – Turkey duopoly is in dominant strategies of putting tariffs on each other and so the two countries are stuck in a Prisoners' Dilemma.

3.1 Overview of economic interactions between Italy and Turkey

Over the last forty years, Italy and Turkey's economic ties have grown in significance, reflecting the broader global interdependence as reported by Aliboni (2011). According to the author, fertile ground for cooperation was generated from the matching of Italy's desire to economically expand in the Mediterranean and Middle Eastern area with Turkey's ambition to join the European Union. Although Turkey's EU accession negotiations never advanced since 2005 (European Commission, 2024), Italy and Turkey developed a solid, complementary economic relationship (Giannotta, 2020).
Moving from these premises, this section presents a brief description of the profiles of both countries. The purpose is to aid in developing an understanding of their economic relations, which will be presented subsequently.

3.1.1 Countries profiles

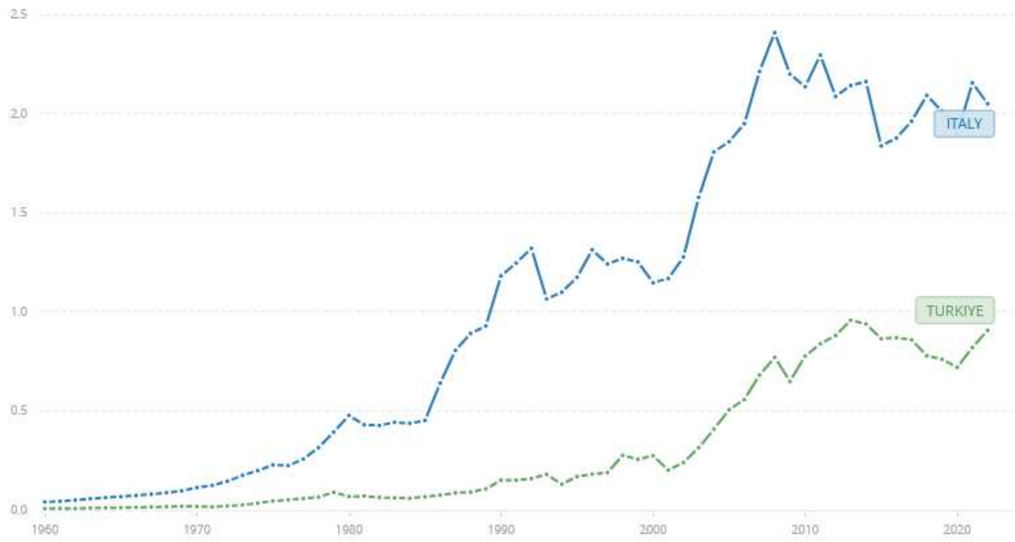

Fig. 3.1.1: *GDP in billion US dollars of Italy and Turkey from 1960 to 2021 (The World Bank, 2024a).*

Figure 3.1.1 shows how, just by looking at the GDP trends of Italy and Turkey over time, it is already possible to identify some differences between the economies of these two countries. Obviously, a detailed analysis of these differences would require a separate study. However, the following data may be a good start in understanding the dynamics of these two economies.

On one side of the relationship, with an area of approximately 302.068 square kilometers (ISTAT, 2024a) and a population of 58.997.201 million people (ISTAT, 2024b), Italy is a major economic force in Europe, with a rich cultural heritage and a diverse economic landscape dominated by small and mid-sized family companies (Aliboni, 2011).

At the base of Italian production is a powerful combination of modern industrial capacity and long-standing craftsmanship, which express at best in sectors like fashion and automotive, which, together with tourism and services, significantly contributed to 2.160 billion US dollars Italy's GDP, which translates into 36.449,30 US dollars per capita GDP, as reported by ISTAT (2024c, 2024d) and The World Bank (2024a, 2024b) for year 2021.

In 2021, Italy's total export, mostly to Germany, France, the US, Spain and the UK, amounted to 691,21 billion US dollars (The World Bank, 2024c), mainly consisting of pharmaceuticals, cars, other motor vehicles and components, and refined petroleum (OEC, 2024a).

In the same year, import mirrored export as Italy, mostly from Germany, France, China, Netherlands and Spain, imported mainly crude petroleum and petroleum gas, cars, and pharmaceuticals (OEC, 2024a) for a total import of 643,09 billion US dollars (The World Bank, 2024d).

This resulted in a positive trade balance for Italy with export exciding import by 48,12 billion US dollars.

Always in 2021, Italy registered a foreign direct investment net outflow of 56,43 billion US dollars, versus a net inflow of 18,91 billion US dollars (The World Bank, 2024e, 2024f) which shows how much Italian companies are active in the global scenario.

On the other side of the relationship, Turkey is located at the crossroads of Europe and Asia, covering a surface of 780.043 square kilometers (MSB, 2024), about 2,6 times the dimension of Italy, and hosting a population of 85.372.377 million people (TURKSTAT, 2024), about 1,4 times population of Italy.

Founded in 1923 on the ashes of the Ottoman Empire, the Republic of Turkey is a vital link between the continents, with a dynamic economy resulting in a mixture of modern industrial activities and traditional agricultural practices (Ayçin and Remonti, 2012).

According to data provided by Turkish Ministry of Trade (T.C., 2024a) and The World Bank (2024a, 2024b, 2024c, 2024d, 2024e, 2024f), large automotive and textile production, combined with the growth of construction industry and tourism contributed to generate a GDP of 819,87 billion US dollars (about 40% of Italian GDP) in 2021, which translates into 9.743,20 US dollars per capita GDP in the same year.

A positive trade balance of 3,32 billion US dollars further boosted the Turkish economy in 2021: with a total export of 293,05 billion US dollars and a total import of 289,73 billion US dollars. Turkey exported, mostly to Germany, the US, the UK, Italy, and Iraq, mainly cars, jewellery, refined petroleum, road vehicles and components; while relied on import mainly for fossil fuels, scrap iron, cars, electrical equipment, and machinery components, importing mostly from China, Germany, Russia, the US, and Italy.

In the same year, with respect to foreign direct investment, Turkey registered a net outflow of 6,45 billion US dollars and a net inflow of 13,32 billion US dollars, registering a strong growth trend concerning the previous year (3,25 and 7,7 billion US dollars in 2020, respectively for net outflow and net inflow); although testifying a still limited impact on the global economy with a greater propensity of Turkish companies to attract foreign investment rather than actively invest abroad.

3.1.2 Economic Interactions

Italy and Turkey have developed strong economic ties over the years, with Italy consistently ranking among Turkey's main global partners (MAE, 2024), and being the country's main partner in the Mediterranean area and the second in the European Union, after Germany (MAE, 2023).

This tight relationship has resulted in significant trade volumes that reached a record level of 21.3 billion US dollars in 2011 (MAE, 2024). Trade subsequently slowed down, as the two economies cooled due to the turbulent global economic situation between 2012 and 2015, to resume growth from 2016 onwards (Ekim and Bilotta, 2020).

In 2020, according to the Italian Ministry of Foreign Affairs (MAE, 2024), although burdened by the global pandemic, the trade level between Italy and Turkey reached 17,3 billion US dollars, with 9,2 billion US dollars of Italian exports toward Turkey and 8,1 billion US dollars of Turkish export toward Italy. Italy confirmed its position as the second European partner of Turkey, registering a positive trade balance of 1,1 billion US dollars, which highlights Italy's economic competitiveness and the demand for its products in the Turkish market.

In the same year, key imports from Turkey to Italy included cars and other road vehicles, machinery and components, textiles, iron and steel. Conversely, Italian exports to Turkey were dominated by machinery and components, cars, motor vehicle components and plastic materials.

However, according to Ekim and Bilotta (2020), in recent years the Italy-Turkey synergy lost significance from a merely quantitative point of view. In fact, despite the overall volume of trade within the relationship continued to grow, the increase in the number of trading partners of Italy and Turkey has therefore led to a decrease in the percentage weight of reciprocal trade on the total overall trade volumes of the two countries (while Italy remains consistently among Turkey's top six trading partners, Turkey is now no longer in the top ten of Italy's trading partners).

This process, which took place throughout the past two decades, especially for the intense activity of Italy on the global scenario, seems likely to continue in the near future as Turkey is planning a “Distant Countries Strategy” (T.C., 2024a) which aims to boost exports by intensifying trade with potential geographically-remote markets such as the US, China, Brazil, and Australia.

Regarding instead capital flows, according to the Italian Ministry of Foreign Affairs (MAE, 2024), in 2020 Italian foreign direct investment to Turkey consisted of 977 million US dollars, resulting in Italy being the first global investor in Turkey, with over 1.400 Italian companies involved. Italian companies investing in Turkey (MAE, 2023) are mostly active in the railway sector, agro-industry sector, industrial production, banking and insurance business, infrastructure and energy sector, and automotive industry, with some car models entirely produced in Turkey (Ayçin and Remonti, 2012). Other areas where there are interesting

opportunities for collaboration are the defense and aerospace industry, and the high-tech and digital sector (MAE, 2023).
This intricate economic relationship reflects how the synergies between Turkey and Italy contribute to the economic growth of both nations.
However, Italy and Turkey's economic partnership extends beyond mere trade transactions. The interdependence created through shared economic interests influences policy decisions and strategic alignments (Camera dei Deputati, 2021). Indeed, Turkey is considered a "facilitator" (Giannotta, 2020) in the management of diplomatic relations over the Mediterranean and Middle Eastern areas. Moreover, in recent years, Turkey positioned itself as an important diplomatic partner in the search for peaceful solutions to worldwide conflicts (MAE, 2023, and Camera dei Deputati, 2021).
The focus on Turkey as a strategic partner is also, and perhaps above all, driven by the country's control over the Turkish Straits (the Bosphorus and the Dardanelles, two fundamental waterways for international trade) and its ambition to become an energy hub. This is because the largest gas field in the southwest Black Sea area was discovered in the Sakarya district (Turkey) in 2020, and because Turkey is actively positioning itself as a hub for energy coming from Asian countries (MAE, 2023).
Besides the significant economic interchange and capital flows, there are also relevant demographic exchanges between Italy and Turkey with more than 20.000 Turkish citizens resident in Italy (ISTAT, 2020) and more than 3.000 Turkish students enrolled in Italian universities (AMBANKARA, 2021). A remarkable presence that strengthens not only economic ties but also those between populations (MAE, 2024).

3.2 Analysis through the Cournot duopoly model: tariffs and trade policies

The Cournot duopoly model, a cornerstone of game theory formalized in the previous chapter, provides a framework for analysing strategic interactions between two countries in a duopoly. Applying this model to Italy and Turkey's economic relationship allows us to explore the implications of their trade policies.
According to the Cournot model (Gibbons, 1992), countries in a duopoly independently choose their production levels to maximize profits, recognizing the interdependence of their actions. As seen, the pursuit of this maximization necessarily passes through the attainment of the consumers' surplus, which is connected to a country's ability to tie and observe agreements that facilitate international trade.

In order to boost international trade and capital circulation, Italy was a founder of the modern European Union established by the Maastricht Treaty of 1992, which subsequently entered into force on 1st November 1993. In fact, back in 1951, signing the Treaty of Paris, Italy joined the European Coal and Steel Community (ECSC), and in 1957, with the Treaty of Rome, joined the European Economic Community (EEC) (EU, 2024, and European Commission, 2024b).
Meanwhile, the Ankara Association Agreement of 1963, signed by Turkey and the then ECC, laid the foundations to expand their economic and trade relations (European Commission, 2024a). However, Turkish local production was protected by international competition with high tariffs, customs duties and restrictions on importable goods until 1996 (Ayçin and Remonti, 2012), when entered into force the EU-Turkey Customs Union agreement, signed on 31st December 1995 (European Commission, 2024a, and Demirci and Aydin, 2011).
According to Sertoglu and Ozturk (2003), a customs union is an area where all the trade barriers such as the tariffs and quotas on goods and services are abolished for member countries, establishing also common tariffs for the trade with external countries. This is the reason why this agreement played a pivotal role in fostering economic cooperation, facilitating the flow of goods and services, promoting a deeper integration, and leading to the increase of Turkish trade volumes to the present day (Ayçin and Remonti, 2012).
Later, Turkey has been a candidate country to join the European Union since 1999, and engaged in negotiations since 2005, but without achieving integration as a member country (European Commission, 2024a). However, according to the Turkish Ministry of Trade (T.C. 2024b), with the Customs Union, Turkey has opened its internal market to the competition of the EU and third countries, while guaranteeing free access of its exporters to the EU market, one of the most competitive economic blocks of the world, increasing the volume of trade with the EU from 33 billion US dollars in 1996 to 178.6 billion US dollars in 2021.
Consequently, due to the improved competition conditions and market access advantages gained, the product composition of Turkish exports transformed, including, apart from traditional sectors like agriculture and textile, certain high value-added sectors such as electronics, machinery and automotive.
The Customs Union has significantly reduced trade barriers, encouraging a more integrated economic landscape. However, certain challenges persist, including non-tariff barriers and differences in regulatory frameworks, as stated by Mercenier and Yeldan (1997) and Sertoglu and Ozturk (2003).
A possible solution was proposed by the European Commission in 2016: modernise the 1996 Customs Unions to extend bilateral trade relations to areas such as services, public procurement, and sustainable development (European Commission, 2024a). In fact, as reported by Altay

(2018), upgrading this two-decade-old agreement would be a significant step toward a "Privileged Partnership", maximizing both Turkish and European political and economic benefits from the relationship. However, although negotiations began in 2018, they have not progressed any further yet (European Commission, 2024a).

Despite the improvement of the Customs Union couldn't be achieved so far, part of its goals is currently carried on by another international initiative. Indeed, in 2008 Turkey joined the Union for the Mediterranean (UfM), an inter-governmental partnership that promotes cooperation and dialogue in the Euro-Mediterranean region, bringing together 42 current members: 27 EU member States and 15 countries of the Southern and Eastern Mediterranean. This program, which represents a continuation of the Euro-Mediterranean Partnership established at the Barcelona Conference in 1995, pursues the main objective of promoting the development of human capital and environmental sustainability within the member states (European Commission, 2024a).

Therefore, as Italy is a European Union member State, Italy's trade policies with Turkey often align with the broader EU framework, according to the commitments between Turkey and the EU. However, according to Ekim and Bilotta (2020), the "special partnership" (Giannotta, 2020) between the two economies is supported by many initiatives of the two governments, which main purposes are to intensify economic interaction, improve coordination of the production in the two economic systems, and remove possible obstacles to trade. From this perspective, is central the role of the periodic editions of the Joint Economic and Trade Commission (JETCO) and the numerous meetings organised by the Investment Support and Partnership Agency of Turkey (ISPAT).

Moreover, as reported by the Turkish Foreign Economic Relations Board (DEIK, 2024), this objective of improving economic interaction is pursued through constant cooperation between the Ministries of Trade and Foreign Affairs of Italy and Turkey respectively, and through an organised presence of Italian institutions in Turkey with the central role of the Italian Chambers of Commerce in Istanbul and Izmir.

In light of all these diplomatic efforts made by Italy and Turkey to improve their relationship and increase trade volumes, it can be concluded that the two economies are not interested in implementing protectionist policies by imposing restrictive measures on imports. Therefore, it seems that Italy and Turkey have successfully avoided the Prisoner's Dilemma resulting from imposing reciprocal tariffs and customs duties on each other.

This aspect will be further elaborated in the next chapter, providing a conclusion to this research.

Chapter 4 – Findings from the Case Study

The exploration of Italy and Turkey's economic relationship, through insights into their economic outlook and trade figures, revealed some of the intricate dynamics shaping their interactions. As Italy and Turkey navigate the complexities of global trade, the lessons drawn from this case study underscore the importance of diplomacy as a tool to achieve strategic cooperation, aligning trade policies with broader economic objectives.

4.1 Implications and lessons from Game Theory: dominant strategies and consumers' surplus

According to Gibbons (1992), in the context of trade policy, dominant strategies may involve the imposition of tariffs or the adoption of non-cooperative measures. Indeed, if the welfare function of a government is "*revenues from tariffs*", then policies would focus on maximising revenues from trade tariffs and customs duties. However, prioritising domestic interests without considering broader welfare could lead to a sub-optimal solution, compromising consumers' surplus in both economies and leading to the Prisoners' Dilemma described by the application of the Cournot duopoly model to imperfect international competition.

Alternatively, governments with a "*social welfare function*" would prioritise total welfare adopting more efficient trade policies to maximise trade volumes achieving the consumers' surplus.

In the case study described, research evidence highlights how Italy and Turkey adopted policies aligned with the achievement of the social optimum, recognizing the mutual benefits of open markets and reduced trade barriers.

In fact, after that Turkey abandoned its protectionist approach to international trade in 1996 (Ayçin and Remonti, 2012), trade volumes between Italy and Turkey started to rise, leading to the tight relationship observed nowadays (MAE, 2023).

Although there is still much to be done regarding non-tariff barriers (Mercenier and Yeldan, 1997) and the Customs Union between EU and Turkey needs to be modernised (Demirci and Aydin, 2011), it can be said that the extensive diplomatic efforts between Italy and Turkey have successfully optimised the economic exchange among the two countries.

4.2 Extensions to the Cournot model of imperfect international competition

The non-tariff barriers discussed by Mercenier and Yeldan (1997), together with a variety of economic, cultural, and social factors, contribute to the asymmetries between the two markets, despite not being captured by that "*t*" proposed by Gibbons (1992) in the formulation of the Cournot model of imperfect international competition.

Shortly, these non-tariff barriers could be defined as mechanisms that restrict imports and exports without imposing tariffs and, in this sense, they may serve protectionist purposes despite complying with international rules on trade (Rebeyrol, 2023).

Following Mercenier and Yeldan (1997), examples of these behaviours could consist of harder customs controls or the demand to comply with higher bureaucratic standards.

In the case of Turkey, customs surcharges include a value-added tax (VAT) levied on most imported goods and services, as the country, to raise government revenue, relies primarily on internal taxes rather than trade taxes such as customs duties (ITA, 2024). And this could be seen as a clear example of a non-tariff barrier to trade, as it contributes to creating asymmetries between the Turkish domestic market and the domestic market of trading partners.

However, apart from these non-tariff barriers, there are other elements determining strong asymmetries among countries. It is the case of economic factors, such as currency change rate, and cost of labor and investment due different regulations. In addition, this phenomenon is further exacerbated by limitations deriving from "the inertia of legal systems and human nature" (Kuhn, 1962), such as technical barriers (defined by Togan, 2000, as market rules and legal standards on quality and production) or cultural and social factors limiting the integration (Aliboni, 2011).

Therefore, although trade policies between Italy and Turkey, and more generally between the EU and Turkey, may appear to avoid the dynamics of the Prisoners' Dilemma as theorised by Gibbons (1992), it is possible that in the real world, burdened by all these elements of complexity, this may not be the case.

Conclusion

In conclusion, the economic interactions between Italy and Turkey analysed through the lens of the Cournot model of imperfect international competition (Gibbons, 1992), reveal how the strategic decision making of both countries led to diplomatic efforts that avoided the Prisoner's Dilemma of imposing reciprocal trade tariffs.
Despite the nature of their relationship is multifaceted and far from being fully explained in this thesis, the lessons from this case study offer insights into the opportunities of approaching international economic relationships through more comprehensive game theory approaches.

Final note: the body of this thesis consists of 9.275 words.

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