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LA DIPLOMACIA DISUASORIA EN LA TEORÍA DE JUEGOS

Autor: Virginia Artigot Souto

Director: Dr. Antonio García de Garmendia

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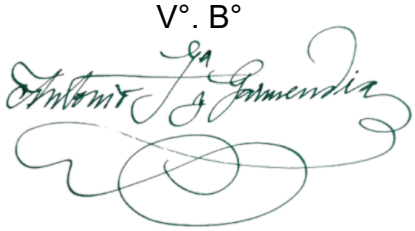

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LA DIPLOMACIA DISUASORIA EN LA TEORÍA DE JUEGOS

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Fdo.: Virginia Artigot Souto Fecha: 17/06/2024

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EL DIRECTOR DEL PROYECTO

Fdo.: Dr. Antonio García de Garmendia Fecha: 17/06/2024

MÁSTER IN INDUSTRIAL ENGINEERING

END OF MASTER THESIS

DETERRENT DIPLOMACY IN GAME THEORY

Author: Virginia Artigot Souto

Director: Dr. Antonio García de Garmendia

Madrid

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LA DIPLOMACIA DISUASORIA EN LA TEORÍA DE JUEGOS

Autor: Artigot Souto, Virginia.

Director: García de Garmendia, Dr. Antonio.

Entidad Colaboradora: ICAI – Universidad Pontificia Comillas

ABSTRACT

El objetivo de este proyecto es estudiar los efectos económicos de las sanciones, aprovechando las herramientas de la teoría de juegos para obtener conclusiones sobre las repercusiones de estas medidas, no sólo para los países objetivo y sancionadores, sino para toda la economía mundial, y posteriormente aplicar estas conclusiones al caso práctico de las sanciones a Rusia debido a su invasión de Ucrania.

A lo largo del estudio, hemos formulado diversas hipótesis sobre las repercusiones esperadas para cada país en distintos escenarios de sanciones. Estas hipótesis son las siguientes:

- ***Hipótesis 1:*** *El beneficio para el país objetivo de realizar la actividad por la cual es sancionado es mayor que el coste de las sanciones para este país*
- ***Hipótesis 2:*** *Cuando las sanciones están activas, esto supone un efecto negativo para los países sancionadores*
- ***Hipótesis 3:*** *A menudo, terceros países que no son ni el país sancionador ni el objetivo derivan beneficios durante periodos de sanciones.*
- ***Hipótesis 4:*** *Los beneficios para estos terceros países aparecen en el medio-largo plazo tras la imposición de sanciones*
- ***Hipótesis 5:*** *Cuando aparecen terceros países, el coste o beneficio de las sanciones para el país objetivo cambia*
- ***Hipótesis 6.*** *La volatilidad de los mercados de los países sancionadores aumenta en periodos de sanciones, y aumenta aún más cuando entran terceros países al juego*

Asimismo, se ha desarrollado un modelo de Teoría de Juegos, el Juego Rasputín, el equilibrio del cual identifica distintos resultados para cada uno de los jugadores. Combinando los resultados obtenidos del Juego Rasputín y un análisis cualitativo de las variables relevantes, se han puesto a prueba estas hipótesis. Nuestros resultados sugieren que la imposición de sanciones afecta a la utilidad final del país objetivo, ya que el coste de las sanciones sobre este país reduce el beneficio que este país obtiene al desarrollar una determinada actividad. Sin embargo, este resultado implica que los países sancionadores deben asumir un coste muy elevado, que se refleja en una reducción del comercio de estos países con el país objetivo, así como un fuerte aumento de la volatilidad del mercado de los países sancionadores.

Además, las reglas del juego cambian cuando se incluye a terceros países: al forjar nuevas

asociaciones económicas, se mitiga parte de la presión económica que las sanciones ejercen sobre los países objetivo, lo que reduce, aún más, la eficacia de estas medidas. Además, a medio y largo plazo, estos terceros países obtienen un beneficio de las sanciones. En consecuencia, estas conclusiones plantean la cuestión de si estas medidas punitivas son las más adecuadas para alcanzar el objetivo de modificar el comportamiento del país objetivo, o si debería reconsiderarse su diseño para orientar sus objetivos de forma más específica y sin que suponga un esfuerzo tan fuerte por parte de los países sancionadores.

En conclusión, este proyecto es el punto de partida para sentar las bases de futuras investigaciones sobre una comprensión global de las ramificaciones económicas de las sanciones. Dado que la dinámica de la geopolítica sigue evolucionando, este tipo de estudios son cruciales para garantizar que las sanciones logren los resultados previstos sin perjudicar la estabilidad económica mundial.

DETERRENT DIPLOMACY IN GAME THEORY

Author: Artigot Souto, Virginia.

Director: García de Garmendia, Dr. Antonio.

Collaborating Entity: ICAI – Universidad Pontificia Comillas

ABSTRACT

This project aims to study the economic effects of sanctions, leveraging game-theoretic tools to produce insightful and applicable conclusions that shed some light on the repercussions of these measures, not only for the target and sanctioning countries but for the whole world economy, and then apply these conclusions to the practical case of sanctions on Russia due to its invasion of Ukraine.

Throughout the study, we have formulated a hypothesis regarding the expected repercussions for each country in different periods of sanctions. The hypotheses are the following:

- ***Hypothesis 1:*** *The benefit for the target country from pursuing the activity is greater than the cost of sanctions for this country.*
- ***Hypothesis 2:*** *Sanctioning countries are affected negatively in periods when sanctions are active.*
- ***Hypothesis 3:*** *Third countries, separate from the sanctioning and the targeted nations, often derive benefits during periods of sanctions.*
- ***Hypothesis 4:*** *Benefits for third countries appear in the medium term after the imposition of sanctions.*
- ***Hypothesis 5:*** *When third countries are in play, the payoff of the target country is affected.*
- ***Hypothesis 6.*** *Market volatility increases in sanction periods and increases even more when third players enter the game.*

In addition, a Game Theory model has been developed, named Game Rasputin. The equilibrium of this game identifies different outcomes for each of the players. By combining the results obtained from Game Rasputin and a qualitative analysis of the relevant variables, these hypotheses have been tested. Our findings suggest that sanction imposition affects the payoff of the target country, as it reduces the benefit this country gets from pursuing a certain activity. Nevertheless, this effect implies a very high cost assumed by sanctioning countries, depicted in high costs associated with trade reduction, as well as a sharp increase in market volatility of sanctioning countries.

Moreover, the rules of the game change when third countries are included: by forging new economic partnerships, some of the economic pressure that sanctions exert over target

countries is mitigated, reducing, even more, the effectiveness of these measures. Additionally, in the medium to long term, these third countries get a benefit from sanctions. As a result, these conclusions raise the question of whether these punitive measures are the most appropriate to reach the goal of shifting the target country's behavior, or if their design should be reconsidered to target their goals more specifically and without involving such a strong effort from sanctioning countries.

In conclusion, this project is the starting point to set the groundwork for further research on a wholesome understanding of the economic ramifications of sanctions. As the dynamics of geopolitics continue to evolve, these types of studies are crucial for ensuring that sanctions achieve their intended outcomes without harm to global economic stability.

Index

Index of Figures

Index of Tables

1.Introduction

In recent years, sanctions have been widely used as an instrument in geopolitical contexts, employed by policymakers as a diplomatic tool to influence behaviors and impose punitive measures without resorting to armed conflict. These sanctions can range from trade restrictions and embargoes to asset freezes and travel bans, each carrying economic and social consequences for the targeted countries and several other agents.

The complex nature of these sanctions, combined with the far-from-constant responses of target countries to them, stresses the need for a comprehensive analysis of their impacts. The complexity of the study of these measures is the reason why the effectiveness of sanctions is often debated, with some arguing that they cause more harm than good.

This project aims to study the economic effects of sanctions, leveraging game-theoretic tools to produce insightful and applicable conclusions that shed some light on the repercussions of these measures, not only for the target and sanctioning countries but for the whole world economy. Recent sanctions on countries like Iran, Cuba, and Russia have had strong economic implications, not just for the targeted nations but also for the global economy. These sanctions have disrupted global supply chains, affected trade flows, and led to shifts in international economic relations. Understanding these impacts requires an in-depth study that can provide clarity and guidance for future policy decisions.

Throughout the study, we have formulated a hypothesis regarding the expected repercussions for each country in different periods of sanctions. By combining the results obtained from a game theoretic model, named Game Rasputin, and a qualitative analysis of the relevant variables, these hypotheses have been tested. Our findings suggest that sanction imposition affects the payoff of the target country, as it reduces the benefit this country gets from pursuing a certain activity. Nevertheless, this effect implies a very high cost assumed by sanctioning countries, depicted in high costs associated with trade reduction, as well as a sharp increase in market volatility of sanctioning countries. Moreover, the rules of the game change when third countries are included: by forging new economic partnerships, some of the economic pressure that sanctions exert over target countries is mitigated, reducing, even more, the effectiveness of these measures. Additionally, in the medium to long term, these third countries get a benefit from sanctions. As a result, these conclusions raise the question of whether these punitive measures are the most appropriate to reach the goal of shifting the target country’s behavior, or if their design should be reconsidered to target their goals more specifically and without involving such a strong effort from sanctioning countries.

In conclusion, this project is the starting point to set the groundwork for further research on a wholesome understanding of the economic ramifications of sanctions. As the dynamics of geopolitics continue to evolve, these types of studies are crucial for ensuring that sanctions achieve their intended outcomes without harming global economic stability.

1.1. Project Motivation

In recent years, we have seen a sharp increase in geopolitical tensions around the world. For those of us who have lived in the “Post-war era”, characterized by harmony and diplomacy around the world, the outbreak of the Ukraine-Russia war, and later, the Israel war has come as a shock that has challenged all our fundamental principles.

Contrary to the situations experienced in the past centuries, the approach toward conflict has changed: nations are drifting away from armed conflict and using other tools instead. The most conventional one is the use of sanctions to countries that are altering the geopolitical order.

These sanctions are complex and, given their recent use, their impacts are still not fully understood, which has raised the motivation to conduct this research. In the end, the way these sanctions impact the sanctioning countries and whether or not they are able to retract the target countries from pursuing certain activities will have a strong impact on our daily lives, as well as on the amount of resources that our nations will allocate to defense and instruments to end with conflicts. This research has shown that their impact goes beyond the agents involved in the conflict, which increases the importance of studying how and why they affect us.

In summary, this project is motivated by the need to understand and optimize the use of economic sanctions in international diplomacy, as their use, cost, and success are very important for all of the members of our planet.

2. State of the Question

In this chapter, we will provide an in-depth description of the current landscape of literature regarding the effect of sanctions. We will conduct a comprehensive analysis of the existing literature that employs game theory and other methodologies to assess the impact of these sanctions. This analysis will enable us to get a grasp of the state of the question, and whether there is scope for further studies.

2.1. Literature Review

In this section, we will perform a comprehensive analysis of previous literature regarding the topic of the impact of economic sanctions through the lens of game theory. This analysis will enable us to get a grasp of the state of the question, and whether there is scope for further studies.

There is sizeable literature that employs game theory to study conventional sanctions. The traditional approach to the analysis of the effectiveness of sanctions using game theory is purely theoretical, with the works of Tsebelis [1], Smith [2] and Eaton and Engers [3] being the three pillars that have served as a fundament for further research. More recent academics have introduced empirical models to fulfill the same purpose, such as the study conducted by Afesorgbor [4].

The model developed by George Tsebelis in 1990 served as a starting point in the theoretical analysis of sanction effectiveness using game theory. In his work, Tsebelis examines 6 different scenarios with different conceptualizations of the problem between a sender and a target country. Table 1 depicts the payoffs for each player, applicable in all scenarios. In these games, the players operate under complete or incomplete information, have perfect rationality or adaptive behavior, move sequentially or simultaneously, and have discrete or continuous options.

	Sanction	***No Sanction***
Violate	a1 a2	b1 b2
Comply	c1 c2	d1 d2

Note: Assumptions are: b1>d1, d2>c2, c1>a1 and a2>b2

Table 1. General Payoff Matrix of Sanctions Game: Six Scenarios. Source: Tsebelis, 1990.

[1] Tsebelis, 1990.
[2] Smith, 1995.
[3] Eaton & Engers, 1992.
[4] Afesorgbor, 2016.

In all of these scenarios, states are assumed to be unitary and rational actors, an unrealistic assumption that is kept with the goal of simplifying the model. Moreover, domestic politics are initially not included in the model and are eventually introduced to reflect their effect on the results. Regardless of the different assumptions, all six scenarios lead to the same equilibrium (1)(2) [1]:

$$x^* = \frac{d_2 - c_2}{d_2 - c_2 + a_2 - b_2} \quad (1)$$

$$y^* = \frac{b_1 - d_1}{b_1 - d_1 + c_1 - a_1} \quad (2)$$

All six scenarios share a set of assumptions defining relations between the payoffs for each player depending on their choice and the other agent's choice. Out of all the assumptions, there are two that are questionable:

- Controversial Assumption 1: Sanctions at maximum capacity have a deterrent effect, and the *target country prefers to avoid sanctions rather than to violate the standard and be sanctioned.*
- Controversial Assumption 2: *the sender country prefers to react and sanction when its interests are violated rather than remain inactive.*

These assumptions are then relaxed further down in the paper but might bring some controversy as they are not 100% accurate with reality: sometimes domestic politics and/or international relations may lead to different scenarios than the ones assumed initially by Tsebelis.

Incomplete information is included in the model by introducing random noise in the payoffs of each player, and assuming that the players know their payoffs but not their opponent's. This noise in the payoffs can be generated by domestic politics or by events relating to international economic competition [5].

Regarding the equilibrium computation, the methodology used involves setting the partial derivatives of the utilities to 0. If the choices are discrete, a pure equilibrium does not exist. Consequently, Tsebelis determines the probabilities associated with the target country's compliance and non-compliance, as well as the sender country's decision to impose sanctions or refrain from doing so. The findings indicate that "*the probabilities of state violation or sanctioning align with the levels observed in the preceding scenario, where the options were continuous rather than discrete*" [5].

[5] Tsebelis, 1990.

Furthermore, when the countries are not considered perfectly rational, Lotka Voltera equations are used to find the equilibrium of the game. This equilibrium is the same as in the other 3 cases. In this scenario, Tsebelis proves that *"the heroic assumptions of perfect rationality are not required in order to arrive at the same equilibrium in the sanctions game. Even adaptive, myopic behavior leads to the same outcome*." [5].

Tsebelis reaches the same equilibrium in all 6 proposed scenarios, which reflects its stability under different conditions. The most important observation from the game is that "*the chosen strategy of each player results dependent exclusively on the payoff of the opponent*" [5]. The explanation that Tsebelis gives to this phenomenon is that intuition in this scenario only considers one player: the target country. Tsebelis argues that decision theory does not take into account that the equilibrium of this game is a result of the interaction between two players, and not a simple decision of one against nature. He names this error the Robinson Crusoe fallacy, which basically involves using decision theory instead of game theory when more than one rational actor takes place in the game.

Finally, Tsebelis explores the results when the two assumptions that were controversial are relaxed. He collects the results in Table 2. We can conclude that if the target country prefers to violate the standard no matter what, the sender country will sanction according to which of its payoffs is greater. Moreover, if the sender country never sanctions, target countries will always violate the standard.

Name	***Conditions***	***Explanation***	***Outcome***
Case 1	b1>d1, d2>c2, c1>a1 and a2>b2		Mixed Strategies
Case 2	b1>d1, d2>c2, a1>c1	Relaxation of Controversial Assumption 1	Violation; sanction if a2>b2
Case 3	c1 c2	Relaxation of Controversial Assumption 2	No sanctions

Table 2. Possible Orders of Payoffs and Corresponding Outcomes in Sanctions Game. Source: Tsebelis, 1990.

Tsebelis concludes his work with the introduction of domestic politics in the model. To do so, he introduces nested games, labeling the sanctions game as the "*principal arena*" and international factors and domestic policies as "*secondary arenas*". Situations in secondary arenas influence the payoffs of the principal arena, altering the equilibrium of the main game.

A second study that serves as a fundament to the theoretical analysis of sanctions using game theory is that of Eaton and Engers [6]. Eaton and Engers examine the power that sanctions have to generate a desired behavior. They incorporate into the model a variable reflecting the sender's and target's toughness, which depends on the patience of the players and the extent to which they have been suffering sanctions. Moreover, they introduce the concept of threat and

[6] Eaton & Engers, 1992.

analyze whether the threat alone is enough to alter the behavior of the target country.

In their findings, they state that "*The threat of a sanction or the promise of a reward can be effective only to the extent that the target believes that the sender will stick to its stated policy*." [6].

Equally to Tsebelis [7], they define two players: sender and target. The sender can choose the level *s* of sanctions and the target, the level *a* of some activity that affects its utility and the sender's utility in opposite directions. The relationship assumed between these two agents is that the sender continuously specifies conditions that the target must meet to avoid sanctions and the target periodically decides whether or not to comply with these conditions. They assume two types of behavior that the sender may want to change from the target:

- Ongoing action modeled as a continuum variable.
- Once-and-for-all choice of an irreversible action, modeled as a discrete variable.

As an addition to previous models, Eaton and Engers define two types of situations regarding the capacity of sanctions:

- Sanctions are considered to have overkill capacity when the target prefers to set the action at a feasible level rather than to be sanctioned.
- Sanctions are considered to have a limited capacity when the target country prefers to be sanctioned rather than comply.

The utility curves proposed by Eaton and Engers [8] are depicted in Figure 1 and Figure 2. They both show the set of possible utility levels per period of the sender (on the horizontal axis) and the target (on the vertical axis). Points on the northeast frontier of this set represent Pareto-efficient outcomes [8].

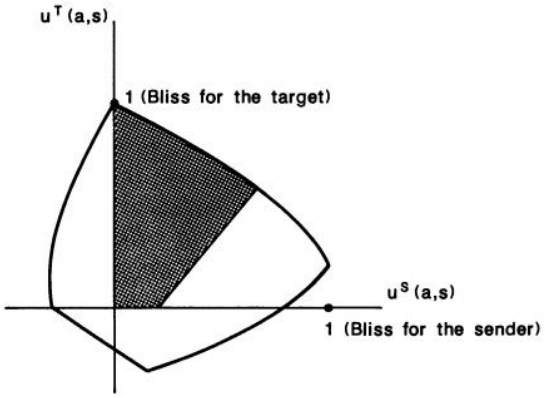

Figure 1. Feasible outcomes when sanctions have overkill capacity. Source: Eaton & Engers, 1992.

[7] Tsebelis, 1990.
[8] Eaton & Engers, 1992.

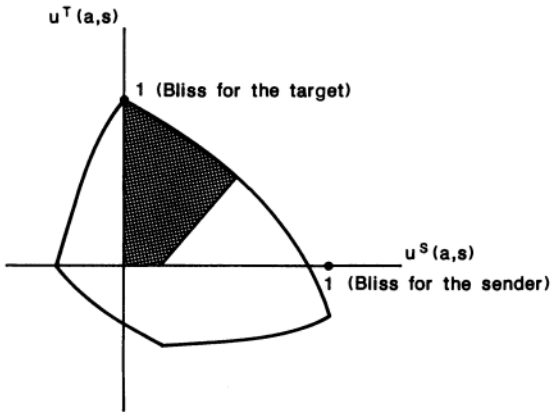

Figure 2. Feasible outcomes when sanctions have limited capacity. Source: Eaton & Engers, 1992.

Regarding the equilibrium calculations, Eaton and Enger [9] consider that the game could potentially go on indefinitely, so there could be many subgame perfect equilibria according to traditional game theory. The authors suggest that, instead of just looking at subgame perfect equilibria, which may not fully capture the dynamics of indefinite interactions, it's useful to focus on those that are at the limit of finite-horizon equilibria, known as "limit equilibria". Additionally, since computing limit equilibria can be challenging, the analysis also considers Markov perfect equilibria, where strategies depend only on the current state and not on historical results making them easier to compute. Moreover, they assume agents act sequentially to represent real situations more accurately. This sequential nature of the game transforms the players' strategies into reaction functions:

- R^s for the sender maps each possible action level *a* to a threshold *t.*
- R^t for the target maps each possible threshold to the choice of an action.

Eaton and Engers affirm that "*The reaction functions R^s and R^t are an equilibrium if, for all a, $R^s(a)$ specifies optimal thresholds for the sender given that the target adheres to R^t and, for all t, $R^t(t)$ specifies optimal action levels for the target given that the sender adheres to R^s* " [9]. Under four general constraints, there exists a Markov perfect equilibrium that sustains an interval of steady states. The effect of these restrictions on the spread of steady states depends on the toughness of each country. In their work, Eaton and Engers distinguish between sender and target toughness:

- To measure the toughness of the sender, the authors use a metric *w*. This metric reflects "the increase from *a* to *t*, where the sender is indifferent between sanctioning but ending up with a level *t* of action or not sanctioning and maintaining a level *a* of actions" [9].
- For the target's toughness, "consider the increment $w^T(a)$ by which *t* must exceed *a* to

[9] Eaton & Engers, 1992.

make the target's gain from staying in *a* when facing a threshold *t* just worth the target's cost of sanctions at *a*, assuming that both *t* and *a* are steady states" [9].

The toughness of each agent clearly is determined by the cost of sanctions to each player. If one's cost of sanctions tends to zero, this party will become uncompromising.

With all this information, Eaton and Engers reach a Markov perfect equilibrium that depends on the player's toughness, which can be seen in Figure 4.

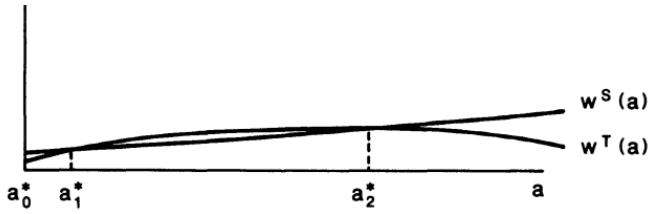

Figure 3. Eaton and Engers Theorem 1. Sender and Target Toughness. Source: Eaton & Engers, 1992.

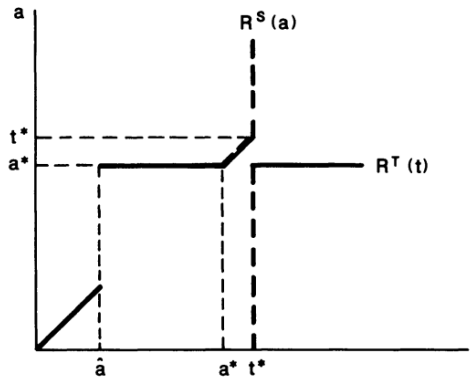

Figure 4. Equilibrium of Eaton and Engers Theorem 1. Reaction functions. Source: Eaton & Engers, 1992.

Overall, Eaton and Engers conclude that, by making their game alternating, they could depict the importance of timing in the results of the game compared to a simultaneous model. Additionally, they open the door for further research to analyze how much the threat of sanctions affects the behavior of governments.

Smith [10] proposes a model where nation A (the sender) imposes sanctions on nation B (the target) to compel a change in its policy. The author develops a continuous time, one-sided incomplete information game to demonstrate that the sender's decision to impose sanctions is intertwined with the target's decision to resist.

More conceptually, the paper discusses the conditions that lead to the imposition of sanctions, the conditions that must take place for the sender to threaten with the imposition of sanctions

[10] Smith, 1995.

and the circumstances under which sanctions succeed. For clarification purposes, Smith defines sanction success when "*target nation B makes the policy concessions that the sender nation A demands*" [10]. The findings suggest that the more successful sanctions are for a country, the more likely this country will choose to sanction. Furthermore, the paper discusses how these findings correspond to empirically observed cases of sanctions.

Contrary to the two previous studies, Smith assumes that sanctions are discrete: the sender either trades with the target or not. Similarly, he assumes that compliance is also binary. The game is modeled as continuous starting in time t=0. A set of variables are presented:

- θ is the payoff the target nation gets for continuing its policy. This is private information, meaning that the sender country does not know this value, but it can have beliefs. P(θ) is A's cumulative beliefs about θ. "*The model's predictions vary markedly with different distributional assumptions* [of P(θ)]" [11].
- *v* is the payoff the sender country gets if the target country changes its policy
- c_a is the cost of sanctions for the sender country. This can be either positive or negative, as sanctions can benefit the sender country by being domestically popular.
- c_b is the cost of sanctions for the target country. This value is always greater than zero.

Figure 5 depicts the payoffs for each agent and period in each possible outcome.

Outcome	***U_a per period***	***U_b per period***
A stops sanctions	0	θ
B complies	v	0
Sanctions	$-c_a$	$\theta-c_b$

NOTE: $v>0$, $\theta>0$, $c_b>0$

Figure 5. Per period payoffs for each outcome. Source: Smith, 1995.

The model's solution is found as a Bayesian equilibrium, which requires that each player maximizes their utility given the strategy of the other player and that the sender's beliefs about the target's payoffs are consistent with Bayes rule [11]. Smith dives into two equilibrium analyses: time independent and time dependent:

- In time independent equilibria, nations either sanction forever or they stop at t=0. Smith distinguishes three equilibrium scenarios within this type:
    - TID 1: the target never complies with sanctions. The sender has no incentive to sanction, so in TID 1 there are never incentives to sanction.
    - TID 2: sender sanctions and the target immediately complies. This equilibrium only exists if $\theta_{máx}$ is less than the cost of sanctions for the target country c_b. Sanctions will unlikely occur in this case, as the target will never resist sanctions so only the threat is enough for it to comply.

[11] Smith, 1995.

    - TID 3: similar to the previous one, the sender always sanctions, and the target only resists if their payoff is smaller than the cost of sanctions. Of the three cases, this is the one in which sanctions will most likely occur.
- Time-dependent equilibria are significantly more complex. It is based on the assumption that "*Both countries want to win the sanctions battle, but conditional on not winning they want to lose quickly"* [11]. The author develops equations that describe the utility for each player in different scenarios and calculates the optimal time for the target country to comply with sanctions. Moreover, Smith characterizes the equilibria assuming uniform beliefs [14].

Overall, Smith's most substantive finding is that "*the decision to sanction and the success of sanctions are interdependent. Therefore, it is not possible to consistently estimate the success of sanctions by looking only at sanctions.*" [14]. It is important to highlight that the model developed by this author does not consider the domestic effects of sanctions, unlike the work of Tsebelis [12].

In his work, Janeba [13] incorporates the concept of extraterritorial sanctions. He argues that "*Under extraterritorial sanctions, the sanctioning country extends its policies to trade of third countries with the sanctioned country*" [13]. The author develops a game-theoretic model with three players to explain the emergence of extraterritorial trade sanctions.

In his findings, Janeba claims that extraterritorial sanctions:

- Do not arise if the policy that the sender country wants to correct is verifiable.
- They emerge if a second activity is verifiable, and the sender countries have different gains from trade with the target country, their harm from the non-verifiable activity and the cost of abandoning the international economic order [13]

In the model developed, Janeba defines three countries. Countries 1 and 2 consider sanctioning country 3. All three countries enjoy economic benefits from trading with one another. Similarly to Smith [14], Janeba presents a binary model where there are two possible scenarios: *T* scenario is free trade between the 3 countries and *N* scenario for no trade with country 3. The author also defines the utilities for countries 1 and 2 under each scenario.

Country 3 can choose between pursuing activity *X*, which is also a binary decision. If country 3 pursues this activity obtains a benefit $B>0$. To clarify, this benefit is solely the benefit from the activity, without subtracting any costs. Engaging in activity *X* can harm country 3 with a loss of trade, c_3. Countries 1 and 2 lose c_1 and c_2 if activity *X* is performed by country 3.

Janeba introduces two trade policy options against country 3, and later on adds a third one:

[12] Tsebelis, 1990
[13] Janeba, 2022.
[14] Smith, 1995.

- *NS:* no sanctions, which means free trade
- *S:* unilateral sanctions. These are conventional sanctions, which means total cease between the two countries.
- *ES:* extraterritorial sanctions. This means that if country 1 imposes extraterritorial sanctions on country 3 and country 2 decides to keep trading with country 3, then country 2 will have to face a cease in trade with country 1.

The equilibrium is calculated firstly in the scenario where the option is to impose unilateral sanctions *(S)* or not *(NS)*. In this case, there are three possible situations:

- The benefit *B* of violating the conditions is smaller than the cost of sanctions to country 3 (at the same level). Table 3 depicts the three resulting Nash equilibria, in which if at least one country between 1 and 2 threatens with sanctions and country 3 complies, because not complying is costly for country 3.

$B < c_1 = c_2 = c$	NS	S
NS	$U^T_1 - L_1, U^T_2 - L_2$	**U^T_1, U^T_2**
S	**U^T_1, U^T_2**	**U^T_1, U^T_2**

Table 3. Utilities for countries 1 (rows) and 2 (columns) for Scenario 1.1. Source: Janeba, 2022.

- The second situation is if losing trade with one country affects country 3 but with the other it does not. In that case, the threat of sanctions from the country that country 3 relies on, let's assume it's country 1, is costly. This situation involves two Nash equilibria, highlighted in Table 4.

$c_1 > B > c_2$	NS	S
NS	$U^T_1 - L_1, U^T_2 - L_2$	$U^T_1 - L_1, U^T_2 - L_2$
S	**U^T_1, U^T_2**	**U^T_1, U^T_2**

Table 4. Utilities for countries 1 (rows) and 2 (columns) for Scenario 1.2. Source: Janeba, 2022.

- Thirdly, it is the case when individually countries 1 and 2 do not have the power to induce costs from cease in trade, but losing trade with both is harmful. In this case there are two Nash equilibria, which involve countries 1 and 2 choosing the same action (Table 5).

$max\{c_1, c_2\} < B$	NS	S
NS	**$U^T_1 - L_1, U^T_2 - L_2$**	$U^T_1 - L_1, U^N_2 - L_2$
S	$U^N_1 - L_1, U^T_2 - L_2$	**U^T_1, U^T_2**

Table 5. Utilities for countries 1 (rows) and 2 (columns) for Scenario 1.3. Source: Janeba, 2022.

Expanding to extraterritorial sanctions *(ES)*, one important assumption is introduced by Janeba: *"Switching to trade with the other sanctioning country [Countries 1 and 2] is preferable for firms in these two countries over trade with country 3*" [15]. Additionally, there is one more variable in the game: δ is the additional cost for the country imposing the extraterritorial sanctions. This cost involves the cost of abandoning the international economic order as well as a reputational cost. This cost is independent of the level of activity *X*. Similarly to conventional sanctions, three situations arise:

- Table 6 describes a situation where conventional sanctions are sufficient to force country 3 to comply. Therefore, Janeba obtains the same equilibria as in Scenario 1.1
- Table 7 depicts the situation where loss of trade with country 1 is harmful for country 3 to stop *X*. There are 2 Nash equilibria and a potential third, given the condition that $L_2 > \delta_2$.
- Table 8 showcases the last situation, where sanctions of both countries are required for country 3 to comply. In this case, the Nash equilibrium from case 1.3 is still remaining, and there are 3 potential additional ones:
    - *(ES,NS)* provided that $L_1 > \delta_1$
    - *(NS,ES)* provided that $L_2 > \delta_2$
    - *(NS,NS)* provided that $L_i > \delta_i$ for *i=1,2*

$B < min\{c_1, c_2\}$	NS	S	ES
NS	$U^T_1 - L_1, U^T_2 - L_2$	**U^T_1, U^T_2**	$U^T_1, U^N_2 - \delta_2$
S	**U^T_1, U^T_2**	**U^T_1, U^T_2**	-
ES	$U^T_1 - \delta_1, U^T_2$	-	-

NOTE: Outcomes denoted by - can be reached, bur are always dominated

Table 6. Utilities for countries 1 (rows) and 2 (columns) for Scenario 2.1. Source: Janeba, 2022.

$c_1 > B > c_2$	NS	S	ES
NS	$U^T_1 - L_1, U^T_2 - L_2$	$U^T_1 - L_1, U^T_2 - L_2$	**$U^T_1, U^T_2 - \delta_2$**
S	**U^T_1, U^T_2**	**U^T_1, U^T_2**	-
ES	$U^T_1 - \delta_1, U^T_2$	-	-

NOTE: Outcomes denoted by - can be reached, bur are always dominated

Table 7. Utilities for countries 1 (rows) and 2 (columns) for Scenario 2.2. Source: Janeba, 2022.

[15] Janeba, 2022.

$max\{c_1, c_2\} < B$	**NS**	**S**	**ES**
NS	$\mathbf{U^T_1 - L_1, U^T_2 - L_2}$	$U^T_1 - L_1, U^N_2 - L_2$	$\mathbf{U^T_1, U^T_2 - \delta_2}$
S	$U^N_1 - L_1, U^T_2 - L_2$	$\mathbf{U^T_1, U^T_2}$	-
ES	$\mathbf{U^T_1 - \delta_1, U^T_2}$	-	-

NOTE: Outcomes denoted by - can be reached, bur are always dominated

Table 8. Utilities for countries 1 (rows) and 2 (columns) for Scenario 2.3. Source: Janeba, 2022.

Other authors have used game theory to study the consequences of sanctions in more particular scenarios. For instance, Brown [16] analyzes the specific case of imposing sanctions against the five permanent members of the UN Security Council. This case is of particular interest because, in general, these countries enjoy a position where they can multilaterally impose sanctions on other countries without being sanctions through the UN, as they have the power to veto that decision.

The model proposed by Brown in his work is an incomplete-information, sequential game. The introduction of incomplete information means that the sender country does not know how the target country will react to sanctions: it could either comply or keep violating. This is why the nature of the target country will define the outcomes of the game: if the target is tolerant, it will cooperate with sanctions, and if it is intolerant, it will have a positive payoff for disregarding the sanctions. Figure 6 summarizes the different possible scenarios and the rewards for each agent.

[16] Brown, 2019.

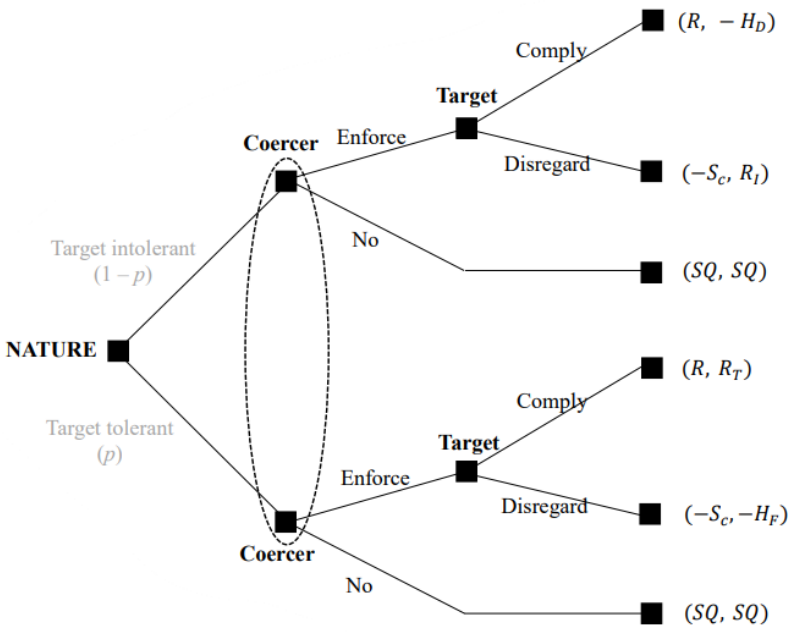

Figure 6. Game scenarios and payoffs for each player. Source: Brown, 2019.

Brown states that there are six possible outcomes as depicted in the previous figure, labeled O1-O6 [17]:

- O1: the target is intolerant, but the sender still imposes sanctions. These sanctions are strong enough to make the target comply.
- O2: the same case as before, but in this case, the sanctions are not strong enough and the target keeps violating.
- O3: the coercer does not impose sanctions, and the target violates.
- O4: the sender enforces sanctions on a tolerant target and makes it comply.
- O5: the sender imposes sanctions, but the tolerant target does not comply.
- O6: the coercer does not enforce sanctions, so the target continues with the action.

The finding of the work of Brown suggests that "*sanctions are largely ineffective in producing the desired result due to reputation costs associated with the target country, and prolonged multilateral sanctions will be questioned for their effectiveness due to the high cost of the sanctioning effort*" [18]. His conclusions point to the rational imposition of sanctions despite the nature of the target (tolerant or intolerant).

Differently, Catherine and Jean-Pierre Langlois take an alternative approach to the study of the effect of sanction enforcement. They argue that the commonly attributed disadvantages of sanctions are characteristics of rational sanction strategies, but they "*view the sanctioning*

[17] Brown, 2019.
[18] Brown, 2019.

game as a subtle mix of bargaining and war of attrition" [19].

The authors introduce a stage game, resulting from discounting a repeated game in time. Payoffs are modeled as flows on each date. If $Y = (y_i, y_j)$ is the sender's level of sanction and the target's level of countermeasure, and x is the level of activity that the target has a choice of doing, each player's utility is defined in (3), for i and j:

$$U_i(Y, x) = u_i(Y) + v_i(x) \quad (3)$$

Table 9 depicts the payoffs in each possible scenario:

i/j	***No Interference ($y_j = 0$)***	***Coercion ($y_j = 1$)***
No countermeasures ($y_i = 0$)	(0,0)	**$(-b_i , a_j)$**
Countermeasures ($y_i = 1$)	**$(a_i , -b_j)$**	**$(-c_i , -c_j)$**

Table 9. Coercion Game Payoffs. Source: Langlois & Langlois, 2010.

The equilibrium of this game depends on the value of the variables. According to the authors, "*if a_i and a_j are negative, then the coercion game has two pure strategy Nash equilibria. […] If a_i and a_j are positive, the coercion game is a Prisoner's dilemma with one equilibrium in C*" [19].The strategy for the sender country suggested by the authors is to impose costly sanctions to influence the target's decision to change its choice x at some point.

Their analysis shows that "*equilibrium behavior involves making one's opponent indifferent between accepting an ungenerous offer and continuing the struggle*", a condition described as countervailing [19]. Countervailing implies that the cost incurred by the sender country is positively correlated with the likelihood of the target country complying, and vice versa. Moreover, these costs do not have an impact on waiting time, unless uncertainty is introduced. This fact opposes the traditional view on the impact of costs in sanctions and suggests that there should be a different approach to the concept of success and failure of sanctions.

Researchers such as Simon [20] suggest alternatives to the study of sanction effectiveness using game theory. In his study, he claims that "*the theory of moves provides a better conceptual account of the dynamics of sanctions disputes over time than traditional game theory"* [20]. He used this tool to assess conditions for sanction success, failure, and stalemated sanction disputes, illustrating with case studies such as the U.S. sanctions against Vietnam and Haiti.

The first step that the author follows is to define a generic sanctions game and develop a set

[19] Langlois & Langlois, 2010.
[20] Simon, 2008.

of preferences by each agent to obtain 11 possible 2x2 sanctions games. Then he makes use of the Theory of Moves to analyze these games assuming sequence rather than simultaneity in the decisions [21]. They divide these games into the ones that result in stalemate (sanctions enforced on a non-compliant target), games where sanctions can result in compliance, or status quo (no sanctions enforced, and target violates).

According to Simon [21], "*To apply TOM to a sanctions episode, we assume unitary actors and binary policy options of actors involved in a dispute where sanctions are being considered*". Additionally, under standard game theory, players choose an initial strategy and then receive a payoff. In this case, the game starts in an initial state, which is elected to be NS/NC (Table 10). From this initial Status Quo, the sender can decide to sanction, the target to comply or keep violating; the sender can then choose to reduce sanctions or keep them, and then the recipient can choose again. It is not until the end of the game that the agents receive their payoffs.

		RECIPIENT	
		C	***NC***
SENDER	NS	Success (S_s, R_s)	Status Quo (S_q, R_q)
	S	Punishment (S_p, R_p)	Resistance (S_r,R_r)

Key: (S.R) = rank of outcome for sender, recipient

Table 10. 2x2 Sanctions Game. Source: Simon, 2008.

Simon distinguishes between two types of equilibrium: traditional Nash equilibrium and nonmyopic equilibria, which basically assumes that agents will act "non myopically", meaning that "*they will not switch strategies if this leads to a final outcome which is inferior to the initial one"* [21]. Between the 11 games resulting from the preferences:

- 6 games result in Resistance.
- 7 games result in Status Quo.
- 1 game results in Success.

An important observation stated by Lacy and Niou in their work is that "*threatening sanctions may be as important as imposing sanctions as a strategy in international disputes*". This is because "*sanctions are a game of issue linkage involving two or more issues, players may not know each other's preferences for the outcome of the game*" [22].

To prove this point, the authors develop a multi-stage two-sided incomplete information game between two players, a sender, and a target country. They therefore introduce a critical threat stage in the evolution of the game, which can be seen in Figure 7, which shows the sequence

[21] Simon, 2008.
[22] Lacy & Niou, 2004.

of moves.

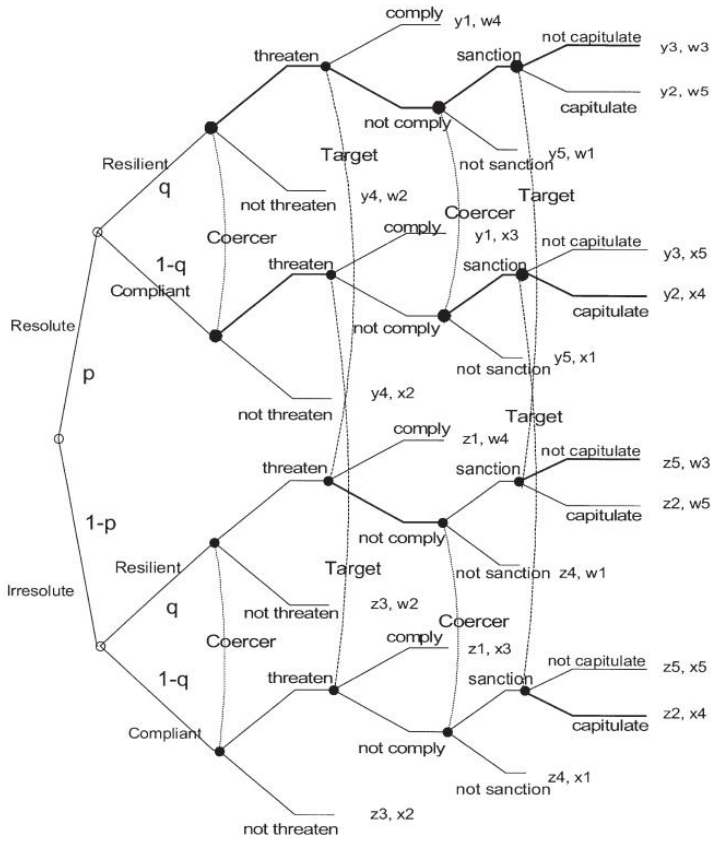

Figure 7. Sequence of Moves. The Economic Sanctions Game in Extensive Form. Source: Lacy & Niou, 2004.

Lacy and Niou [22] find five possible outcomes for this game, displayed in Table 11 alongside with their respective payoffs.

	Target		Coercer	
Outcome	***Resilient***	***Compliant***	***Resolute***	***Irresolute***
O1 = (no threat)	w2	x2	y4	z3
O2 = (threat, compliance)	w4	x3	y1	z1
O3 = (threat, no compliance, sanctions, no capitulation)	w3	x5	y3	z5
O4 = (threat, no compliance, sanctions, capitulation)	w5	x4	y2	z2
O5 = (threat, no compliance, no sanctions)	w1	x1	y5	z4

Table 11. Payoffs for Target (Resilient or Compliant) and Coercer. Source: Lacy & Niou, 2004.

Their findings reveal that *"Economic sanctions are likely to be imposed when they are not likely to succeed in changing the target's behavior. Sanctions that are likely to succeed will*

do so at the mere threat of sanctions" [23].

The work of Afesorgbor [24] sets a robust starting point in the analysis of the effectiveness of sanctions using the empirical method.

Similarly to Lacy and Niou [23], Afesorborg compares the empirical effect of threatening with sanctions and imposing them on international trade. In his work, he investigates whether different sanction instruments yield different effects and whether these effects are product specific. He uses the gravity model and detailed, disaggregated data on sanctions from 1960 to 2009. The findings reveal that "*The threat has important consequences for international trade between the sender and the target. The empirical results show that the impact of the threat of sanctions is qualitatively and quantitively different from the actual imposition of sanctions: the threat has a positive and significant effect on the bilateral trade flow, and the imposition has a negative and significant effect. However, the positive effect of sanction threat is only seen in exports.*" [24].

The increase in exports with sanction threat may result from economic agents in both the sender and target countries stockpiling goods in anticipation of sanctions. These differing impacts also apply to food and medicinal products and vary with different sanction instruments.

Walentek [25] combines theoretical and empirical methodologies to determine what determines cooperation on economic sanctions. Using a game theoretic framework, with repeated interactions and a variable for reputation, Walentek concludes that "*reputation is a strong predictor of cooperation on multilateral economic coercion. The effect of repeated interaction appears conditional on reputation; states with poor reputation positively mediate its effect through repeated interaction*" [25].

Using a more theoretical approach, Felbermayr et, al. [26] provide a comprehensive analysis of research regarding economic sanctions. The authors discuss the techniques employed by academics to collect data, conduct theoretical and empirical analyses, and identify potential directions for future work.

Filipenko et, al. [27] use an autoregressive vector to study the economic effect of sanctions in Iran. In their conclusions, the authors dive into the concept of the relative power of the two agents in the game and its effects on the outcome of the game. They argue that "*economic sanctions nowadays are a comprehensive tool in global economic wars, which effectiveness largely depends on the ratio of the economic power of the sanction imposing country to the*

[23] Lacy & Niou, 2004.
[24] Afesorgbor, 2016.
[25] Walentek, 2022.
[26] Felbermayr, Morgan, Syropoulos, & Yotov, 2021.
[27] Filipenko, Bazhenova, & Stakanov, 2020.

sanctioned one" [27].

Han [28] uses the same case study as Filipenko [29] to investigate the role of secondary sanctions and *"analyze their effectiveness as a mechanism to overcome the commitment and enforcement problems that arise in sustaining multilateral sanction campaigns*" [28].

The work of Zhukovskiy and Zhukovskaya [30] introduces a new method to find equilibrium in complex dynamic systems and puts it into practice in a model that includes sanctions and countersanctions, seeking a balance of three macro-systems: economic, legal and social.

Bapat [31] develops a game in which there is a coercer country, a target, and a company from the sanctioning country that trades with the target country. He then evaluates the effect of sanctions on the three players. Further in his study, Bapat adds to the model the effect of an external agency that regulates that the firm does not engage in illicit activities with the target country. He measures this effect for different levels of interactions between the company and the target country, using a Probit model to test the results. According to the authors, *"sanctions are more likely to succeed when the sender's firm retains a moderate share of the target's market relative to foreign competitors*" [31].

This vast revision of literature enables us to get a picture of the state of research regarding the effect of sanctions using game theory. There is a wide offer of studies that dig into this question, and the methodologies used as well as the models developed are very diverse. This allows us to conclude that there is no formal consensus on the best approach to analyze and draw conclusions from this topic, which leaves room for further studies and research.

Intending to fill a gap in the literature, we have developed a game theoretic model to analyze the effect of sanctions, which will be introduced in the following section.

[28] Han, 2016.
[29] Filipenko, Bazhenova, & Stakanov, 2020.
[30] Zhukovskiy & Zhukovskaya, 2023.
[31] Bapat & Kwon, 2014.

3. Scope of the Project

The main conclusion from the previous section is that there is a wide range of studies that target the analysis of sanctions through game theory, although there seems to be no specific consensus on the best approach to do so. Multiple models have been designed, using different assumptions and techniques to draw conclusions on this matter. As a result, there is significant room in the literature to analyze the effect of sanctions using this methodology.

The project involves a comprehensive analysis to understand the short-term and long-term effects of sanctions on the intervening economies. This analysis is composed of the development of a game-theoretic model, Game Rasputin, which assesses the payoffs for each country under different scenarios, based on different assumptions. It also includes an analysis of time-dependent situations, defining an optimal time for sanctions to stop. This theoretical model is then applied to the case of the sanctions following the Russian invasion of Ukraine.

3.1. Objectives

The main goal of this research is to develop a model that can analyze the effect of sanctions by depicting real situations more accurately than any game designed in previous literature. To reach this final goal, a set of intermediate objectives have to be achieved, which include:

- Deep understanding of previous literature: conduct a comprehensive literature review on previous research about game theory applied to the effect of sanctions. This is a key step to find gaps in the current models that can be addressed in the model developed.
- Develop a model that, through accurate variable description and definition of equations, reflects real situations optimally. Obtain the theoretical equilibria of the defined model.
- Build a complete dataset with the required variables to feed the model.
- Perform the numerical implementation by substituting the variables of the theoretical model with the values obtained from the dataset, resulting in numerical payoff matrix.
- Conduct a qualitative analysis of the results of the numerical implementation, as well as the evolution of the variables of the dataset.

3.2. Methodology

To reach the aforementioned objectives, a set of methods and techniques will be put into practice. We will make use of references from the literature review and game theory to develop the model. Later, we will take the inputs from data collected from different resources to feed the model and obtain the numerical payoffs for the specific situation. Figure 8 reflects

the link between the different inputs, tools and models that constitute the methodology to follow.

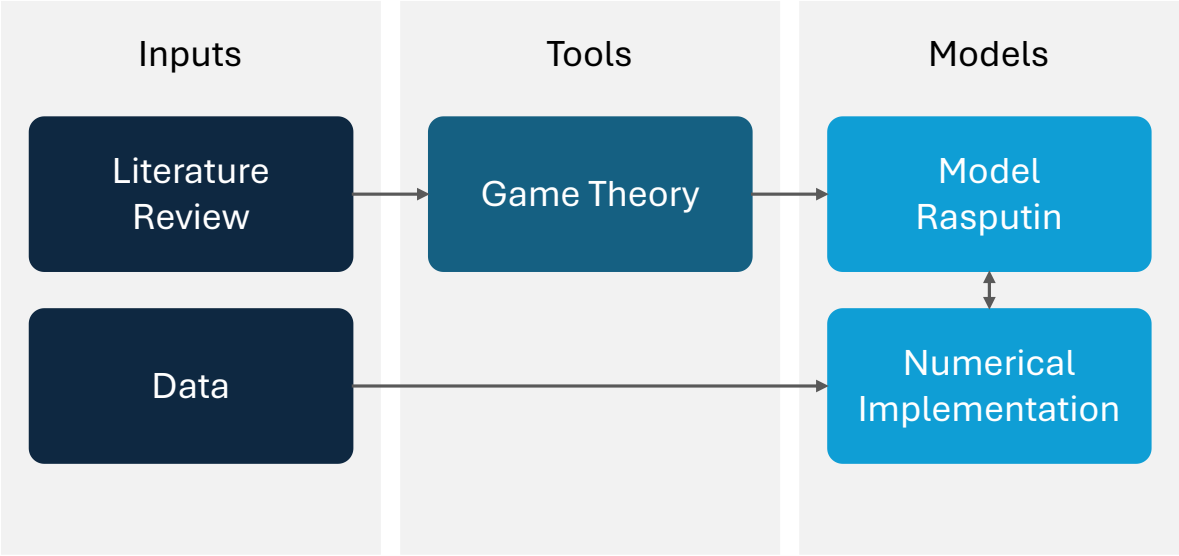

Figure 8. Methodology Diagram. Source: self-elaboration, 2024.

To reach the objectives using the described methodology, we will develop a set of tasks and distribute them in a chronogram to evaluate the evolution of the project:

- **Literature Review**: Conduct an extensive review of existing literature on economic sanctions and their impacts.
- **Develop the theoretical model.**
- **Calculate the equilibria of the model.**
- **Data Collection**: Gather relevant economic data from credible sources such as international financial institutions, government reports, and academic publications.
- **Numerical Implementation:** feed the model with the data collected and define a set of hypotheses that are expected to take place in this specific case.
- **Result Analysis:** analyze the results obtained and the trends and behaviors of the variables.
- **Check if the hypotheses have been tested.**

Figure 9 depicts a chronogram with the allocated time for each task.

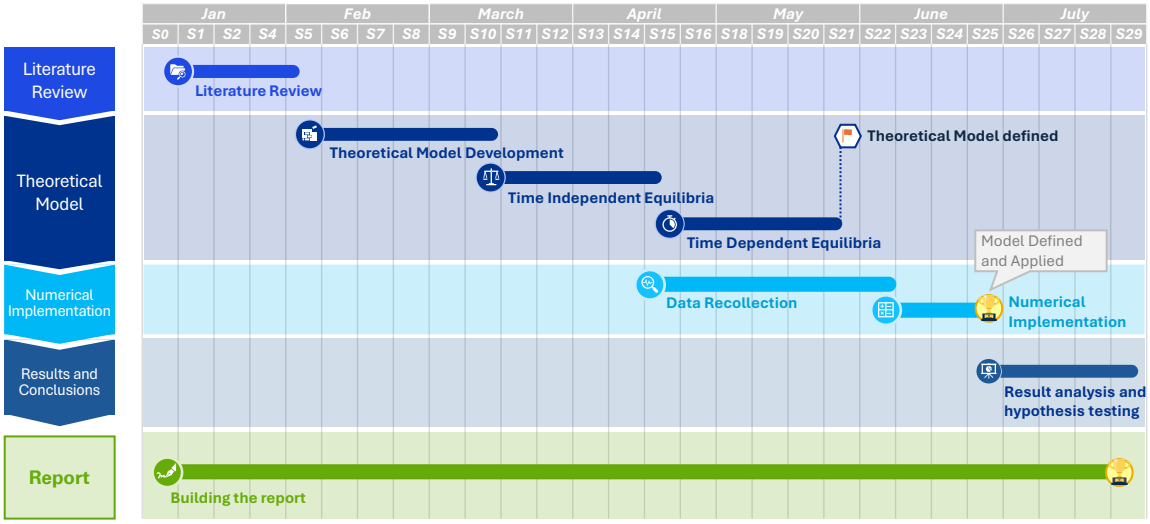

Figure 9. Chronogram of the Project. Source: self-elaboration, 2024.

3.3. Resources

The techniques and tasks mentioned above require the use of tools to properly implement them. In this section we will list all the required resources, which are:

- **Software Tools**: Access to data analytics software such as Python. Jupiter has been used to clean the data and build the dataset.
- **Data Access**: Data repositories like Refinitiv, Capital IQ, and others.

By ensuring the availability and efficient use of these resources, the project aims to deliver a comprehensive analysis and insights on the economic impacts of sanctions, aligning with the objectives set above.

4. Description of Game Rasputin

The purpose of this chapter is to construct a game theoretic model that illustrates the effect of sanctions on different players in the sanctions game. The name of this model will be Game Rasputin, and we will refer to it with this name throughout the study. We considered that the most effective approach to simulate real-world situations regarding sanctions is by developing a continuous-time model with one-sided incomplete information. This approach assumes that agents receive their payoffs on a timely basis, and these payoffs must be discounted using an interest rate to determine their total value. Additionally, as in real-world geopolitics, there is no complete information, as the value that the target country places on continuing the policy for what they are being sanctioned is unknown to the countries that are sanctioning.

In terms of model objectives, we aim to be able to provide a thorough representation of all potential cases that can take place in a sanctions war in real life. To achieve this, we have calculated the equilibrium points for multiple scenarios under various assumptions, offering a comprehensive view of all possible strategies players might adopt in the game.

As a result, in the following section, we will outline the setup of Game Rasputin, and later on, we will apply this model to a real case study.

4.1. Game Rasputin Setup

The world economy consists of four countries $i = 1,2,3,4$. Country 3 has the option to pursue a particular policy $X \in \{0, 1\}$ which is a binary decision. Countries 1 and 2 are dissatisfied with this activity and are exploring imposing sanctions on country 3 with the objective of changing its behavior. Although countries 1 and 2 care about the behavior of country 3, it is country 3 that unilaterally decides its behavior. Country 4 takes advantage of sanction periods to trade with country 3: "*This may considerably lower the impact of sanctions and hence the probability that they will succeed"* [32]. Let us denote B as the benefit country 4 makes from an increase in trade with country 3 resulting from sanctions.

Let $\theta \geq 0$ be the value, per period, that country 3 gives to this policy. According to the work of Smith [33], if the interest rate is $1 - \delta$, then the present value of θ from time $t = 0$ until $t = t'$ is reflected in (4). If country 3 receives this income forever, this has a present value of $\theta/(1-\delta)$.

[32] Martin, 1992.
[33] Smith, 1995.

$$\int_0^{t'} \theta\, e^{-(1-\delta)t}\, dt$$

(4)

The value of θ is unknown for countries 1 and 2, as it is private information. Nevertheless, countries 1 and 2 have beliefs on which type of country country 3 is. Let $P(\theta)$ be country 1 and 2's cumulative beliefs about the type of country 3. Therefore, $P(y)$ is the probability that country 3's type is less than y: $P(y) = Prob(\theta < y)$. Let $p(\theta)$ be the associated density. "*Assume that P(θ) is continuous, twice differentiable, and bounded away from zero*" [33]. θ ranges between 0 and θ_{max}.

The counterpart of engaging in policy X for Country 3 is a potential loss of trade with countries 1 and 2. We will denote c_i the per-period welfare loss of country 3 from lost free trade with country $i = 1, 2$. Whether c_1+c_2 is greater or smaller than θ is a very relevant aspect for the below analysis.

Regarding the cost associated with sanctions, countries 1 and 2 have to face a payment of $m_i > 0$, $i = 1,2$, every period sanctions are active. Additionally, countries 1 and 2 experience a loss of $L_i > 0$, $i = 1,2$, if activity X is pursued by country 3. So that sanction imposition makes sense, we assume $m_i < L_i$.

For simplification purposes, we will consider two cases: $o \in \{T, N\}$. T stands for free trade between countries and N for no trade. We will define $U_{o,i}$ the utility of country $i = 1, 2$, from bilateral trade with country 3, where $o \in \{T, N\}$. As a result, $U_{T,i}$ and $U_{N,i}$ represent utility levels of country i when trading and not trading with country 3, respectively. We assume that countries 1 and 2 always trade with each other, and therefore $U_{T,i} > U_{N,i} \geq 0$. Furthermore, we consider implicit in this assumption that the benefits from trade of country i with country 3 are independent of the trading between countries j and country 3.

As mentioned previously, sanctions are modeled in continuous time. The game starts at $t = 0$. For time-dependent analysis, sanctions are assumed to be active at the start of the game, and at any point in time any agent can stop the sanctions: Countries 1 and 2 can decide not to continue sanctions any longer, and country 3 can comply, which ends sanctions. We will assume that once country 3 has stopped policy X it never reverts to this policy. Once 3 complies with sanctions, the income stream of countries 1 and 2 lasts forever.

4.2. Time independent equilibria

Time-independent equilibria imply that each country chooses its strategy, and this strategy remains forever: countries 1 and 2 either sanction forever or never sanction. Firstly, we will analyze the game using three players, and in the following section, we will introduce Country 4 to see the numerical difference in the payoffs of each agent. Initially, we consider 2 possible cases:

a) Case $C = c_1+c_2 \leq \theta$: regardless of the sanctions, country 3 will choose $X=1$. In this situation, there exists 1 Nash equilibrium, where countries 1 and 2 do not sanction country 3, given that it will not change its behavior.

		Country 1	
	$\theta > c_1 + c_2$	**NS**	**S**
Country 2	NS	$\mathbf{U_{T,1} - L_1 \,/\, U_{T,2} - L_2 \,/\, \theta}$	$U_{N,1} - m_1 - L_1 \,/\, U_{T,2} - L_2 \,/\, \theta - c_1 + B_4$
	S	$U_{T,1} - L_1 \,/\, U_{N,2} - m_2 - L_2 \,/\, \theta - c_2 + B_4$	$U_{N,1} - m_1 - L_1 \,/\, U_{N,2} - m_2 - L_2 \,/\, \theta - c_1 - c_2 + B_4$

NOTE: Utilities are displayed as follows $U_{country\,1} / U_{country\,2} / U_{country\,3}$

Table 12. Outcomes of Game Rasputin in Case (a). Source: self-elaboration, 2024.

b) Case $C = c_1+c_2 \geq \theta$: in this case, country 3 will decide the value of X depending on the individual actions of countries 1 and 2. We divide into 3 sub-cases:

1. $\theta < min\{c_1, c_2\}$: the loss of trade with any of the two sanctioning countries is detrimental for country 3. As a result, in this case, the threat or imposition of sanctions is strong. Table 13 represents the possible per-period outcomes for this case. In this situation, there are two Nash equilibria, both involving sanctions from either country 1 or country 2.

		Country 1	
	$\theta < min\{c_1, c_2\}$	**NS**	**S**
Country 2	NS	$U_{T,1} - L_1 \,/\, U_{T,2} - L_2 \,/\, \theta$	$\mathbf{U_{T,1} - m_1 \,/\, U_{T,2} \,/\, 0}$
	S	$\mathbf{U_{T,1} \,/\, U_{T,2} - m_2 \,/\, 0}$	$U_{T,1} - m_2 \,/\, U_{T,2} - m_2 \,/\, 0$

NOTE: Utilities are displayed as follows $U_{country\,1} / U_{country\,2} / U_{country\,3}$

Table 13. Outcomes of the Game Rasputin in Case (b1). Source: self-elaboration, 2024.

2. $c_2 < \theta < c_1$: for country 3, losing trade with country 1 is very costly, but, relative to the benefit of pursuing X, losing trade with country 2 is not that threatening. The possible per-period outcomes of this case are depicted in Table 14. There is one Nash equilibrium, which involves country 1 sanctioning country 3.

	$c_2 < \theta < c_1$	**NS**	**S**
Country 2	NS	$U_{T,1} - L_1 \,/\, U_{T,2} - L_2 \,/\, \theta$	$\mathbf{U_{T,1} - m_1 \,/\, U_{T,2} \,/\, 0}$
	S	$U_{T,1} - L_1 \,/\, U_{N,2} - m_2 - L_2 \,/\, \theta - c_2 + B_4$	$U_{T,1} - m_2 \,/\, U_{T,2} - m_2 \,/\, 0$

NOTE: Utilities are displayed as follows $U_{country\,1} / U_{country\,2} / U_{country\,3}$

Table 14. Outcomes of the Game Rasputin in Case (b2). Source: self-elaboration, 2024.

3. $\theta > max\ \{c_1, c_2\}$: losing trade with each country individually is not so costly, but the combined effect is strong enough to make country 3 comply. The per-period outcomes for each scenario of this case are represented in Table 15. There is one Nash equilibrium, which involves both countries 1 and 2 sanctioning country 3.

		Country 1	
	$\theta > max\{c_1, c_2\}$	**NS**	**S**
Country 2	NS	$U_{T,1} - L_1 \,/\, U_{T,2} - L_2 \,/\, \theta$	$U_{N,1} - m_1 - L_1 \,/\, U_{T,2} - L_2 \,/\, \theta - c_1 + B_4$
	S	$U_{T,1} - L_1 \,/\, U_{N,2} - m_2 - L_2 \,/\, \theta - c_2 + B_4$	**$U_{T,1} - m_2 \,/\, U_{T,2} - m_2 \,/\, 0$**

NOTE: Utilities are displayed as follows $U_{country\ 1} / U_{country\ 2} / U_{country\ 3}$

Table 15. Outcomes of the Game Rasputin in Case (b3). Source: self-elaboration, 2024.

To be able to compare the results among the different players, we will normalize the values of the trade flows and market volatilities of each region. To do so, we will use the method of standardization. This method converts the data points in a distribution with a mean of 0 and a standard deviation of 1. This method is suitable to compare and make calculations with data from different distributions, as the standardized data has common statistical properties.

To standardize a value, we have to calculate the mean (μ) and the standard deviation (σ) of the group of observations it belongs to and then use the following formula to obtain the normalized value:

$$x_{normalized} = \frac{x_{original} - \mu}{\sigma} \quad (5)$$

where:

- $x_{normalized}$ is the normalized value.
- μ is the average of the variable
- σ is the standard deviation of the variable
- $x_{original}$ is the original value.

4.3. Time dependent equilibria

In this section, we will calculate the time-dependent equilibria of the sanctions game. To do so, we will part from the game developed by Smith [34] and adapt it to the particular case described above.

Before diving into the characterization of the time-dependent equilibria, we will develop some of the intuition behind the outcomes. According to the work of Smith [34], "*If nations are engaged in the sanctions battle, they all face similar incentives: They want to win the sanctions battle, but conditional on not winning they want to lose quickly*". As a result, let's consider the game from the side of country 3. This player is evaluating whether to comply with sanctions on time α. Considering we are currently on time *t=0*, to make this decision we must calculate the benefit and cost of waiting an extra time α.

$Q_i(t) = \int_0^{+\alpha} s_i(t)\, dt$ is the probability that countries *i = 1, 2*, stop sanctioning between *0* and α. As a result:

- The benefit for country 3 of waiting an extra time α is:

$$Q_1(t) * \big(1 - Q_2(t)\big) * \frac{\theta - c_2}{1-\delta} + \; Q_2(t) * (1 - Q_1(t)) * \frac{\theta - c_1}{1-\delta} + \; Q_1(t) * Q_2(t) * \frac{\theta}{1-\delta} \qquad (6)$$

  The first term reflects the situation of country 1 stopping sanctions, the second is the situation of country 2 stopping sanctions, and the third term is the situation where both countries stop sanctions. Each term is calculated by multiplying the probability of it occurring and the benefit from each situation for country 3.

- The cost for country 3 of waiting an extra time α is:

$$\big(1 - Q_1(t)\big) * Q_2(t) * \tfrac{c_1 - \theta}{1-\delta} + \; (1 - Q_2(t)) * Q_1(t) * \tfrac{c_2 - \theta}{1-\delta} + \; \big(1 - Q_1(t)\big) * (1 - Q_2(t)) * \tfrac{c_1 + c_2 - \theta}{1-\delta} \qquad (7)$$

  The first term reflects the situation of country 1 stopping sanctions, the second is the situation of country 2 stopping sanctions, and the third term is the situation where both countries stop sanctions. Each term is calculated multiplying the probability of it occurring and the cost from each situation for country 3.

The payoff for country 3 of waiting an extra time α is the benefit of waiting minus its cost. If this payoff is positive, country 3 will wait. On the contrary, a negative payoff will imply country 3 will comply with sanctions. The expected payoff is increasing in θ, which means that if country 3 is a type of country that values its policy highly, it will wait longer to comply with sanctions. Let $t_3(\theta)$ be the optimal time for country 3 to stop sanctions. Following Smith's

[34] Smith, 1995.

work[34], we will define $\Phi(t)$ as the inverse function of $t_3(\theta)$, which basically gives the type of nation that complies at time t.

If country 3 of type θ, complies with sanctions until time t_3, its expected payoff is $E[U_3(t_3, \theta, s_i(t))]$

$$E[U_3(t_3, \theta, Q_i(t))] = Q_1(t_3) * \left(1 - Q_2(t_3)\right) * \frac{\theta - c_2}{1-\delta} + Q_2(t_3) * \left(1 - Q_1(t_3)\right) * \frac{\theta - c_1}{1-\delta} + Q_1(t_3) * Q_2(t_3) * \frac{\theta}{1-\delta} - \left\{\left(1 - Q_1(t_3)\right) * Q_2(t_3) * \frac{c_1 - \theta}{1-\delta} + \left(1 - Q_2(t_3)\right) * Q_1(t_3) * \frac{c_2 - \theta}{1-\delta} + \left(1 - Q_1(t_3)\right) * \left(1 - Q_2(t_3)\right) * \frac{c_1 + c_2 - \theta}{1-\delta}\right\}$$

(8)

Rearranging the terms in Equation (8) we obtain (9):

$$E[U_3(t_3, \theta, Q_i(t))] = 2 * Q_1(t_3) * \left(1 - Q_2(t_3)\right) * \frac{\theta - c_2}{1-\delta} + 2 * Q_2(t_3) * \left(1 - Q_1(t_3)\right) * \frac{\theta - c_1}{1-\delta} + Q_1(t_3) * Q_2(t_3) * \frac{\theta}{1-\delta} - \left(1 - Q_1(t_3)\right) * \left(1 - Q_2(t_3)\right) * \frac{c_1 + c_2 - \theta}{1-\delta}$$

(9)

For countries $i = 1, 2$, if they decide to stop sanctions at time t_i, their payoff depends on their strategy and country 3's strategy (10).

$$E[U_i(t_i, \Phi(t))] = \int_0^{t_i} p(\phi(t)) * \frac{d\phi(t)}{dt} * \frac{U_{T,i}}{1-\delta} * e^{-(1-\delta)t} dt - (m_i + L_i) \int_0^{t_i} (1 - P(\phi(t)) * e^{-(1-\delta)t} dt$$

(10)

The first term represents the benefit for countries $i=1, 2$, from sanction enforcement. It is obtained by multiplying the rate at which country 3 complies with sanctions ($p(\phi(t)) * \frac{d\phi(t)}{dt}$) by the expected payoffs for the sanctioning countries. The second term represents the sanctions costs for the coercer country, multiplying the probability that country 3 does not comply by the cost for countries $i=1, 2$, if country 3 does not comply and sanctions are imposed.

The solution to the game lies in Bayesian equilibrium. In this scenario, each player achieves maximum utility based on the strategy of the other player. Additionally, country $i=1,2$, beliefs about the type of country 3 have to be consistent with Bayes rule.

Given equation (9), we can calculate the optimal time for country 3 to comply with sanctions to maximize its utility:

$$\frac{dE[U_3(t_3, \theta, Q_i(t))]}{dt_3} = \frac{\theta + c_1 - c_2}{1-\delta} * Q_1'(t_3) * \left(1 - Q_2(t_3)\right) + \frac{\theta - c_1 + c_2}{1-\delta} * Q_2'(t_3) * \left(1 - Q_1(t_3)\right) + \frac{2c_2 - \theta}{1-\delta} * Q_2'(t_3) * Q_1(t_3) + \frac{2c_1 - \theta}{1-\delta} * Q_1'(t_3) * Q_2(t_3) = 0$$

(11)

For simplification purposes, we will assume $Q_1(t) = Q_2(t) = Q_i(t)$. This means that countries 1 and 2 have the same belief on the type of country 3, which is accurate with real cases, as countries that are aligned tend to communicate with each other. Substituting θ for $\Phi(t)$ results in (12).

$$\int_0^t \boldsymbol{s_i(t)\,dt} = \frac{-2*\boldsymbol{\phi(t)}}{\boldsymbol{c_1+c_2-2*\phi(t)}} \quad \text{or} \quad \boldsymbol{s_i(t)} = \frac{-2*\boldsymbol{\phi'(t)}*(\boldsymbol{c_1+c_2})}{(\boldsymbol{c_1+c_2-2\phi(t)})^2}$$

(12)

To obtain equation (12) from equation (11): we follow the following steps:

1- We substitute $Q_1(t)$ and $Q_2(t)$ by $Q_i(t)$ and θ for $\Phi(t)$:

$$\frac{\phi(t_3)+c_1-c_2}{1-\delta} * Q_i'(t_3) * \big(1 - Q_i(t_3)\big) + \frac{\phi(t_3)-c_1+c_2}{1-\delta} * Q_i'(t_3) * \big(1 - Q_i(t_3)\big) + \frac{2c_2-\phi(t_3)}{1-\delta} * Q_i'(t_3) * Q_i(t_3) + \frac{2c_1-\phi(t_3)}{1-\delta} * Q_i'(t_3) * Q_i(t_3) = 0$$

(13)

2- We rearrange and combine terms:

$$Q_i'(t_3) * \left(\frac{\phi(t_3)}{1-\delta} + 2 * Q_{i(t)} * \frac{c_1 + c_2 - 2 * \phi(t_3)}{1-\delta}\right) = 0$$

(14)

3- We obtain the value of $Q_i(t)$:

$$Q_{i(t)} = \frac{-2 * \phi(t_3)}{c_1 + c_2 - 2 * \phi(t_3)} = \int_0^t s_i(t)\,dt$$

(15)

4- We obtain $s_i(t)$:

$$s_i(t) = \frac{-2 * \phi'(t) * (c_1 + c_2)}{\big(c_1 + c_2 - 2\phi(t)\big)^2}$$

(16)

Similarly, with equation (10) we can calculate the optimal time t_i for countries $i=1,2$, to stop sanctioning:

$$\frac{dE[U_i\,(t_i,\theta,Q_i(t))]}{dt_i} = e^{-(1-\delta)t_i} * \left[p\big(\phi(t)\big) * \frac{d\phi(t)}{dt} * \frac{U_{T,i}}{1-\delta} - (m_i + L_i) * (1 - P(\phi(t)))\right] = 0$$

(17)

From equation (17) we obtain:

$$\frac{d\phi(t)}{dt} = (m_i + L_i) * \frac{1-\delta}{U_{T,i}} * \frac{1-P(\phi(t))}{p(\phi(t))}$$

(18)

Under the condition set by equation (18), we obtain:

$$\frac{d^2 E[U_i(t_i, \theta, Q_i(t))]}{dt_i^2} = 0$$

(19)

This means that countries *i = 1,2,* are indifferent between all the stopping times that satisfy the condition set by equation (18).

As a result, we can affirm that if t_3^* and s_i^* constitute a time-dependent equilibrium strategy profile, then the following conditions have to stand:

- $\frac{d\phi(t)}{dt} = (m_i + L_i) * \frac{1-\delta}{U_{T,i}} * \frac{1-P(\phi(t))}{p(\phi(t))}$
- $s_i(t) = \frac{-2*\phi'(t)*(c_1+c_2)}{(c_1+c_2-2\phi(t))^2}$

We will now characterize the time-dependent equilibria according to different distributions of countries *i=1, 2,* beliefs about country 3's type.

Uniform Distribution

Assuming a uniform distribution for *Φ(t),* equation (18) results in

$$\frac{d\phi(t)}{dt} = (m_i + L_i) * \frac{1-\delta}{U_{T,i}} * (1 - \phi(t))$$

(20)

To obtain *Φ(t),* we solve the differential equation and get:

$$\phi(t) = 1 - e^{-(m_i+L_i)*\frac{1-\delta}{U_{T,i}}*t}$$

(21)

The final step to obtain the optimal stopping time for country 3 is to calculate the inverse function of *Φ(t),* resulting in:

$$t_3(\theta) = -\frac{U_{T,i}}{(1-\delta)*(m_i+L_i)} \ln(1-\theta)$$

(22)

As defined before:

$$s_i(t) = \frac{-2 * \phi'(t) * (c_1 + c_2)}{\left(c_1 + c_2 - 2\phi(t)\right)^2} = \frac{-2 * (c_1 + c_2) * (m_i + L_i) * \frac{1-\delta}{U_{T,i}} * e^{-(m_i+L_i)*\frac{1-\delta}{U_{T,i}}*t}}{\left(c_1 + c_2 - 2 * \left(1 - e^{-(m_i+L_i)*\frac{1-\delta}{U_{T,i}}*t}\right)\right)^2}$$

(23)

To prove that the obtained equations qualify as equilibrium points, we have to consider the strategy of the agents:

- If we consider the strategy of country 3, we can see that $t_3(\theta)$ is an increasing function, where $t_3(0) = 0$ and $t_3(1) = +\infty$. Additionally, given the found $s_i(t)$, country 3 maximizes its utility with $t_3(\theta)$, which makes it the best response for this player.
- For countries $i=1,2$, given that $t_3(\theta)$ satisfies equation (18), then these countries are indifferent between the stopping time, and their beliefs on country 3's type are consistent with Bayes rule.

As a result, the obtained values for $t_3(\theta)$ and $s_i(t)$ are valid to qualify as equilibrium points.

Exponential Distribution

In similar game setups, it is common to assume that country types θ are distributed exponentially. With this, $P(\theta) = 1 - e^{-\theta}$ and $p(\theta) = e^{-\theta}$, which leaves equation (18) as:

$$\frac{d\phi(t)}{dt} = (m_i + L_i) * \frac{1-\delta}{U_{T,i}}$$

(24)

At the same time, if we integrate, we obtain $\Phi(t)$:

$$\phi(t) = (m_i + L_i) * \frac{1-\delta}{U_{T,i}} * t$$

(25)

Undoing the inverse we get:

$$t_3(\theta) = \frac{U_{T,i}}{(1-\delta) * (m_i + L_i)} * \theta$$

With this result, we can observe that $t_3(1) \neq +\infty$, which was one of our basic assumptions to qualify the results as equilibrium. Therefore, we can affirm that if types of country 3 are

distributed exponentially, there are no time-dependent equilibria.

In the following section, we will apply Game Rasputin to the case of US and EU sanctions against Russia. We will use data to give a numerical value to our variables and the results from the model. Additionally, we will study the change in the values of these variables once a fourth country is included in the game, which will represent a country that is not part of the sanctions game but that benefits from increased trade with country 3 after countries *i=1,2*, impose sanctions on it. We assume that including country 4 will reduce the damage of sanctions for country 3 and increase its cost for countries *i=1,2*, given that "*an important factor in the success or failure of international sanctions is whether nations can collectively commit to sanctioning*"[35].

[35] Martin, 1992.

5. Case Study: EU and US sanctions against Russia

In this section, we will describe the sanctions timeline historically enforced on Russia. We will distinguish between sanctions imposed by the European Union and sanctions implemented by the United States.

5.1. Retrospective of Sanctions against Russia

According to the European Parliament Research Service [36] the first collection of EU sanctions against Russia was adopted in March 2014, after the Russian illegal annexation of the territories of Crimea and Sevastopol, as well as the country's support for an illegal insurgence that aimed the separation of eastern Ukraine.

These measures involved EU travel bans and asset freezes and targeted 33 officials responsible for actions that threatened the territorial integrity of Ukraine [37]. Moreover, a planned EU-Russia summit was canceled, and any further bilateral summits with Russia were to be turned down by member states.

In June 2014, an import ban on goods from Crimea and Sevastopol was implemented [37]. In July, Russia was targeted with 6 new restrictive measures, which included a restriction on economic cooperation with the EU [37]. In this same month, passenger flight MH17 was downed, and consequently, EU sanctions were strengthened.

The European Council adopted a package of economic sanctions, designed to "*limit access to EU capital markets for Russian State-owned financial institutions, impose an embargo on trade in arms, establish an export ban for dual-use goods for military end users, and curtail Russian access to sensitive technologies, particularly in the field of the oil sector*" [38]. In September 2014, this package was reinforced with a new set of restrictive measures, which included, among others: prohibition for EU nationals and companies to provide loans to five Russian banks or to trade in new bonds, equity, or other financial instruments issued by these banks. These measures extended to three Russian energy companies and three major Russian defense companies [38]. Two months later, in November 2014, sanctions were strengthened against the separatists in Eastern Ukraine: 13 individuals and 5 companies were banned from traveling and had their assets frozen [38].

2015 started with an extension of the individual restrictive measures until September 2015, which at this point affected 132 persons and 28 companies. Nevertheless, these measures were put on hold until mid-February to give room for diplomatic discussions and the Minsk talks.

[36] Caprile, 2023.
[37] European Council, 2024.
[38] European Council, 2014.

In March 2015, "*Leaders decided to align the existing sanctions regime to the implementation of the Minsk agreements. Economic sanctions were enforced until the end of 2015 when the last point of the peace plan was to be implemented: Ukraine regaining control over its borders in the east"* [37]. Later, in June 2015, the restrictions were extended until June 2016 as a response to the annexation of Crimea and Sevastopol by the Russians. These englobed: banning on product imports and certain exports, tourism, investment, and services, among others. Moreover, economic sanctions targeting exchanges in the financial, defense, and energy sectors were also extended until July 2016.

Given the negative of the Russian government to change their behavior, sanctions over actions against Ukraine's territorial integrity, sanctions in response to the illegal annexation of Crimea and Sevastopol, economic sanctions, and sanctions over misappropriation of Ukrainian state funds were constantly being extended in multiple meetings throughout the years 2016, 2017, 2018, 2019, 2020 and 2021. Additionally, the sanctions list was constantly being updated with new members.

An important date is November 21, 2017, day on which the "Governor of Sevastopol" was added to the sanctions list over *actions against Ukraine's territorial integrity* [39]. In March 2020, an extension of the sanctions over *actions against Ukraine's territorial integrity* included, not only a fund freezing but also a ban on making funds or resources available to the individuals and firms listed [39].

In 2022, Russia's large-scale invasion of Ukraine led to the immediate introduction of new EU sanctions, coordinated with other countries. This 'sanctions revolution' involved EU Member States adopting 13 sanctions packages rapidly. Each package progressively amended and expanded the sanctions in place since 2014. In February 2022, a new regime was added, banning imports of goods from the illegally annexed territories of Donetsk, Luhansk, Kherson, and Zaporizhzhia into the EU [40], as well as restricting Russia's access to the EU's capital and financial market services [39]. With the measures enforced, Russia entered a humanitarian crisis. As a response, in April 2022, the European Council introduced exceptions in two sanctions regimes.

Figure 10 depicts a summarized timeline of all the sanctions imposed by the EU on Russia, as well as the events that led to the enforcement of these measures.

[39] European Council, 2024.
[40] Caprile, 2023.

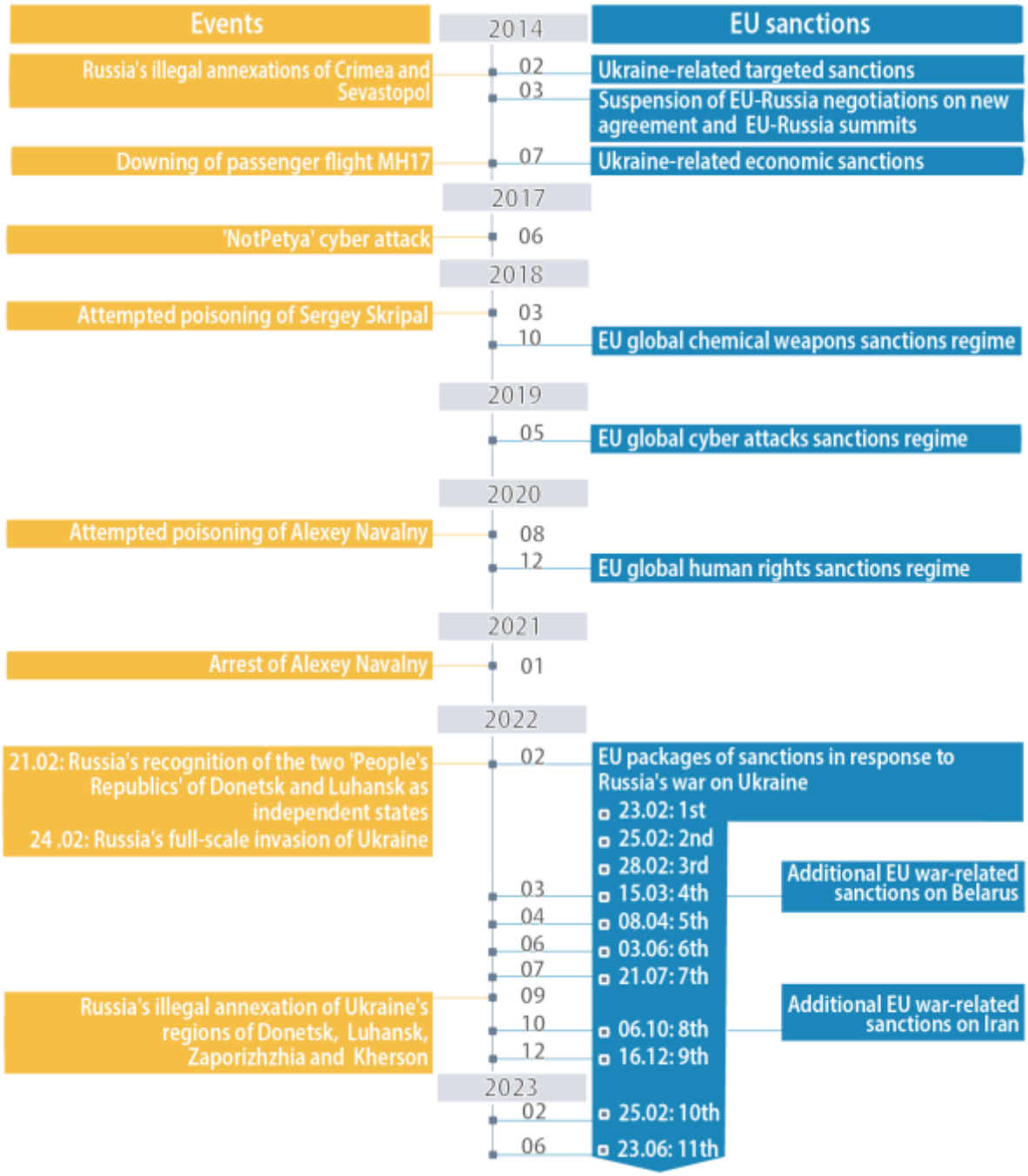

Figure 10. Timeline of EU sanctions. Source: European Parliamentary Research Service

Table 16 summarizes the 13 packages of sanctions imposed by the EU and its global partners as a response to the Ukraine invasion.

Package	***Date***	***Target***
Package 1	February 23, 2022	• Targeted sanctions against 351 members of the Russian State Duma • Restrictions on economic relations with the areas of Donetsk and Luhansk • Restrictions on Russia's access to the EU's capital and financial markets and services
Package 2	February 25, 2022	• Freezing of the assets of Vladimir Putin, president of Russia, and of Sergey Lavrov, Minister for Foreign Affairs. • Restrictive measures on members of the National Security Council of the Russian State Duma
Package 3	February 28, 2022	• Prohibition of conducting transactions with Russian banks • €500 million destined to finance equipment and supplies to Ukraine. • Russian carriers banned from overflying EU airspace. • New sanctions on 26 more individuals and 1 entity • 7 Russian banks excluded from SWIFT. • Prohibition to participate in projects alongside Russian Direct Investment Funs • Prohibition to sell, supply or transfer euro banknotes to Russia or any individual or entity in Russia. • Suspension of broadcasting Russia Today and Sputnik in the EU
Package 4	March 15, 2022	• Ban on all transactions with Russian state-owned companies. • Ban on the provision of credit rating to any Russian individual or entity. • Ban to engage in new investment in the Russian energy sector. Additional measures targeting Belarus and Russia: • Restrict three Belarusian banks from SWIFT. • Ban transactions with the Central Bank of Belarus • Prohibit the listing and service provision to Belarusian SOE on EU trading markets. • Limit financial inflows to the EU from Belarus • Ban supply of euro-denominated banknotes to Belarus
Package 5	April 8, 2022	• Ban on imports of Russian coal and other fossil fuels. • Prohibition of all Russian boats from accessing EU ports • Ban on Russian and Belarusian road transport vehicles from entering the EU. • Ban on imports of other goods (wood, cement, seafood…) • Prohibition of exports to Russia of jet fuel and other goods • Ban on crypto-wallet deposits

Package	***Date***	***Target***
Package 6	June 3, 202 2	• Ban on Russian crude oil and petroleum products. Temporary exception for crude oil delivered by pipeline. • SWIFT ban for an additional three Russian banks and one bank from Belarus • Three more Russian channels suspended in the EU
Package 7	July 21, 2022	• Prohibition to buy or transfer Russian-origin gold or jewelry. • More restrictive controls on exports of dual-use goods • Port access ban is extended to locks. • Sanctions on 54 persons and 10 companies more
Package 8	October 6, 2022	• Price cap on transport of Russian oil for third countries • More limitations on trade and services with Russia • Sanctions on 30 persons and 7 entities more
Package 9	December 16, 2022	• Prohibitions of exports of drone engines • Ban on investment in the mining industry. • Ban of transactions with the Russian Development Bank • Ban providing advertising, public opinion, and market research polling service
Package 10	February 25, 2023	• Prohibition of exporting critical technology and industrial goods. • Ban on imports of building materials. • Ban to provide gas storage capacity to Russians. • Prohibition to transit through Russia EU exported dual-use goods and technologies
Package 11	June 23, 2023	• Strengthening of cooperation with third countries to ensure the effect of sanctions. • Forbid transit of products and technology via Russia • Strengthen export restrictions
Package 12	December 18, 2023	Target high-value sector of the Russian economy: • Ban on buying or transferring diamonds. • No Russia clause • Stronger cooperation with third countries • Enforcement of oil cap • Stricter restrictions on imports of products such as copper and aluminum wires • Ban on liquefied propane imports
Package 13	February 23, 2024	• Extra measures on 106 persons and 88 companies, as well as entities located in third countries. • Stronger measures on drones and export of goods that can improve Russian industrial capabilities

Table 16. Summary of the EU's 11 sanction packages against Russia. Source: European Council, 2024.

Overall, the sanctions set to date by the European Union to Russia include [41]:

- Asset freezes (€21.5 billion) and travel bans on nearly 1,800 individuals and companies, including Vladimir Putin.
- Blocking access to Russia's Central Bank reserves (€300 billion).
- Banning transactions with certain Russian state-owned enterprises.
- Isolating 10 major Russian banks, including Sberbank, from SWIFT.
- Prohibiting exports of dual-use goods, arms, military vehicles, and luxury items.
- Closing EU airspace, seaports, and roads to Russian transport.
- Suspending Russian state-owned channels broadcasts.
- Banning imports of Russian coal, crude oil, and petroleum products with some exceptions.
- Imposing a price cap on Russian oil sold to third countries and banning related transport services.
- Prohibiting exports and investments in the Russian energy and mining sectors.
- Restricting Russian nationals from holding positions in EU critical infrastructure.
- Introducing measures to prevent sanctions circumvention by third parties.

In the United States, sanctions are imposed after the U.S. President issues an executive order, declaring a national emergency and thus obtaining special competencies to regulate trade with a nation that has become a threat.

Similarly to the EU, US sanctions against Russia due to the Ukraine-Russia conflict were first issued in March 2014. Starting at this date, President Barack Obama issued 4 Executive Orders in response to the illegal annexation of Crimea and Sevastopol. Table 17 depicts details about each of these orders, which collectively affected 480 companies, 253 persons, 7 vessels, and 3 aircraft.

Executive order (EO)	***Date of sanctions***	***Purpose***
EO 13660	March 2014	Targets those responsible for undermining Ukraine's democracy
EO 13661	March 2014	Targets Russian officials operating in the arms sector
EO 13662	March 2014	Targets those operating in Russia's financial, energy, and defense sectors
EO 13685	December 2014	Prohibits U.S. business in occupied Crimea

Table 17. Executive Orders issued by President Barack Obama in 2014. Source: Congressional Research Service, 2022.

According to Moret [42], "*The US' sanctions against Russia have been renewed and broadened in various rounds since their inception in March 2014*". President Obama extended the

[41] Caprile, 2023.
[42] Moret, 2017.

measures until March 2018, and further administrations (Trump and Biden), have continued this policy and added more restrictions, specially targeted to Russia due to malicious cyber activities (Table 18). A critical target of these sanctions is the Internet Research Agency (IRA), which is a Russian company that engages in online influence operations.

Executive order (EO)	*Date of sanctions*	*Purpose*
EO 13757	December 2016	Targets those who aim to interfere with the election process
EO 13848	September 2018	Targets those that have engaged in foreign interference of a U.S. election
EO 13849	September 2018	Expands the scope of previous sanctions
EO 14024	April 2021	Targets those engaged in malicious cyber activities on behalf of the Russian government

Table 18. Executive Orders issued against malicious cyber activities. Source: Congressional Research Service, 2022.

Moreover, further sanctions were imposed following of the two recent cases of alleged poisoning linked to Russia. In contrast to the previous cases, these sanctions were not enacted via executive orders but under a 1991 Act. The first incident involved a former Russian intelligence officer, Sergei Skripal, who was allegedly poisoned in March 2018 in the United Kingdom. The second one took place in August 2020, when the Russian opposition leader, Alexei Navalny was also allegedly poisoned. In 1991, the US Congress passed the Chemical and Biological Weapons Control and Warfare Elimination Act. This Act authorized to sanction any country that used chemical weapons, thereby enabling the US Government to sanction Russia for these poisonings. Nine individuals and five companies were sanctioned because of the two cases.

Between 2018 and 2022, several executive orders were passed to counteract Russian presence abroad. Overall, these orders affected 23 companies, 17 persons, and 7 vessels[43]. These executive orders mainly aimed at three targets:

- Syrian Civil War: sanctions against a Russian state-owned enterprise for supplying weapons to the Syrian governments.
- North Korea: sanctions against Russia for trading with North Korea and providing supplies for its WMD program, against UN directives.
- Venezuela: sanctions against a state-owned company and two Russian tankers for assisting the Venezuelan oil sector.

[43] Congressional Research Service, 2022.

Executive order (EO)	*Date of sanctions*	*Purpose*
EO 13582	January 2018, November 2018, September 2019	Targets those who provide material support to the government of Syria
EO 13850	March 2019, March 2020, January 2021	Targets financial institutions providing support to the government of Venezuela
EO 13810	August 2018, September 2018	Targets those who engage in significant transactions with North Korea
EO 13382	June 2019, January 2022	Targets those who contribute to the proliferation of weapons of mass destruction
EO 13722	November 2020	Targets those who trade raw materials or software with the government of North Korea

Table 19. Executive Orders issued to counteract Russian influence abroad. Source: Congressional Research Service, 2022.

Finally, the Russian invasion of Ukraine was a catalyst for more sanctions from the United States. Issued in February 2022, EO14024 "*targets Russia's major financial institutions and their subsidiaries (83 entities in total). Included in this list are the country's two largest banks, Sberbank and VTB Bank. Together, they hold more than half of all Russian banking assets*"[44]. This measure froze the US assets of these companies and banned any American person from dealing with them. Moreover, it imposed new debt and equity restrictions on 13 public and private companies critical to the Russian economy.

Also in February 2022, and similarly to the EU, the United States sanctioned Vladimir Putin and Minister of Foreign Affairs Sergei Lavrov and blocked transactions with the Russian Central Bank [45]. Following sanctions targeted Russian elites and their relatives in March 2022, as well as imposing bans on Russian energy sources (oil, gas, and others). It is in this month that the leader of Belarus is included in the sanctions connected to human rights violations. Moreover, the United States aligns with the EU in the sanctioning of the Russian Duma, as well as the technology sector and its efforts to bypass sanctions.

In 2023, US sanctions against Russia strengthened. They targeted more than 200 additional persons and companies in Russia and in other countries in the world that had ties with Russia. Moreover, they sanctioned 11 more banks[45]. In April they unveiled new measures that sanctioned financial agents helping Russian billionaires bypass sanctions, for instance, the International Investment Bank (IIB). Throughout this year multiple sanctions were imposed and extended, targeting, among others: Russian-based lenders, Russian officials, high-technology companies, mining companies, investors, military-linked elites, energy production players, third-country networks facilitating sanction evasion, etc.

February 2024 saw 500 new sanctions against Russia as a consequence of the death of the Russian opposition leader Alexei Navalny. Targets included the National Payment Card System, Russian-based banks, and other players in the financial and defense sectors. On April 2, 2024, VTB was removed from the US sanctions list, and the Chicago Mercantile Exchange blocked the trade of precious metals produced by Russia. Finally, on April 30, 2024, the US Senate passed a bill prohibiting the imports of Russian uranium[45]. In May, Sberbank was removed from the sanctions list, given its sale, restructuring, and rebranding, and 300 more

[44] U.S. Department of Treasury, 2022.
[45] S&P, 2024.

entities were added to the list for various reasons: engaging in Russia's plans for future energy supply, metals and mining exports, chemical, and biological weapons, aiding billionaires to circumvent sanctions. In June 2024 the scope of industrial-based companies is widened again, including Sberbank and VTB, which means that any company engaging with these companies will receive sanctions.

5.2. Data

The first step in the use of Game Rasputin to study the case of US and EU sanctions against Russia is data collection. In this section, we will discuss the sources and characteristics of the data used to give value to the variables of the model formalized in the previous section. Table 20 represents a summary of the Game Rasputin's variables, with their upper and lower limits, units, and associated metrics.

Variable	Description	Values	Units	Metric
Country 1	Sanctioning country			EU
Country 2	Sanctioning country			United States
Country 3	Target country			Russia
Country 4	Country that benefits from trading with country 3 when sanctions take place			China
Country 5	Country that benefits from trading with country 3 when sanctions take place			Turkey
X	Activity pursued by target country	0 or 1	-	
B	Benefit that country 4 gets from increased trade with country 3	between 0 and 1	$	Average of trade with to Russia in years 2019-2021 - average of total trade with Russia in years 2015-2018
θ	Value country 3 gives to policy	≥0	%	Percentage from 0 to 100
θ_{max}	Maximum value a country can give to policy X	≥0	%	
$1-\delta$	Interest discount rate	≥0	%	Interest rate for each country
$P(\theta)$	Country 1 and 2's cumulative beliefs about the type of country 3	between 0 and 1	-	
$p(\theta)$	Associated density	between 0 and 1	-	
c_i	Cost for country 3 to lose trade with country i=1,2	≥0	$	Loss of trade with USA and EU
m_i	Price country i pays when sanctions are active	≥0	$	Difference between $U_{T,i}$ and $U_{N,i}$ + Reputation Cost
L_i	Cost for country i that X=1	≥0	$	Market volatility
$U_{T,i}$	Utility of country i when trading with country 3	≥0	$	Trade with Russia without sanctions
$U_{N,i}$	Utility of country i when not trading with country 3	≥0	$	Trade with Russia with sanctions
$\Phi(t)$	Type of nation (θ) that complies at time t	≥0	$	
$t_3(\theta)$	Time when country 3 stops sanctions	≥0	days	
$t_i(\theta)$	Time when country i stops sanctions	≥0	days	
$s_i(t)$	Probability that country i stops sanctioning at time t	between 0 and 1	-	

Table 20. Summary of all Game Rasputin's variables and associated metrics. Source: self-elaboration, 2024.

5.2.1. Data Sources and Transformations

We use multiple data sources to build a panel dataset, composed of annual observations from 2007-2022 of the different variables. Using data from this time period enables us to observe the evolution of these variables through what we consider three different stages of sanctions:

- **Stage 1**: from 2007 until 2014. This phase encompasses the years prior to the Russian occupation of Crimea and Sevastopol, where sanctions were still not enforced on Russia. As a result, this corresponds in the model to a situation of no sanctions by countries 1 and 2 *(NS, NS)*, and $X = 0$.
- **Stage 2:** from 2015 until the end of 2021. In this stage, sanctions are active because of the occupation of Crimea and Sevastopol. In the model, this corresponds to a situation of sanctions imposed by countries 1 and 2 *(S, S)*, and $X = 1$.
- **Stage 3**: the year 2022 and onwards. Russia has invaded Ukraine, and with this, the sanctions imposed in stage 2 have been strengthened. In the model, it corresponds to the same situation as in phase 2 (*S, S)*, and $X = 1$), but the numeric value of the variables changes. Due to the time proximity of the events, we only have data available for the year 2022, so we understand the limitation this may pose to the analysis of this stage.

Bilateral Trade

We have extracted data regarding country trade flows from 2000 until 2022 using BACI, which is the International Trade Database at the Product-Level [46]. BACI provides data on bilateral trade flows for 200 countries at the product level (5000 products).

To obtain the exact variables that we wanted, we had to clean and transform the data from the BACI database. To do so, we first eliminated the trade flows that did not involve any country that was not the USA, EU, Russia, China, or Turkey. Then we added all the trade flows from the United States, China, Russia, and Turkey to foreign countries, thereby creating variables for total trade for these countries. For the European Union and given that we had data at the country level, we had to add all the trade flows from each EU country to countries outside of the EU to obtain the total trade of the EU. After this, we adjusted the variable for inflation, with the objective of obtaining the real value of trade evolution. We used inflation data from the World Bank[47]

Similarly, we computed the value of the trade of each of these countries with Russia, with the goal of analyzing its evolution through the different stages described above.

With this data, we will be able to give value to multiple variables of Game Rasputin, including:

[46] Gaulier and Zignago, 2010.
[47] World Bank, 2022.

- Utility of country *i=1,2* when trading with country 3: $U_{T,i}$
- Utility of country *i=1,2* when not trading with country 3: $U_{N,i}$
- Price country *i=1,2* pays when sanctions are active: m_i

Market Volatility

We have extracted the annual market volatility in USD from the principal US and EU market indices for the period 2000-2022. For the volatility of the S&P, we have used data of the daily price performance of this index, obtained from Investing [48], while for the Eurostoxx50, we have retrieved the daily price data from Refinitiv [49].

The data obtained from both providers involved the price performance of the two indices. To transform this data into a volatility metric, we had to calculate the daily percentage return for each index, using the formula:

$$Daily\ return = \frac{Price_{today}}{Price_{yesterday}} - 1 \quad (26)$$

Once we have the daily returns, we calculate the standard deviation of this variable for all the days in each year. This way we obtain the yearly volatility of the price of the index in percentage. The only remaining step is to multiply this percentage by the market cap of the region at the end of each year to obtain the figure for the volatility in currency units. This market cap has been retrieved from the World Bank[50]. For the Eurostoxx50, we have obtained the EUR/USD exchange rate from the European Central Bank [51] to transform the EUR volatility into USD, with the goal of comparing both metrics.

In terms of Game Rasputin, we will use the market volatility of the S&P and Eurostoxx50 as a proxy to describe the cost for countries *i=1, 2* that *X=1*: L_i. In other words, we will use the increase in the volatility of the markets to describe the cost for the EU and the United States that Russia invades Ukraine. Increased volatility reflects a situation where there is more uncertainty in the financial markets, which is detrimental for the economy of the affected countries.

Interest Rates

In the Game Rasputin, the interest rate is used to discount the per period payoffs to the present (δ). We have retrieved the countries interest rates from the years 2000-2022 for qualitative analysis purposes, although for the model we will use the 2022 interest rate as the present

[48] Investing.com, 2024.
[49] Refinitiv, 2024.
[50] World Bank, 2022.
[51] European Central Bank, 2024.

interest rate to discount the future expected payoffs.

The interest rates from the United States, Russia and China have been extracted from the World Bank Data, using data from the International Monetary Fund[52]. For the European Union, we have extracted data on the lending rate from the reported European Central Bank lending rates[53]. Finally, the Turkish lending rate has been obtained from the data provided by the Central Bank of Turkey[54].

5.2.2. Descriptive Statistics

In this section, we present a comprehensive statistical summary of the variables stated above. The variables are measured with their mean, median, standard deviation, minimum, and maximum values, giving insights into their distribution and variability.

Table 21 describes the total trade of the EU with foreign countries. When adjusted for inflation, the mean results significantly higher than the median, indicating a possible skewness in the data where a few high values might be inflating the average. Moreover, high standard deviation suggests considerable variability in trade values, a hypothesis that is validated by looking at the range: the minimum value is quite low, whereas the maximum is very high, pointing towards significant fluctuations in trade volumes over time.

Europe Total Trade Descriptive Statistics

	t	*v*	*inflation*	*AdjustmentFactor*	*RealValue*
count	23	23	23	23	23
mean	2011	1.852.322.684,27 USD	2,5%	2,20	4.395.846.635,75 USD
std	6,78	538.431.755,00 USD	1,7%	6,13	12.185.372.502,49 USD
min	2000	848.136.356,62 USD	-0,4%	-9,39	-15.342.981.841,76 USD
25%	2005,5	1.502.488.968,53 USD	1,6%	1,02	1.624.513.569,25 USD
50%	2011	2.026.382.660,19 USD	2,3%	1,39	2.190.199.429,56 USD
75%	2016,5	2.252.900.634,01 USD	3,2%	2,07	4.075.024.629,74 USD
max	2022	2.602.160.111,58 USD	8,0%	28,17	57.076.444.928,74 USD

Table 21. Europe Total Trade: Descriptive Statistics. Source: self-elaboration, 2024.

Table 22 depicts the behavior of trade flows from the European Union to Russia. We can observe a more symmetrical distribution than before, with a mean slightly higher than the median, suggesting a slight right skew. The standard deviation of $468 million indicates, similarly to the total EU trade, a high variability over time and strong fluctuations over the different years. This, combined with the wide range, indicates significant variations in trade

[52] World Bank, IMF, 2022.
[53] European Central Bank, 2022.
[54] Central Bank of Turkey, 2022.

volumes, potentially due to political and economic factors affecting EU-Russia trade relations.

EU to Russia: Descriptive Statistics

	t	*v*	*inflation*	*AdjustmentFactor*	*RealValue*
count	23	23	23	23	23
mean	2011	86.964.633,46 USD	2,5%	2,20	179.958.419,76 USD
std	6,78	38.044.716,53 USD	1,7%	6,13	468.944.959,63 USD
min	2000	20.123.294,10 USD	-0,4%	-9,39	-811.148.234,72 USD
25%	2005,5	60.095.105,09 USD	1,6%	1,02	65.453.133,94 USD
50%	2011	87.594.516,90 USD	2,3%	1,39	131.299.084,98 USD
75%	2016,5	109.020.711,79 USD	3,2%	2,07	210.660.963,28 USD
max	2022	145.934.777,53 USD	8,0%	28,17	2.093.022.673,75 USD

Table 22. EU to Russia Trade: Descriptive Statistics. Source: self-elaboration, 2024.

Table 23 showcases the data regarding American trade with the rest of the world. Similarly to the EU trade data, in this case, we see a median significantly lower than the mean, and a high standard deviation. All of these observations lead us to conclude that there might be a skewness to the right, where some years' high trade values inflate the mean. Additionally, the high standard deviation and wide range indicate strong fluctuations over time, resulting from policy changes toward trade.

United States Total Trade Descriptive Statistics

	t	*v*	*inflation*	*AdjustmentFactor*	*RealValue*
count	23	23	23	23	23
mean	2011	1.237.535.703,00 USD	2,5%	2,20	3.031.281.272,70 USD
std	6,78	341.811.128,49 USD	1,7%	6,13	8.401.823.405,36 USD
min	2000	706.904.713,92 USD	-0,4%	-9,39	-9.441.130.046,96 USD
25%	2005,5	946.263.957,42 USD	1,6%	1,02	1.049.105.837,08 USD
50%	2011	1.355.574.416,56 USD	2,3%	1,39	1.502.728.259,79 USD
75%	2016,5	1.470.716.357,24 USD	3,2%	2,07	2.664.407.950,24 USD
max	2022	1.953.002.503,30 USD	8,0%	28,17	39.762.207.449,15 USD

Table 23. United States Total Trade: Descriptive Statistics. Source: self-elaboration, 2024.

In Table 24 we can see the behavior of the trade flows from the United States to Russia. The average trade value is 6,875 million USD, while the median is slightly higher at 7,075 million USD. This suggests a relatively symmetrical distribution with a slight left skew, which drives down the value of the mean. Also, there is moderate variability in the figures, with a standard deviation of 3,319 million USD. Finally, the wide range indicates once again fluctuations in

the trade flows, as a result of geopolitical relations.

USA to Russia: Descriptive Statistics

	t	*v*	*inflation*	*AdjustmentFactor*	*RealValue*
count	23	23	23	23	23
mean	2011	6.875.161,61 USD	2,5%	2,20	18.171.334,02 USD
std	6,78	3.319.084,88 USD	1,7%	6,13	50.192.908,58 USD
min	2000	1.625.873,15 USD	-0,4%	-9,39	-52.511.336,31 USD
25%	2005,5	3.897.100,33 USD	1,6%	1,02	4.324.885,01 USD
50%	2011	7.074.537,72 USD	2,3%	1,39	9.357.298,29 USD
75%	2016,5	8.965.375,87 USD	3,2%	2,07	15.953.242,84 USD
max	2022	14.150.863,28 USD	8,0%	28,17	237.412.585,24 USD

Table 24. USA to Russia Trade: Descriptive Statistics. Source: self-elaboration, 2024.

In terms of the trade flows seen from the other side, Table 25 describes the trade flows from Russia. We can see that, in nominal terms, the mean and median of the trade flows are very similar, suggesting a very symmetrical distribution. However, in real terms, the mean is significantly higher than the median, which suggests a right skewness, with some high values that drive the mean up. The standard deviation is very high, as well as the range, suggesting that fluctuations in trade flows due to geopolitical reasons are not only unidirectional (country 1 and 2 to country 3), but also bidirectional.

Russia Total Trade Descriptive Statistics

	t	*v*	*inflation*	*AdjustmentFactor*	*RealValue*
count	23	23	23	23	23
mean	2011	333.283.290,29 USD	2,5%	2,20	752.598.472,23 USD
std	6,78	136.454.591,65 USD	1,7%	6,13	2.022.999.942,58 USD
min	2000	103.739.079,36 USD	-0,4%	-9,39	-2.721.553.941,27 USD
25%	2005,5	251.429.444,63 USD	1,6%	1,02	225.893.613,00 USD
50%	2011	333.716.551,97 USD	2,3%	1,39	395.776.121,28 USD
75%	2016,5	454.557.429,43 USD	3,2%	2,07	789.326.529,08 USD
max	2022	496.616.031,01 USD	8,0%	28,17	9.397.290.796,38 USD

Table 25. Russia Total Trade: Descriptive Statistics. Source: self-elaboration, 2024.

The case of China, described in Table 26 and Table 27 is slightly different from the others. For one, the mean is significantly higher than the others, suggesting that China is a country that relies heavily on trade. Similarly to others, there is a high standard deviation and a wide range, but in this case, we attribute these to major changes in the policy of the country, which is still figuring a trade strategy. The same logic applies to the trade with Russia. The statistics

suggest a high variability and right skewness, with a mean higher than the median. Nevertheless, we would have to see the evolution of the trade flows over time to see the reasoning behind these results. Overall, the wide range and high standard deviation hint at outliers or periods of unusual economic activity.

China Total Trade Descriptive Statistics

	t	*v*	*inflation*	*AdjustmentFactor*	*RealValue*
count	23	23	23	23	23
mean	2011	1.797.334.351,20 USD	2,5%	2,20	4.857.679.091,23 USD
std	6,78	953.476.263,45 USD	1,7%	6,13	13.969.143.941,85 USD
min	2000	331.715.946,67 USD	-0,4%	-9,39	-12.704.988.908,13 USD
25%	2005,5	1.015.265.986,80 USD	1,6%	1,02	901.782.488,66 USD
50%	2011	2.054.463.458,51 USD	2,3%	1,39	2.197.495.724,61 USD
75%	2016,5	2.431.181.144,20 USD	3,2%	2,07	4.376.471.411,61 USD
max	2022	3.609.471.597,61 USD	8,0%	28,17	66.567.355.635,46 USD

Table 26. China Total Trade: Descriptive Statistics. Source: self-elaboration, 2024.

China to Russia: Descriptive Statistics

	t	*v*	*inflation*	*AdjustmentFactor*	*RealValue*
count	23	23	23	23	23
mean	2011	33.619.507,89 USD	2,5%	2,20	81.726.672,92 USD
std	6,78	21.268.093,67 USD	1,7%	6,13	202.250.486,81 USD
min	2000	2.250.706,22 USD	-0,4%	-9,39	-184.470.072,85 USD
25%	2005,5	14.433.052,73 USD	1,6%	1,02	11.345.644,07 USD
50%	2011	35.396.522,98 USD	2,3%	1,39	46.640.175,11 USD
75%	2016,5	48.484.456,42 USD	3,2%	2,07	83.557.557,07 USD
max	2022	75.356.475,22 USD	8,0%	28,17	962.471.219,75 USD

Table 27. China to Russia Trade: Descriptive Statistics. Source: self-elaboration, 2024.

In the case of Turkey, the similar mean and median of the nominal values show a balanced distribution. In these values, the standard deviation is moderate. The increasing trend towards the maximum (262.30 million USD) reflects Turkey's growing global trade presence. For the values of trade towards Russia, a very high standard deviation and moderate range may indicate a recent shift in policies.

Turkey Total Trade Descriptive Statistics					
	t	***v***	***inflation***	***AdjustmentFactor***	***RealValue***
count	23	23	23	23	23
mean	2011	132.089.560,31 USD	2,5%	2,20	333.218.129,55 USD
std	6,78	64.029.324,84 USD	1,7%	6,13	944.761.884,33 USD
min	2000	28.874.369,56 USD	-0,4%	-9,39	-1.016.456.621,70 USD
25%	2005,5	81.158.043,36 USD	1,6%	1,02	80.986.893,92 USD
50%	2011	140.552.520,87 USD	2,3%	1,39	150.337.822,96 USD
75%	2016,5	173.089.902,89 USD	3,2%	2,07	314.462.804,62 USD
max	2022	262.300.452,97 USD	8,0%	28,17	4.463.730.320,60 USD

Table 28. Turkey Total Trade: Descriptive Statistics. Source: self-elaboration, 2024.

Turkey to Russia: Descriptive Statistics					
	t	***v***	***inflation***	***AdjustmentFactor***	***RealValue***
count	23	23	23	23	23
mean	2011	33.619.507,89 USD	2,5%	2,20	81.726.672,92 USD
std	6,78	21.268.093,67 USD	1,7%	6,13	202.250.486,81 USD
min	2000	2.250.706,22 USD	-0,4%	-9,39	-184.470.072,85 USD
25%	2005,5	14.433.052,73 USD	1,6%	1,02	11.345.644,07 USD
50%	2011	35.396.522,98 USD	2,3%	1,39	46.640.175,11 USD
75%	2016,5	48.484.456,42 USD	3,2%	2,07	83.557.557,07 USD
max	2022	75.356.475,22 USD	8,0%	28,17	962.471.219,75 USD

Table 29. Turkey to Russia Trade: Descriptive Statistics. Source: self-elaboration, 2024.

The data describing the evolution of both market indices gives us a picture of the typical market performance, as well as a highlight of potential outliers that reflect the indices' responsiveness to economic conditions, investor sentiment, and geopolitical events.

For instance, Table 30 depicts the descriptive statistics of the S&P. The mean volatility is 18%, lower than the Eurostoxx50, which has a mean of 21,6%, as showcased in Table 31. The range is also tighter than the European index. This suggests a relatively higher stability of this index compared to the European one, which could lead us to conclude that the cost for the United States of the Russian invasion of Ukraine is lower than the cost for the European Union.

S&P Price Evolution: Descriptive Statistics

	Year	*Volatility Percentage*	*Annualized Volatility*	*Closing Price*	*Volatility*
count	23	23	23	23	23
mean	2011	1.3%	18.0%	2.33E+13	4.06E+12
std	6.78	0.6%	8.3%	1.03E+13	2.80E+12
min	2000	0.0%	7.0%	1.11E+13	1.70E+12
25%	2005.5	1.0%	12.0%	1.54E+13	2.54E+12
50%	2011	1.0%	16.0%	1.96E+13	3.18E+12
75%	2016.5	1.5%	22.5%	2.89E+13	4.26E+12
max	2022	3.0%	41.0%	4.85E+13	1.41E+13

Table 30. S&P Price Evolution: Descriptive Statistics. Source: self-elaboration, 2024.

EuroStoxx50 Price Evolution: Descriptive Statistics

	Year	*Volatility Percentage*	*Annualized Volatility*	*Closing Price*	*Volatility*
count	23	23	23	23	23
mean	2011	1.5%	21.6%	6.77E+12	1.39E+12
std	6.78	0.6%	8.0%	1.54E+12	4.37E+11
min	2000	1.0%	10.0%	3.69E+12	6.94E+11
25%	2005.5	1.0%	15.0%	5.72E+12	1.22E+12
50%	2011	1.0%	22.0%	6.37E+12	1.33E+12
75%	2016.5	2.0%	27.0%	8.08E+12	1.62E+12
max	2022	3.0%	39.0%	1.05E+13	2.59E+12

Table 31. Eurostoxx50 Price Evolution: Descriptive Statistics. Source: self-elaboration, 2024.

To give a complete description of the variables of the Game Rasputin, it is key to represent their distribution to confirm the hypothesis stated above. Figure 11 shows the histograms reflecting the distribution of the trade of each region with Russia. Overall, these histograms provide insights into the economic interactions between these regions and Russia.

The European Union's histogram indicates higher and more stable trade values, with trade values spread relatively evenly across ranges.

The United States shows a more varied distribution, reflecting a dynamic trade relationship. The slight left skewness can be seen in the histogram, with more towards the higher values, which drive the mean up.

China's trade values indicate substantial and consistent volumes., indicating steady trade relationships with moderate volumes. The histogram of Turkey is extremely similar to the Chinese one, reflecting a similar behavior of these two countries toward trade with Russia.

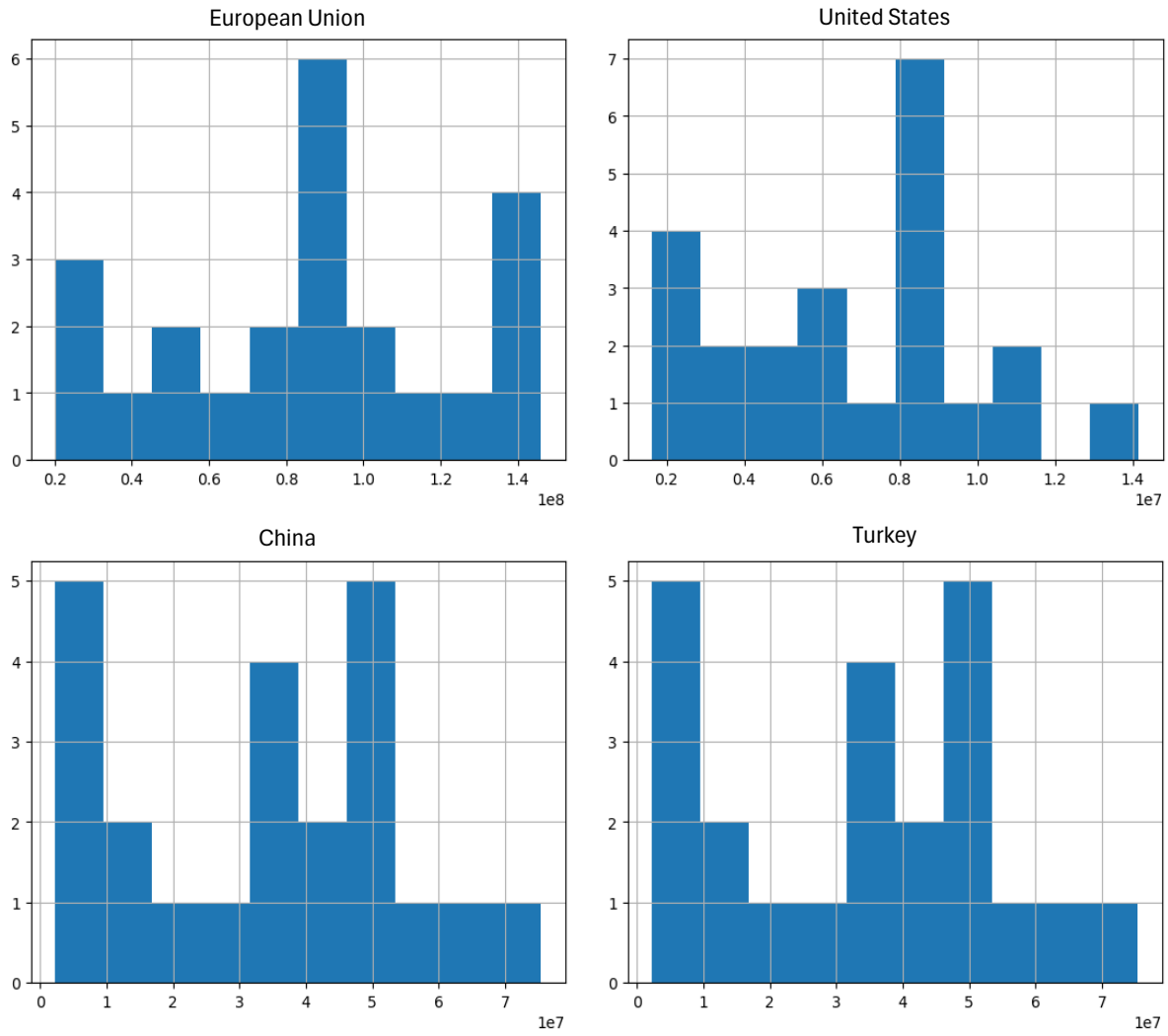

Figure 11. Trade to Russia. Histograms. Source: self-elaboration, 2024.

The total trade histograms in Figure 12 depict a slightly different picture. For one, China is the country with the highest trade figures, followed by the EU and the US. This suggests that China's bulk of trade is not dependent on Russia, but on other regions, which could potentially be the European Union and the United States. We still see a similar behavior in the distribution of China and Turkey, which could reflect that the latter is following a similar trade strategy as China, with smaller flows. All in all, the histograms reflect what was assumed in the descriptive statistics, which is a wide range and a relatively high fluctuation of trade flows in the observations, reflecting changes in policies potentially due to geopolitical issues.

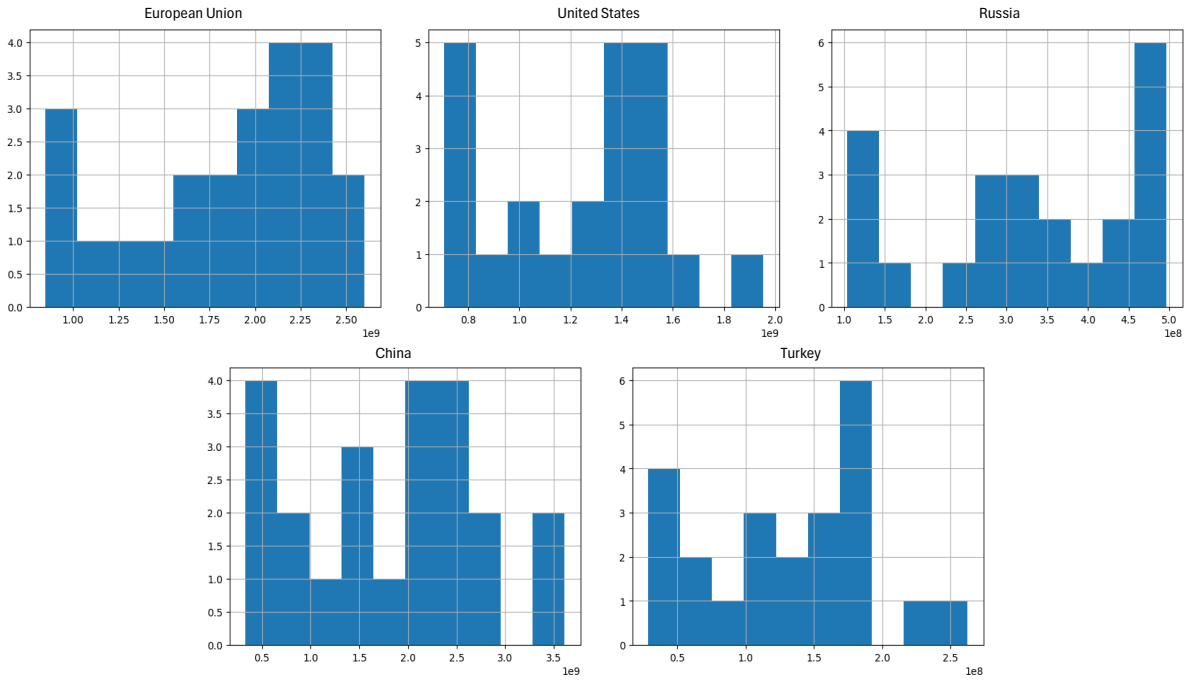

Figure 12. Total Trade. Histograms. Source: self-elaboration, 2024.

The distributions of the S&P500 and the Eurostoxx50 clearly confirm the hypotheses stated above: for one, the mean volatility of the S&P is much lower than the volatility of the Eurostoxx50. Moreover, the range of values is much lower in the American index, and the right skewness is also much more pronounced in this index, reflecting much less frequency of high volatility values.

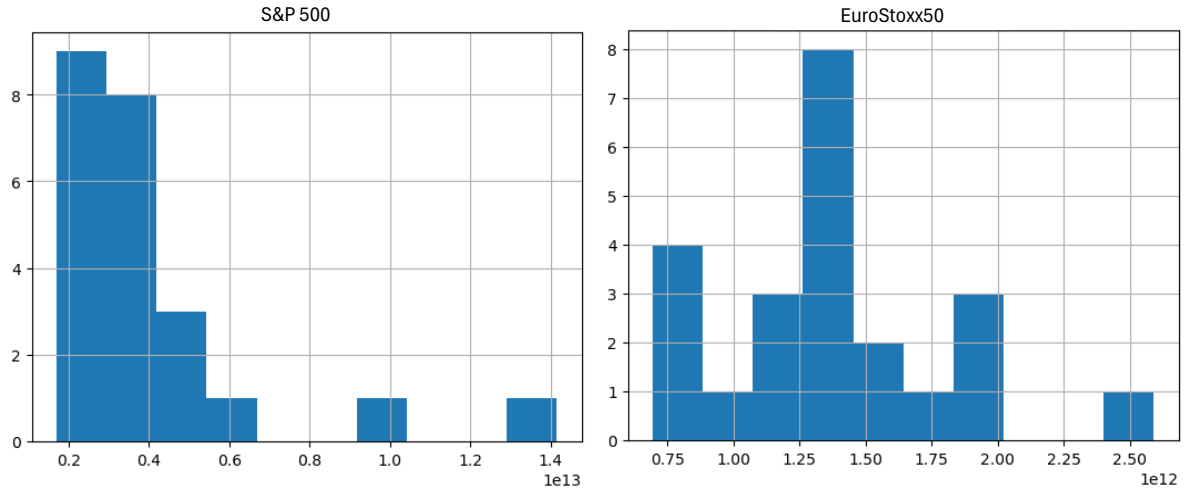

Figure 13. Market Indices Price Evolution. Histograms. Source: self-elaboration, 2024.

Overall, this comprehensive data analysis enables us to fully understand the behavior of the variables that we are going to use in the Game Rasputin, providing us with a stronger foundation and arguments when analyzing the results obtained.

5.3. Numerical Implementation

In this section, we are going to introduce numerical values to the variables of the Game Rasputin, as well as study the evolution of these variables over time and through different phases of sanctioning. By combining qualitative and quantitative approaches, we aim to provide a comprehensive study of the payoffs for each player during different sanction stages.

We will explore two scenarios: a base case focusing on the three-player game introduced in the previous chapter, and a multi-player case involving a fourth country.

As a reminder, we will divide the analysis focusing on the evolution of the variables through three stages:

- **Stage 1**: from 2007 until 2014. This phase encompasses the years prior to the Russian occupation of Crimea and Sevastopol, where sanctions were still not enforced on Russia. As a result, this corresponds in the game to a situation of no sanctions by countries 1 and 2 *(NS, NS)*, and $X = 0$.
- **Stage 2:** from 2015 until the end of 2021. In this stage, sanctions are active because of the occupation of Crimea and Sevastopol. In the Game Rasputin, this corresponds to a situation of sanctions imposed by countries 1 and 2 *(S, S)*, and $X = 1$.
- **Stage 3**: the year 2022 and onwards. Russia has invaded Ukraine, and with this, the sanctions imposed in stage 2 have been strengthened. In the model, it corresponds to the same situation as in phase 2 (*S, S)*, and $X = 1$), but the numeric value of the variables changes. Due to the time proximity of the events, we only have data available for the year 2022, so we understand the limitation this may pose to the analysis of this stage.

The goal of this section is to obtain the numerical payoff matrixes for each of the phases described above. To complete the payoff matrix, we need to provide values for the following variables:

- $U_{T,i}$: this is the utility that countries 1 and 2 obtain from trading with Russia. We will obtain the value of this variable from the average of the trade flows in phases 2 and 3.
- $U_{N,i}$: this is the utility that countries 1 and 2 obtain when not trading with Russia. The value of this variable is the average of the trade flows of each country in phase 1.
- L_i: this is the cost for countries 1 and 2 that country 3 pursues activity X. We will obtain this value from the average of market volatilities in phases 2 and 3.
- m_i: this is the cost for countries 1 and 2 when sanctions are enforced. We will obtain this value from the difference between the values of trade flows in phase 1 and the values in phases 2 and 3.

In this section, we will work with the normalized values of all of the variables of Game Rasputin, to be able to compare the figures more easily between countries and phases.

One of the first questions to arise is whether to use the total trade flows of each country or only the trade flows with Russia. To decide which metric to use we have computed the required values for each phase of each of the metrics, available in Table 32. In this table, we can see that the values of total trade in phases 1 and 2 don't follow the condition that $U_{T,i} > U_{N,i} \geq 0$, while the variables of trade with Russia generally follow this condition. As a result, we consider these metrics to be more representative of the variables of Game Rasputin and their expected values, so we will choose the metric of individual trade with Russia as the one to give values to the variables $U_{T,i}$ and $U_{N,i}$.

Metric	Phase 1: 2007-2014	Phase 2: 2015-2021	Phase 3: 2022
EU Total Trade	3.686.324.700,46 USD	4.419.484.360,35 USD	1.099.412.647,14 USD
USA Total Trade	2.356.027.704,00 USD	2.947.844.906,27 USD	825.143.557,64 USD
Russia Total Trade	749.433.946,70 USD	734.712.658,91 USD	205.325.887,34 USD
China Total Trade	3.423.330.656,53 USD	5.153.108.702,81 USD	1.525.001.749,99 USD
Turkey Total Trade	254.034.131,05 USD	358.096.875,78 USD	110.821.941,38 USD
EU Total Trade to Russia	219.447.647,41 USD	174.818.981,55 USD	23.286.333,09 USD
USA Total Trade to Russia	16.789.654,49 USD	16.372.163,52 USD	686.931,41 USD
China Total Trade to Russia	69.006.820,66 USD	91.063.018,65 USD	31.838.110,78 USD
Turkey Total Trade to Russia	10.146.853,67 USD	7.600.820,08 USD	3.903.788,54 USD
S&P Volatility	3.355.761.534.594,91 USD	5.674.975.680.801,69 USD	9.741.656.623.360,87 USD
Eurostoxx Volatility	1.580.215.544.181,12 USD	1.326.580.615.952,45 USD	1.886.697.396.096,82 USD

Table 32. Value of the metrics in each phase of sanctions. Source: self-elaboration, 2024.

Using the average and standard deviation from the table below, we normalize the values of the trade flows to get a picture of the relative importance of each value within their distribution:

Metric	Average	Standard Deviation
EU Total Trade	3,068,407,235.99 USD	1,424,098,671.65 USD
USA Total Trade	2,043,005,389.31 USD	894,409,481.54 USD
Russia Total Trade	563,157,497.65 USD	253,096,523.20 USD
China Total Trade	3,367,147,036.44 USD	1,481,701,154.00 USD
Turkey Total Trade	240,984,316.07 USD	101,370,431.42 USD
EU Total Trade to Russia	139,184,320.68 USD	83,953,110.33 USD
USA Total Trade to Russia	11,282,916.47 USD	7,494,431.23 USD
China Total Trade to Russia	63,969,316.70 USD	24,439,445.75 USD
Turkey Total Trade to Russia	7,217,154.10 USD	2,563,118.57 USD
S&P Volatility	6,257,464,612,919.16 USD	2,639,366,595,506.18 USD
Eurostoxx Volatility	1,597,831,185,410.13 USD	229,005,727,674.74 USD

Table 33. Mean and Average of Game Rasputin's variables. Source: self-elaboration, 2024.

Metric	Phase 1: 2007-2014	Phase 2: 2015-2021	Phase 3: 2022
EU Total Trade	0.434	0.949	-1.383
USA Total Trade	0.350	1.012	-1.362
Russia Total Trade	0.736	0.678	-1.414
China Total Trade	0.038	1.205	-1.243
Turkey Total Trade	0.129	1.155	-1.284
EU Total Trade to Russia	0.956	0.424	-1.381
USA Total Trade to Russia	0.735	0.679	-1.414
China Total Trade to Russia	0.206	1.109	-1.315
Turkey Total Trade to Russia	1.143	0.150	-1.293
S&P Volatility	-1.099	-0.221	1.320
Eurostoxx Volatility	-0.077	-1.184	1.261

Table 34. Normalized Values of the metrics in each phase of sanctions. Source: self-elaboration, 2024.

We consider it important to highlight that the information in Table 32 is not fully representative of the behavior of the variables depicted. If we look at the averages of total trade in different phases, it may look like trade increased in every region in Phase 2. Nevertheless, Figure 14 until Figure 16 clearly depict a decreasing trend in total trade after sanction episodes in countries 1, 2, and 3.

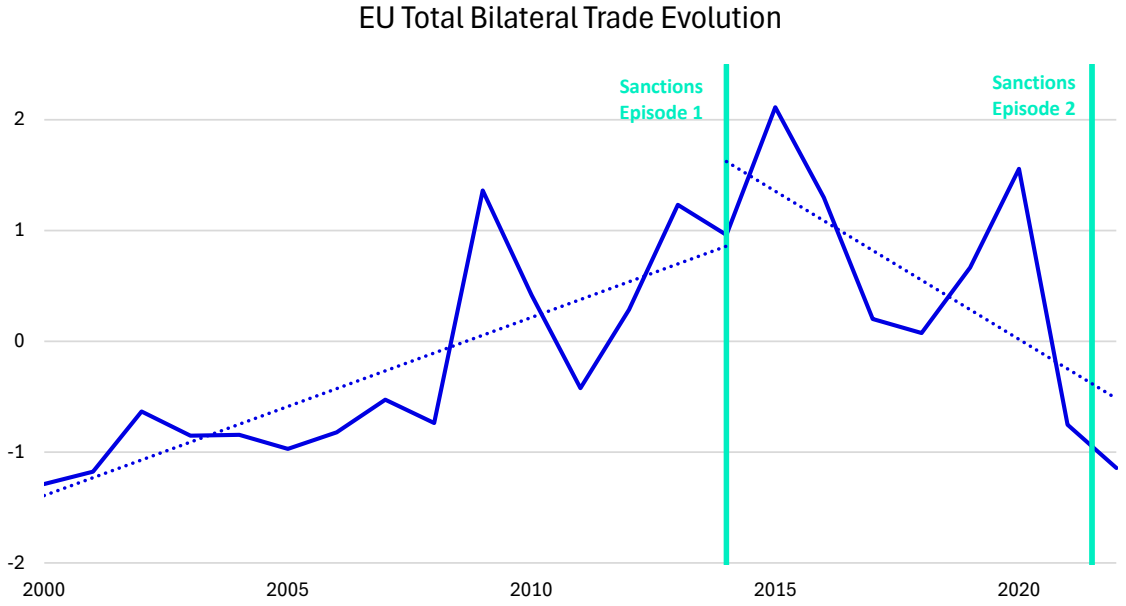

Figure 14. EU Total Bilateral Trade Evolution. Source: self-elaboration, 2024.

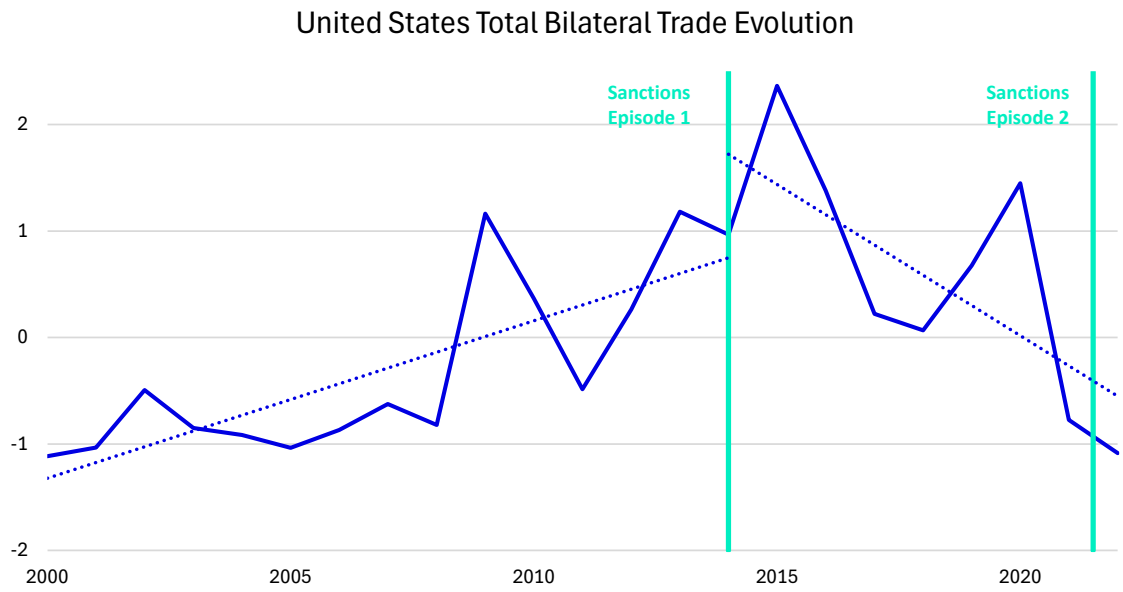

Figure 15. United States Total Bilateral Trade Evolution. Source: self-elaboration, 2024.

If we look at the trend in trade flows from Russia, they also show a sharp decrease. Therefore, we expect Russia to gain something from pursuing activity *X*, to compensate for the reduction in trade:

Hypothesis 1: *The benefit for the target country from pursuing the activity is greater than the cost of sanctions for this country.*

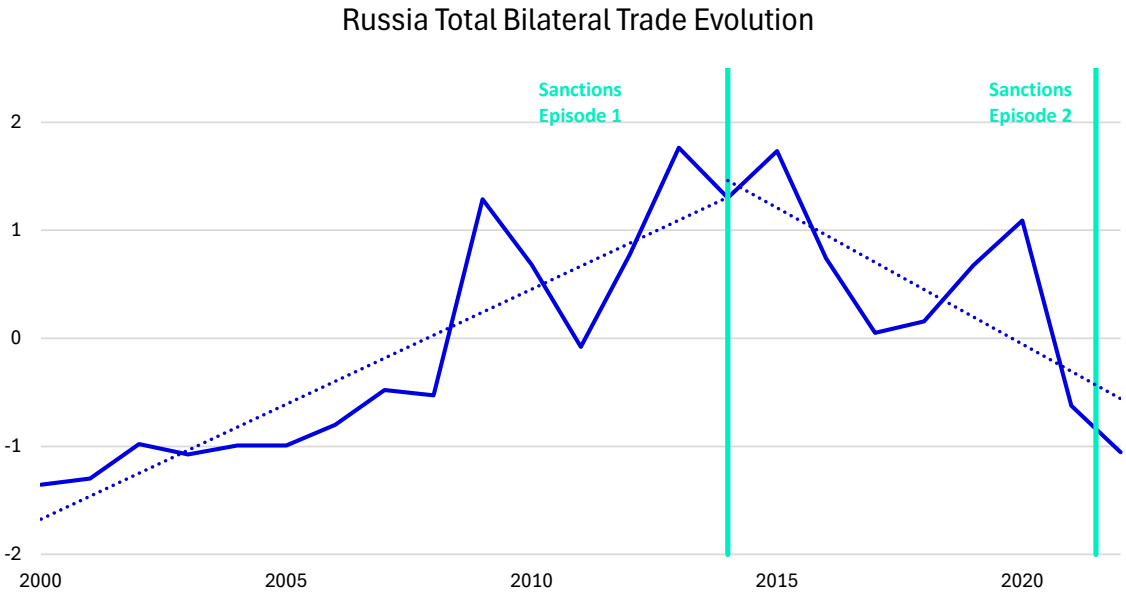

Figure 16. Russia Total Bilateral Trade Evolution. Source: self-elaboration, 2024.

This decrease in trade can be attributed to a shift in policies, driven by geopolitical tensions.

In the case of the EU and USA, the imposition of sanctions has reduced trade with one of their biggest trade partners. Nevertheless, the shift in the behavior of this variable is not only attributable to this, as total trade englobed trade with many other important players. For instance, the United States is undergoing an economic decoupling from China, which is also driving down their trade flows as these two countries are not exchanging as many products as in the past. The multitude of forces driving total trade can give inaccurate conclusions about the influence of sanctions. This is the reason why this variable has not been used to feed Game Rasputin.

Regarding the case of country 4, we have studied the trade flows of China and Turkey, as these two are the potential candidates to behave as country 4 is expected. Initially, our hypothesis was that in sanction episodes, their trade flows would increase. In Table 32, the averages in each phase seemed to confirm our assumption. However, in Figure 17 and Figure 18 we can see a clear downward trend in bilateral trade flows in each country after 2014.

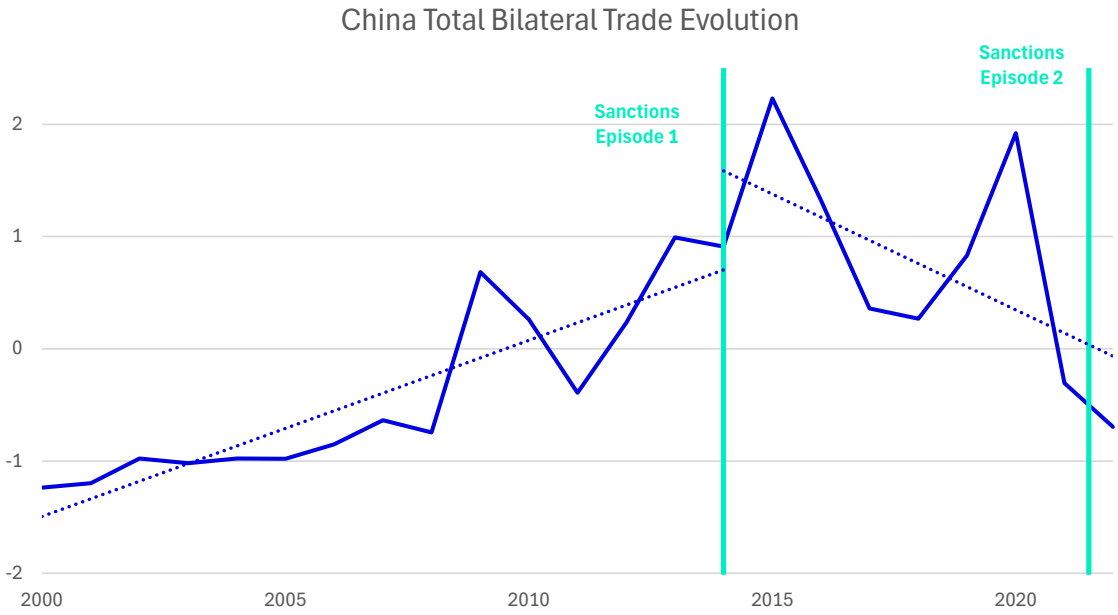

Figure 17. China Total Bilateral Trade Evolution. Source: self-elaboration, 2024.

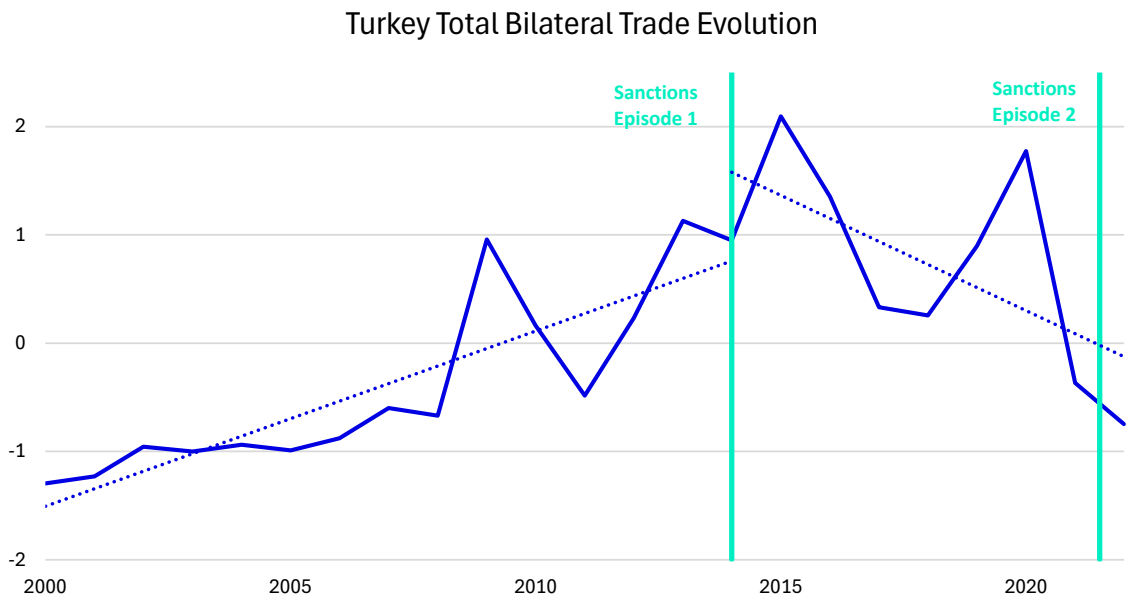

Figure 18. Turkey Total Bilateral Trade Evolution. Source: self-elaboration, 2024.

The situation is different when we analyze the trade with Russia. For countries 1 and 2 (EU and USA), the imposition of sanctions can be easily linked to a reduction in trade flows between the sanctioning country and the target country (Figure 19 and Figure 20). As a result, we expect these countries to suffer from a reduction in trade with sanction enforcement:

Hypothesis 2: *Sanctioning countries are affected negatively in periods when sanctions are active.*

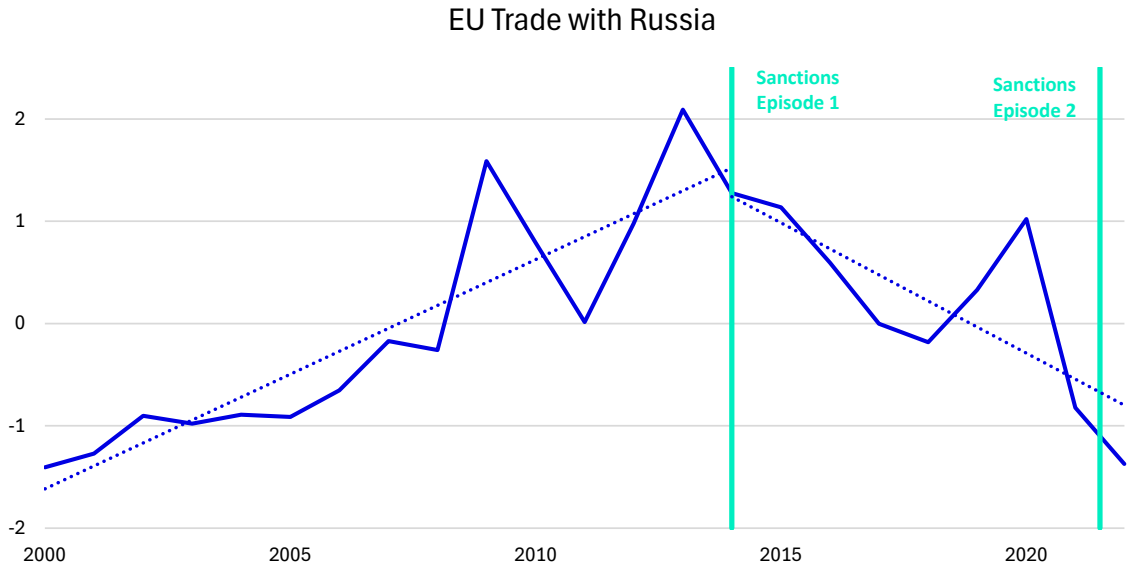

Figure 19. EU Trade with Russia. Source: self-elaboration, 2024.

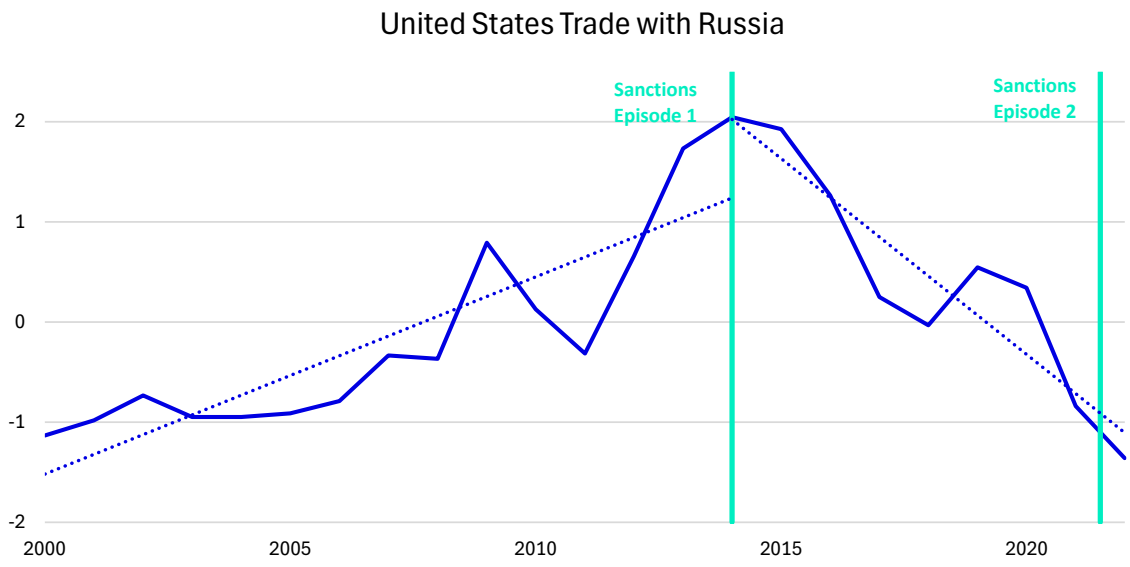

Figure 20. United States Trade with Russia. Source: self-elaboration, 2024.

In terms of the trade flows between China and Turkey with Russia, and contrary to the total flows depicted above, Figure 21 and Figure 22 reflect that, after a slight decrease in trade flows between these two countries and Russia following the imposition of sanctions, trade began to increase to reach its maximum around 2020/2021. With this, we build our second and third assumptions:

Hypothesis 3: *Third countries, separate from the sanctioning and the targeted nations, often derive benefits during periods of sanctions,*

Hypothesis 4: *Benefits for third countries appear in the medium term after the imposition of sanctions.*

A possible explanation for this could be that, after being banned from trading with the US and EU, Russia began to look outside to find new trading partners. China and Turkey were two new strong partners that provided this service to Russia, and after some years of adaptation and building the agreements and infrastructure, these players came into play to extend the game to five players.

These facts incline us to believe that trade with third countries will not only affect them but also the target country.

Hypothesis 5: *When third countries are in play, the payoff of the target country is affected.*

This fact raises the need to divide phase 2 into two sub-phases:

- Phase 2a: Country 4 still not considered a new player in the game, as its trade with Russia has not increased to counteract the decrease in trade with the EU and US. The time period of this subphase is 2015-2018.

- Phase 2b: the game is considered to have 4 players, as country 4 benefits from the decrease in trade between the USA, Europe, and Russia to trade more with Russia. The time period of this subphase is 2019-2021.

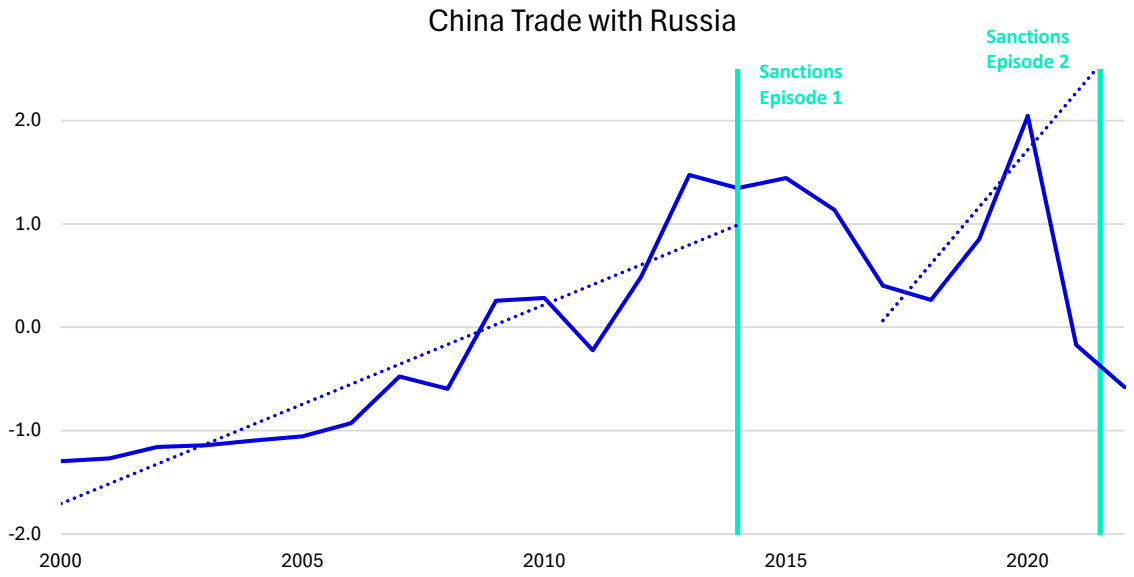

Figure 21. China Trade with Russia. Source: self-elaboration, 2024.

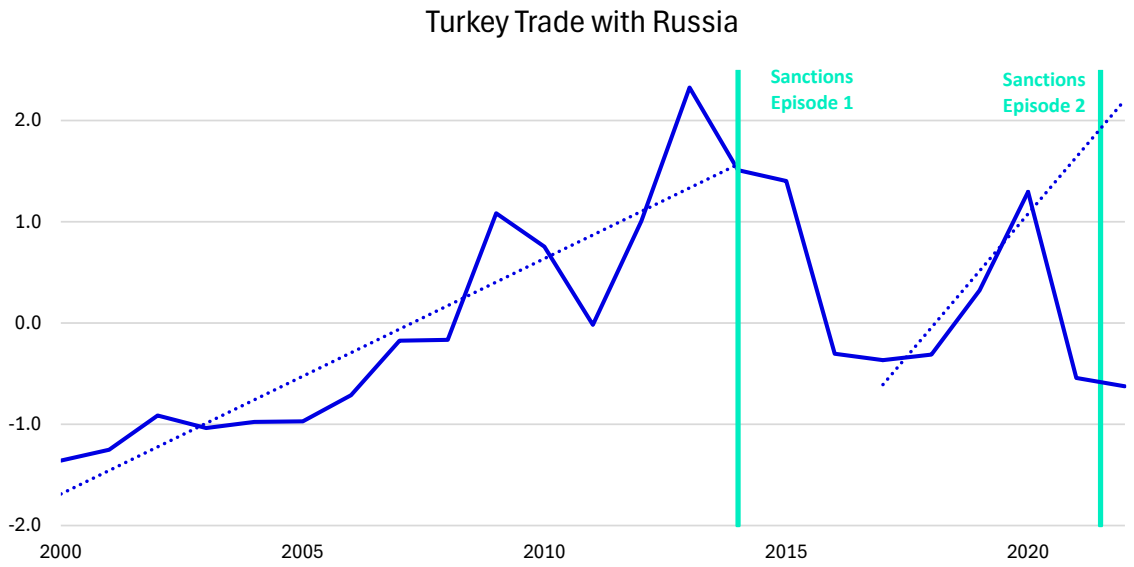

Figure 22. Turkey Trade with Russia. Source: self-elaboration, 2024.

As a result, the different trade flow values for each country in the different phases result in:

Metric	Phase 1: 2007-2014	Phase 2a: 2015-2018	Phase 2b: 2019-2021	Phase 3: 2022
EU Total Trade to Russia	219,447,647.41 USD	183,021,632.26 USD	163,882,113.93 USD	23,286,333.09 USD
USA Total Trade to Russia	16,789,654.49 USD	19,402,753.17 USD	12,331,377.32 USD	686,931.41 USD
China Total Trade to Russia	69,006,820.66 USD	89,345,690.59 USD	93,352,789.40 USD	31,838,110.78 USD
Turkey Total Trade to Russia	10,146,853.67 USD	7,121,655.48 USD	8,239,706.23 USD	3,903,788.54 USD

Table 35. Trade Flow with Russia in each Phase. Source: self-elaboration, 2024.

Using the average and standard deviation from the table below, we normalize the values of the trade flows to get a picture of the relative importance of each value within their distribution:

Metric	Average	Standard Deviation
EU Total Trade to Russia	147,409,431.67 USD	74,390,231.58 USD
USA Total Trade to Russia	12,302,679.10 USD	7,167,119.68 USD
China Total Trade to Russia	70,885,852.86 USD	24,360,756.20 USD
Turkey Total Trade to Russia	7,353,000.98 USD	2,266,188.77 USD

Table 36. Mean and Average of the Trade Flows to Russia. Source: self-elaboration, 2024.

Metric	Phase 1: 2007-2014	Phase 2a: 2015-2018	Phase 2b: 2019-2021	Phase 3: 2022
EU Total Trade to Russia	0.968	0.479	0.221	-1.669
USA Total Trade to Russia	0.626	0.991	0.004	-1.621
China Total Trade to Russia	-0.077	0.758	0.922	-1.603
Turkey Total Trade to Russia	1.233	-0.102	0.391	-1.522

Table 37. Normalized Trade Flow with Russia in each Phase. Source: self-elaboration, 2024.

With all of this information, we can infer the normalized values of each of the variables of Game Rasputin that reflect the utility of each country from trading with Russia in each phase. We have taken China as country 4, and we will further apply the results obtained to Turkey, to test the robustness of the model results:

Variable	Phase 1: 2007-2014	Phase 2a: 2015-2018	Phase 2b: 2019-2021	Phase 3: 2022
$U_{T,1}$	0.968	-	-	-
$U_{T,2}$	0.626	-	-	-
$U_{N,1}$	-	0.479	0.221	-1.669
$U_{N,2}$	-	0.991	0.004	-1.621
B_4	-	0.835	0.999	-1.526

Table 38. Numerical Value of Utility Variables in each Phase. Source: self-elaboration, 2024.

For the values of $U_{T,i}$ and $U_{N,i}$ we have used the values of each trade flow for each phase. For the values of the benefit of country 4 from the additional trade with country 3, we have calculated the difference between the trade flows with the additional exchanges with country 3 and the trade flows without them. We have used the flows of phase 1 as a proxy of the trade flows that country 4 would have with Russia without these additional exchanges, as we

considered that given the time proximity and similarity of the situations, phase 1 serves as a good counterfactual.

The next variable of Game Rasputin that we are going to give value to is L_i. This variable represents the cost for countries 1 and 2 that country 3 pursues the policy for which it is being sanctioned. We have considered market volatility as an accurate proxy of the cost that the United States and European Union are paying for the Russian invasion of Ukraine. With the new phase distribution, the value of these volatilities results in:

Metric	Phase 1: 2007-2014	Phase 2a: 2015-2017	Phase 2b: 2018-2021	Phase 3: 2022
S&P Volatility	3.355.761.534.594,91 USD	3.204.803.708.370,09 USD	7.527.604.660.125,39 USD	9.741.656.623.360,87 USD
Eurostoxx Volatility	1.580.215.544.181,12 USD	1.226.618.078.865,21 USD	1.401.552.518.767,87 USD	1.886.697.396.096,82 USD

Table 39. Market Volatilities in each Phase. Source: self-elaboration, 2024.

Similarly to the trade flows, we have normalized the values of the volatilities using the mean and standard deviations depicted in the table below:

Metric	Average	Standard Deviation
S&P Volatility	5,957,456,631,612.81 USD	2,789,778,212,630.52 USD
Eurostoxx Volatility	1,523,770,884,477.76 USD	243,997,321,319.93 USD

Table 40. Mean and Average of the Market Volatilities. Source: self-elaboration, 2024.

Metric	Phase 1: 2007-2014	Phase 2a: 2015-2017	Phase 2b: 2018-2021	Phase 3: 2022
S&P Volatility	-0.933	-0.987	0.563	1.356
Eurostoxx Volatility	0.231	-1.218	-0.501	1.487

Table 41. Normalized Market Volatilities in each Phase. Source: self-elaboration, 2024.

We believe that, as sanctions are costly for the sanctioning country, these countries would only consider implementing them if they were damaged by country 3 pursuing activity *X*. As a result:

Hypothesis 6. *Market volatility increases in sanction periods and increases even more when third players enter the game.*

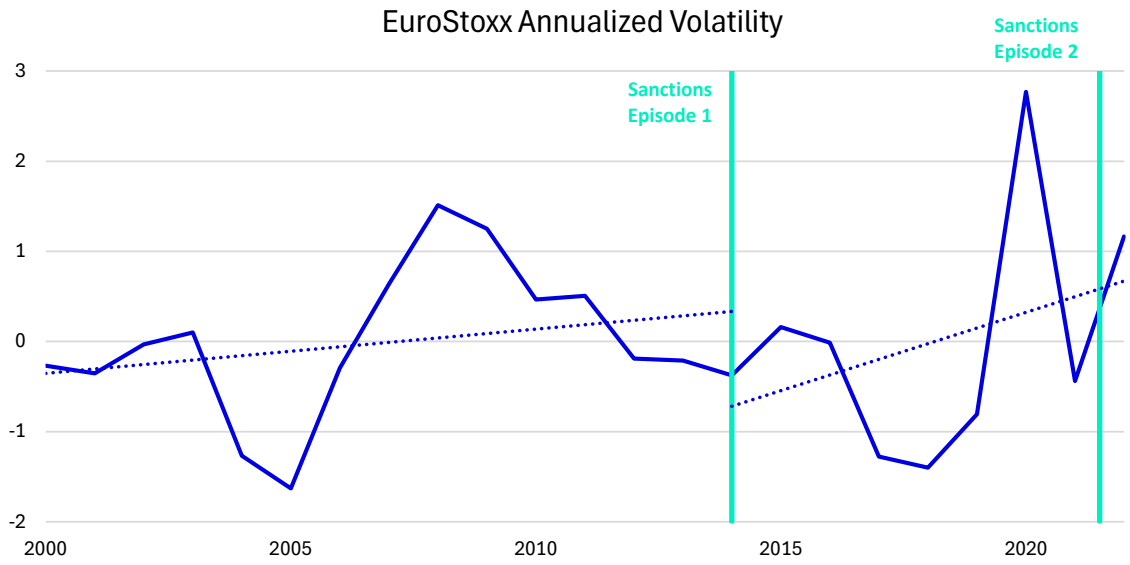

Figure 23. Eurostoxx50 Volatility Evolution. Source: self-elaboration, 2024

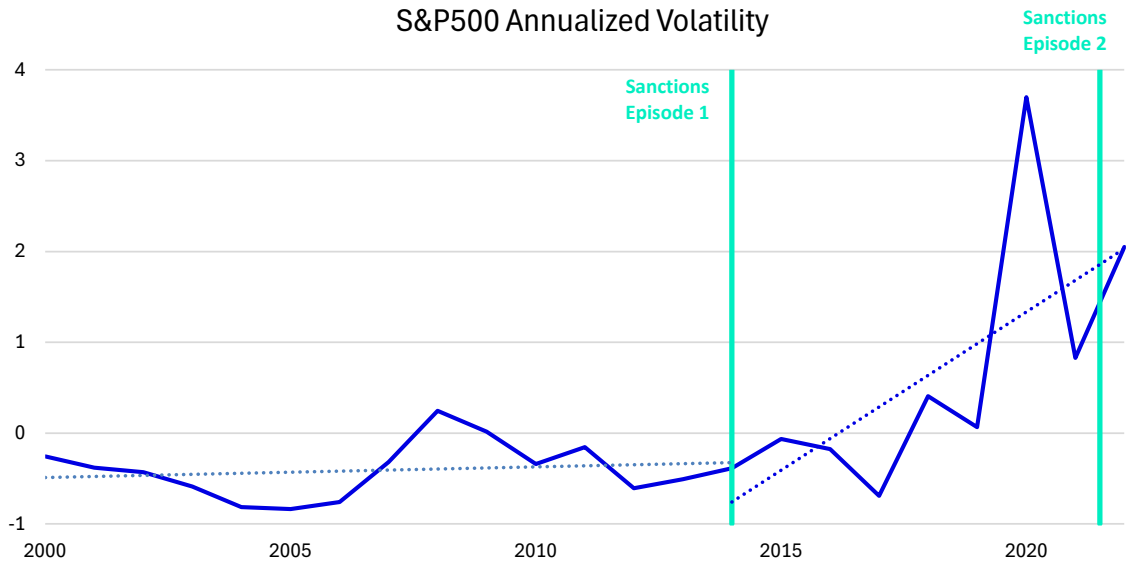

Figure 24. S&P500 Volatility Evolution. Source: self-elaboration, 2024.

As a result, we can infer the normalized value of L_i in each phase:

Variable	Phase 1: 2007-2014	Phase 2a: 2015-2018	Phase 2b: 2019-2021	Phase 3: 2022
L_1	-	-0.987	0.563	1.356
L_2	-	-1.218	-0.501	1.487

Table 42. Normalized Value of Cost of Activity X in each Phase. Source: self-elaboration, 2024.

The third variable to analyze from Game Rasputin is the cost of sanctions for countries 1 and 2. In periods where sanctions are enforced, the sanctioning countries see a decrease in trade with the target country, which severely affects their income. However, this is not the only cost

associated with sanctions. As most of the trade in the world is regulated under the rules of the WTO, "*threatening extraterritorial trade sanctions undermines the multilateral effort to resolve trade conflicts in a rules-based system, in which each country cannot impose measures that impact other countries without approval of the WTO"* [55].

This fact reflects the importance of reputation cost in the eyes of the government that imposes those sanctions. For instance, if we look at the case of sanctions in Iran, President Obama and Biden adhered to a multilateral approach, while President Trump did not. As a result, the perceived reputation of each president is depicted in Figure 25:

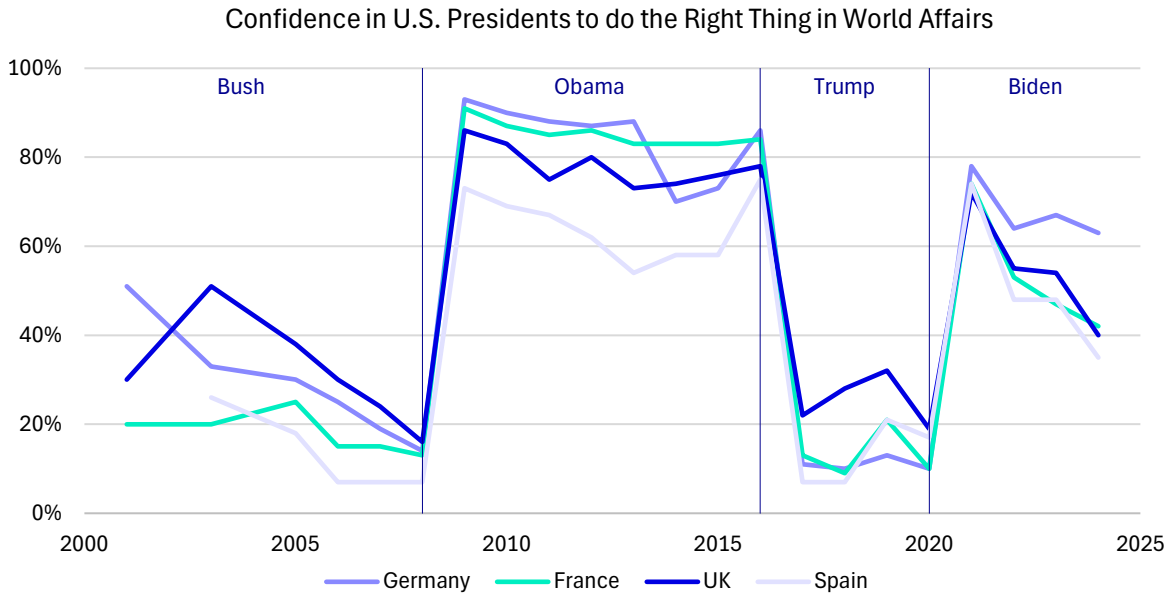

Figure 25. Confidence in U.S. Presidents to do the Right Thing. Source: Pew Research Center, 2021.

Janeba claims that "*President Trump did not care much about his international reputation, as expressed in his "America first" policy, while Obama and Biden do care*"[56]. As a result, the perceived reputational cost would be much larger for the two democrats than the republican. Moreover, in the case of the European Union: "*due to its relative military weakness, the EU's approach to international affairs has always been a multilateral one. Reputation cost would be high for European countries if they imposed extraterritorial sanctions*"[56].

This justifies the fact that each administration will impose measures not only based on its economic cost but also with the goal of minimizing its reputational cost. The high reputation of Biden and Obama makes their reputational cost insignificant, and the fact that Trump did not care about his reputation also minimized the cost. As a result, this reputational cost, although important, is insignificant when giving value to our variable m_i in Game Rasputin,

[55] Janeba, 2022.
[56] Janeba, 2022.

which results in:

Variable	Phase 1: 2007-2014	Phase 2a: 2015-2018	Phase 2b: 2019-2021	Phase 3: 2022
m_1	-	0.490	0.747	2.637
m_2	-	0.000	0.622	2.247

Table 43. Normalized Value of Cost of Sanctions for Countries 1 and 2 in each Phase. Source: self-elaboration, 2024.

We obtain the value of m_i by calculating the difference between the trade of each country with Russia in Phase 1 (no sanctions) and the trade of each country with Russia in each of the other phases. In the case of country 2 (United States) in Phase 2a, we can see that the cost is 0. This is because in the first couple of years after the sanctions, the United States still had high amounts of bilateral trade with Russia, although the trend was dramatically decreasing, as depicted in Figure 20. This highlights a potential inaccuracy in the data selection for this particular variable in this specific phase, an issue that we will address further as a recommendation for future studies.

Finally, the last variable to complete the payoff matrix is c_i, which is the cost for country 3 that sanctions are enforced. In this case, the cost for Russia that the EU imposes sanctions is the loss of trade with this region. This loss of trade is the same figure as the one for m_i. the same applies to the United States. As a result, the normalized values for c_i are:

Variable	Phase 1: 2007-2014	Phase 2a: 2015-2018	Phase 2b: 2019-2021	Phase 3: 2022
c_1	-	0.490	0.747	2.637
c_2	-	0.000	0.622	2.247

Table 44. Normalized Value of Cost of Sanctions for Country 3 in each Phase. Source: self-elaboration, 2024.

With all of this, we can obtain the payoff matrix for each phase. Let us remind that, for each phase we will provide a payoff matrix that will depend on the value θ that Russia gives to pursuing activity X (invasion of Ukraine). As formulated in Game Rasputin, this is private information and we will keep it private, giving value to the variable for each possible value of this parameter.

As a result, we obtain the following payoff matrixes for each case:

a) Case $C = c_1+c_2 \leq \theta$: regardless of the sanctions, country 3 will choose $X=1$. In this situation, there exists 1 Nash equilibrium, where countries 1 and 2 do not sanction country 3, given that it will not change its behavior. However, this situation does not happen in real life, as ever since Russia pursued $X=1$ countries 1 and 2 sanctioned. Depending on the value of the payoffs according to the level of sanctions and number of players, we get different payoff matrixes (Phase 2a, 2b and 3)

		Country 1	
	θ > 0,490	***NS***	***S***
Country 2	NS	1.955 1.844 θ	0.976 1.844 θ - 0,490
	S	1.955 2.208 θ	0.976 2.208 θ - 0,490

NOTE: Utilities are displayed as follows $U_{country\ 1}$ / $U_{country\ 2}$ / $U_{country\ 3}$

Table 45. Payoff Matrix Case (a) Phase 2a. Source: self-elaboration, 2024.

In the case of Phase 2b, we have included the payoffs for Countries 4 and 5. Given the case that one of the sanctioning countries were to sanction, we distributed the benefit to countries 4 and 5 proportionately to the trade loss from country 3 to countries 1 and 2.

		Country 1	
	θ > 1,369	***NS***	***S***
Country 2	NS	0.406 1.127 θ 0.000	-1.088 1.127 θ - 0,202 0.545
	S	0.406 -0.117 θ - 0,168 -0.382	-1.088 -0.117 θ - 0,370 -0.842

NOTE: Utilities are displayed as follows $U_{country\ 1}$ / $U_{country\ 2}$ / $U_{country\ 3}$ / $U_{country\ 4}$

Table 46. Payoff Matrix Case (a) Phase 2b. Source: self-elaboration, 2024.

		Country 1	
	θ > 4,884	***NS***	***S***
Country 2	NS	-0.388 -0.861 θ	-5.662 -0.861 θ - 2.637
	S	-0.388 -5.355 θ - 2.247	-5.662 -5.355 θ - 4.884

es are displayed as follows $U_{country\ 1}$ / $U_{country\ 2}$ / $U_{country\ 3}$

Table 47. Payoff Matrix Case (a) Phase 3. Source: self-elaboration, 2024.

b) Case $C = c_1+c_2 \geq \theta$: in this case, country 3 will decide the value of X depending on the individual actions of countries 1 and 2. We divide into 3 sub-cases:
   1. $\theta < min\ \{c_1, c_2\}$: the loss of trade with any of the two sanctioning countries is detrimental for country 3. As a result, in this case, the threat or imposition of sanctions is strong. In this case, if one of the sanctioning countries sanctions, country 3 complies. This situation does not happen in any of the phases, as both the European Union and the United States have sanctioned, and Russia has not stopped pursuing its activity, X.

		Country 1	
	θ < min{0,490; 0}	***NS***	***S***
Country 2	NS	1.955	0.479
		1.844	0.626
		θ	0.000
	S	0.968	0.479
		0.626	0.626
		0.000	0.000

NOTE: Utilities are displayed as follows $U_{country\ 1}$ / $U_{country\ 2}$ / $U_{country\ 3}$

Table 48. Payoff Matrix Case (b1) Phase 2a. Source: self-elaboration, 2024.

		Country 1	
	θ < min{0,662; 0,747}	***NS***	***S***
Country 2	NS	0.406	0.221
		1.127	0.626
		θ	0.000
		0.000	0.000
	S	0.968	0.221
		0.004	0.004
		0.000	0.000
		0.000	0.000

NOTE: Utilities are displayed as follows $U_{country\ 1}$ / $U_{country\ 2}$ / $U_{country\ 3}$ / $U_{country\ 4}$

Table 49. Payoff Matrix Case (b1) Phase 2b. Source: self-elaboration, 2024.

		Country 1	
	θ < min{2,247;2,637}	***NS***	***S***
Country 2	NS	-0.388	-1.669
		-0.861	0.626
		θ	0.000
	S	0.968	-1.669
		-1.621	-1.621
		0.000	0.000

NOTE: Utilities are displayed as follows $U_{country\ 1}$ / $U_{country\ 2}$ / $U_{country\ 3}$

Table 50. Payoff Matrix Case (b1) Phase 3. Source: self-elaboration, 2024.

2. $c_2 < \theta < c_1$: for country 3, losing trade with country 1 is very costly, but, relative to the benefit of pursuing *X*, losing trade with country 2 is not that threatening. This case could be this way or vice versa. Nevertheless, none of the cases where only one country sanctions and Russia stops pursuing the activity applies to the case study, given that both the United States and the EU have sanctioned, and Russia is still pursuing activity *X*.

		Country 1	
	0 < θ < 0,490	***NS***	***S***
Country 2	NS	1.955	0.479
		1.844	0.626
		θ	0.000
	S	1.955	0.479
		2.208	0.626
		θ	0.000

NOTE: Utilities are displayed as follows $U_{country\ 1}$ / $U_{country\ 2}$ / $U_{country\ 3}$

Table 51. Payoff Matrix Case (b2) Phase 2a. Source: self-elaboration, 2024.

		Country 1	
	0,662 < θ < 0,747	***NS***	***S***
Country 2	NS	0.406	0.221
		1.127	0.626
		θ	0.000
		0.000	0.000
	S	0.406	0.221
		-0.117	0.004
		θ - 0,168	0.000
		0.454	0.000

NOTE: Utilities are displayed as follows $U_{country\ 1}$ / $U_{country\ 2}$ / $U_{country\ 3}$ / $U_{country\ 4}$

Table 52. Payoff Matrix Case (b2) Phase 2b. Source: self-elaboration, 2024.

		Country 1	
	2,247 < θ < 2,637	***NS***	***S***
Country 2	NS	-0.388	-1.669
		-0.861	0.626
		θ	0.000
	S	-0.388	-1.669
		-5.355	-1.621
		θ - 2.247	0.000

NOTE: Utilities are displayed as follows $U_{country\ 1}$ / $U_{country\ 2}$ / $U_{country\ 3}$

Table 53. Payoff Matrix Case (b2) Phase 3. Source: self-elaboration, 2024.

3. $\theta > max\ \{c_1, c_2\}$: losing trade with each country individually is not so costly, but the combined effect is strong enough to make country 3 comply. In this case, intermediate cases where one country sanctions and the target country does not comply could take place in real life, if at a certain point in time, only the United States or the European Union had active sanctions. However, the case where two countries sanction and the target country complies has not taken place in the case study, at least for now.

		Country 1	
	θ > max{0,490;0}	***NS***	***S***
Country 2	NS	1.955 1.844 θ	0.976 1.844 θ - 0,490
	S	1.955 2.208 θ	0.479 0.626 0.000

NOTE: Utilities are displayed as follows $U_{country\ 1}$ / $U_{country\ 2}$ / $U_{country\ 3}$

Table 54. Payoff Matrix Case (b3) Phase 2a. Source: self-elaboration, 2024.

		Country 1	
	θ > max{0,662;0,747}	***NS***	***S***
Country 2	NS	0.406 1.127 θ 0.000	-1.088 1.127 θ - 0,202 0.545
	S	0.406 -0.117 θ - 0,168 0.454	0.221 0.004 0.000 0.000

NOTE: Utilities are displayed as follows $U_{country\ 1}$ / $U_{country\ 2}$ / $U_{country\ 3}$ / $U_{country\ 4}$

Table 55. Payoff Matrix Case (b3) Phase 2b. Source: self-elaboration, 2024.

		Country 1	
	θ > max{2,247;2,637}	***NS***	***S***
Country 2	NS	-0.388 -0.861 θ	-5.662 -0.861 θ - 2.637
	S	-0.388 -5.355 θ - 2.247	-1.669 -1.621 0.000

NOTE: Utilities are displayed as follows $U_{country\ 1}$ / $U_{country\ 2}$ / $U_{country\ 3}$

Table 56. Payoff Matrix Case (b3) Phase 3. Source: self-elaboration, 2024.

As formulated in Game Rasputin, the payoffs depicted in the tables above consist of the per-period payoffs. To obtain the present value of the flow of payoffs we would have to discount them using the interest rate of the moment, which depends on the region. Figure 26. Interest Rate Evolution. Source: self-elaboration, 2024.Figure 26 reflects the interest rate evolution of the players in the game.

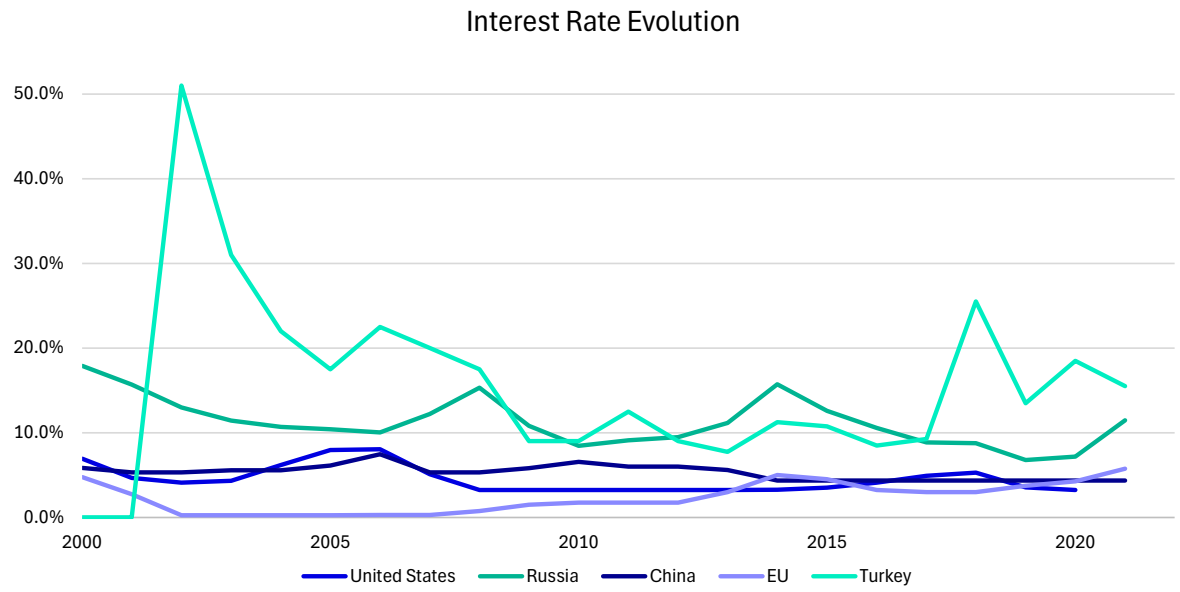

Figure 26. Interest Rate Evolution. Source: self-elaboration, 2024.

Overall, in this section, we have used data from the evolution of trade flows, market volatilities, and sanction episodes from the Russia-Ukraine conflict to feed the formulated model. The aim of this is to obtain the payoffs that each player in the game will get in a range of potential outcomes. In the following section, we will analyze the results obtained, focusing on variable trend shifts and payoffs for each situation, driving links between the geopolitical events and their impact on the metrics analyzed.

6. Result Analysis

The goal of this section is to analyze the results obtained in the previous section, with a focus on the impact of sanctions and the strength of sanctions on trade flows, market volatilities and overall utilities and payoffs of the different players in the game: European Union, United States, Russia, China and Turkey.

We will divide the analysis into three stages corresponding to different phases of sanctioning from 2007 to 2022.

6.1. Stage 1: 2007-2014 (Pre-Sanctions)

As mentioned previously, this stage corresponds to the time prior to the Russian occupation of Crimea and Sevastopol, there were no sanctions imposed on Russia. This period is very useful as it serves as a baseline for understanding the trade dynamics and market conditions without the influence of sanctions.

In terms of trade, all players enjoyed robust flows with positive trends, indicating a strengthening in the economic relations of these countries. The only period in this stage when trade stagnated was during 2008-210, due to the effects of the Financial Crisis. Moreover, the market volatilities for the Eurostoxx50 and S&P500 were relatively stable, reflecting a period of economic growth and stability without geopolitical tensions.

The payoffs for each country in this stage are not reflected in any of the tables of the time-independent equilibria, given that we could describe this stage as a prior phase to the start of the game, where neither the sanctioning countries sanction nor the target country pursues activity *X (NS, NS, X=0)*. However, if we were to estimate the payoffs in this stage, they would be equal to the utilities of trading with each other:

- **Payoff for the EU = $U_{T,1}$ = 219,447,647.41 USD**
- **Payoff for the USA = $U_{T,2}$ = 16,789,654.49 USD**
- **Payoff for Russia = $U_{T,1}$ + $U_{T,2}$ = 236,237,301.90 USD**
- In this case, country 4 is not considered part of the game, as there are no trade restrictions applied to Russia, and therefore this country won't need to find additional trade partners.

As a result, this means that, when sanctions are not active and Russia is not pursuing an invasion of Ukraine, the EU gets 219 million USD, the United States 17 million USD and Russia 236 million USD of benefit from this situation.

6.2. Stage 2: 2015-2021 (Post-Crimea Sanctions)

The occupation of Crimea and Sevastopol by the Russian authorities led to the imposition of

sanctions on Russia by the United States and Europe in 2014. These sanctions targeted, among others, individuals from Russian elites close to the government, enterprises that took part or had an influence in the invasion and set restrictions on trade to punish Russia for its actions. As mentioned in the previous section, in this stage we distinguish two sub-phases with different dynamics:

Stage 2a: 2015-2018 (Initial Sanctions)

In terms of trade, after the sanctions imposed in 2014, there was a noticeable decline in trade flows between the European Union and the United States, and Russia. Although the average of this phase was higher than the average of flows in the previous phase, the evolution clearly depicted a decreasing trend. This downward trend reflects the immediate impact of sanctions, which curtailed economic interactions. It is important to highlight that in this phase trade between Russia and China and Turkey also decreased, contrary to initial assumptions that sanctions would increase trade flows between the targeted country and third countries that are not sanctioning. As trade flow graphs clearly depict, in the short term after sanctions are imposed trade flows with the target country decline, regardless of the country it is interacting with.

When analyzing volatility, conclusions are much more straightforward. In periods of sanctions, market uncertainty trends clearly shift towards heightened volatility. This shift in the trend can be seen both in Eurostoxx50 and S&P Indices, although it is much more pronounced in the latter.

The payoffs for each country in this stage are the ones depicted below. In this stage, countries 1 and 2 are sanctioning and country 3 is pursuing activity *X (S, S, X=0)*. Moreover, country 4 still has not entered the game.

		Country 1	
	θ > 0,490	***NS***	***S***
Country 2	NS	1.955 1.844 θ	**0.976** **1.844** **θ - 0,490**
	S	1.955 2.208 θ	0.976 2.208 θ - 0,490

NOTE: Utilities are displayed as follows $U_{country\,1}$ / $U_{country\,2}$ / $U_{country\,3}$

Table 57. Payoffs for each country in the years 2015-2018. Source: self-elaboration,2024.

In unnormalized terms, the payoffs for each country are as follows:

- **Payoff for the EU = $U_{T,1} – m_1 – c_1$ = -3,204,657,112,752.99 USD**
- **Payoff for the USA = $U_{T,2} – m_2 – c_2$ = -1,226,601,289,210.72 USD**
- **Payoff for Russia = $\theta – c_1 – c_2$ = θ - 36,426,015.15 USD**
- In this case, country 4 is not considered part of the game, as trade agreements have not yet been formalized between these two players, given the recent nature of sanctions.

The fact that both the United States and the European Union are imposing sanctions on Russia and this country is still pursuing the invasion of Ukraine indicates the payoff that Russia must be taking from invading Ukraine (θ > 36,426,015.15 USD). We will deepen this conclusion in the following section.

Phase 2b: 2019-2021 (Country 4 enters the game)

In this phase, the degree of sanctions is extremely similar to the one of the previous phases, with the difference that an increase in trade between a third country and the target country alters the payoffs of the players.

Regarding trade, during this sub-phase, trade flows between Russia and third countries began to increase. As mentioned previously, this trend suggests that Russia sought new trading partners to mitigate the impact of sanctions. The trade between the target country and the sanctioning countries continues with a downward trend, with the exception of the year 2020 where there was a slight stagnation in the decrease.

In this period, volatility in the sanctioning countries increases sharply, indicating that markets sense more damaging effects from activity *X* rather than stabilization and adaptation to geopolitical realities.

The payoffs for each country in this stage are the ones depicted below. In this stage, countries 1 and 2 are sanctioning and country 3 is pursuing activity *X (S, S, X=0)*. The difference between this phase and Phase 2a is the fact that in this stage country 4 has entered the game. As a result, this country obtains a payoff from the game, also depicted in the table.

			Country 1	
	θ > 1,369		***NS***	***S***
Country 2	NS		0.406	**-1.088**
			1.127	**1.127**
			θ	**θ - 0,202**
			0.000	**0.545**
	S		0.406	-1.088
			-0.117	-0.117
			θ - 0,168	θ - 0,370
			-0.382	-0.842

NOTE: Utilities are displayed as follows $U_{country\ 1}$ / $U_{country\ 2}$ / $U_{country\ 3}$ / $U_{country\ 4}$

Table 58. Payoffs for each country in the years 2019-2021. Source: self-elaboration,2024.

In unnormalized terms, the payoffs for each country are as follows:

- **Payoff for the EU = $U_{T,1} - m_1 - c_1$ = -7,527,496,343,544.94 USD**
- **Payoff for the USA = $U_{T,2} - m_2 - c_2$ = -1,401,544,645,667.72 USD**
- **Payoff for Russia = $\theta - c_1 - c_2$ = θ - 37,486,142.23 USD**
- **Payoff for China = B_4 = 24,345,968.75 USD**

Similarly to the previous phase, the fact that this situation is taking place indicates that Russia is getting a benefit from this situation: θ > 37,486,142.23 USD. In this case, the cost of

sanctions to Russia is lower than the reduction in trade with the European Union and the United States, as it is mitigated by an increase in trade with China.

6.3. Stage 3: 2022 (Post-Ukraine Invasion)

The 2022 invasion of Ukraine led to further strengthening of sanctions. This stage examines the immediate short-term effect of these intensified sanctions, given that only data from the year 2022 is available.

For this year following the strengthening of the punitive measures against Russia, trade flows between Russia and the sanctioning countries continued to decline dramatically. Additionally, and similarly to what happened in phase 2a, trade with China and Turkey decreased, which shows a similar behavior as with the sanctions in 2014: in the short term after sanction imposition, trade with third countries decreases. Regarding market volatilities, they spiked significantly, reflecting the heightened geopolitical risk and uncertainty in global markets.

The payoffs for each country in this stage are the ones depicted below. In this stage, countries 1 and 2 are sanctioning and country 3 is pursuing activity *X (S, S, X=0)*. This case is very similar to phase 2a, with the exception of changes in the metrics that feed Game Rasputin, resulting in different values of the model variables.

		Country 1	
	θ > 4,884	***NS***	***S***
Country 2	NS	-0.388 -0.861 θ	**-5.662** **-0.861** **θ - 2.637**
	S	-0.388 θ - 2.247	-5.662 θ - 4.884

NOTE: Utilities are displayed as follows $U_{country\,1}$ / $U_{country\,2}$ / $U_{country\,3}$

Table 59. Payoffs for each country in the year 2022. Source: self-elaboration,2024.

In unnormalized terms, the payoffs for each country are as follows:

- **Payoff for the EU = $U_{T,1} - m_1 - c_1$ = -9,741,829,498,342.10 USD**
- **Payoff for the USA = $U_{T,2} - m_2 - c_2$ = -1,886,712,811,888.50 USD**
- **Payoff for Russia = $\theta - c_1 - c_2$ = θ - 212,264,037.40 USD**
- In this case, country 4 is not considered part of the game, as trade agreements have not yet been formalized between these two players, given the recent nature of sanctions.

Similarly to the previous phase, the fact that this situation is taking place indicates that Russia is getting a benefit from this situation: θ > 212,264,037.40 USD.

Overall, this analysis provides a comprehensive examination of the numerical implementation results of the sanction model. The findings highlight the significant economic impact of sanctions on trade flows and market volatilities, while also revealing the adaptive strategies employed by Russia to mitigate these effects. Despite the substantial economic costs, the

deterrent effect of sanctions on Russia's actions remains limited, suggesting the need for a reevaluation of sanction strategies and their implementation.

7. Conclusions

This research uses Game Rasputin and its numerical application to study the effect of sanction imposition on different players. Throughout the research, several hypotheses have been formulated about the expected benefit or loss that each player will experiment in different scenarios. In this section, we will gather all the information obtained from the model and its numerical implementation to test these hypotheses. To do so, we will make use of the numerical payoff matrixes for each country in each scenario, the evolution of the variables studied, and the facts from the sanction retrospective and its consequences to build a wholesome analysis that reflects a clear picture of the effects of sanctions.

Hypothesis 1: *The benefit for the target country from pursuing the activity is greater than the cost of sanctions for this country.*

The first hypothesis raises as a conclusion from the evolution of Russian trade. Once sanctions are imposed on Russia, their bilateral trade flows dramatically shift downwards (Figure 16), implying an elevated cost for the target country attributable to sanction imposition.

Nevertheless, pursuing activity X gives a benefit to this target country, θ, which is private information. This means that at first sight we would have no way of knowing the value of the benefit for Russia of invading Ukraine, and no apparent way of testing this hypothesis. However, let us remind that we found the payoffs for each country defining cases for different assumptions of the value of the variable θ:

a) Case (a)*:* $C = c_1 + c_2 \leq \theta$
b) Case (b): $C = c_1 + c_2 > \theta$
    1. Case (b1): $\theta < min\ \{c_1, c_2\}$
    2. Case (b2): $c_2 < \theta < c_1$:
    3. Case (b3): $\theta > max\ \{c_1, c_2\}$

Of all of the resulting payoff matrices, there was only one of these cases where when countries 1 and 2 sanctioned, country 3 continued pursuing the activity *(S, S, X=1)*. This is case (a), where the benefit from pursuing the activity is greater than the sum of the cost for the target country of being sanctioned by both countries 1 and 2. As a result, this hypothesis is proven.

Hypothesis 2: *Sanctioning countries are affected negatively in periods when sanctions are active.*

The second hypothesis stated in the study was related to the effects of sanctions on sanctioning countries. when these policies are designed and evaluated, it is common to focus on the effects of these measures on the target country: whether sanctions affect its economy, its power to make their regimes change their behavior, etc. but seldom times the analysis puts its focus on the effects of the sanctioning country. After conducting a deep literature review and study the timeline of sanctions and the way they are executed, we assumed that the

imposition of these measures required an allocation of capital and resources that had to be costly for sanctioning countries. To test this hypothesis, it is enough to look at the payoffs for the United States and Europe through the different phases of sanctions, where sanctions get stronger and stronger as phases go by. In Figure 27 we can clearly see how, as sanction measures get stronger, the overall payoff for sanctioning countries decreases significantly, proving the veracity of *Hypothesis 1*. The only exception would be the case of the United States in Phase 2a, which might show a lag in the effects of sanctions in this country. We also see how the effect of sanctions seems to be tougher for Europe than for the United States, in normalized terms. Moreover, the fact that this hypothesis is true raises the question of whether these measures compensate for the elevated costs they involve.

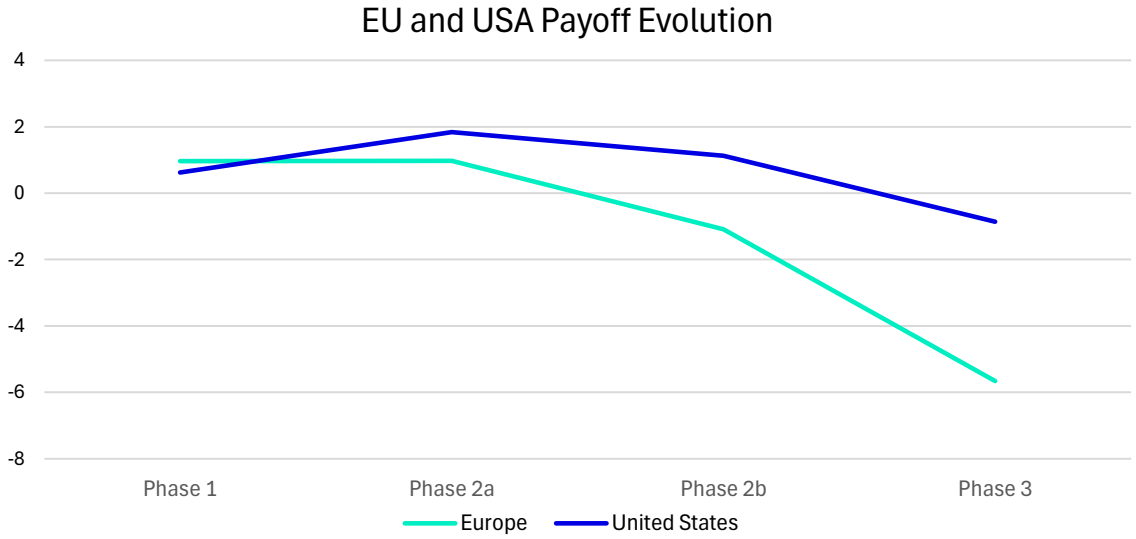

Figure 27. USA and EU Payoff Evolution through the Sanction Phases. Source: self-elaboration, 2024.

Hypothesis 3: *Third countries, separate from the sanctioning and the targeted nations, often derive benefits during periods of sanctions.*

The third hypothesis is related to the impact of sanctions outside the sanctioning and target countries. In the case of Russia, a wide number of countries have sanctioned the Russian Federation for its invasion of Ukraine, but there are other economies in the world that have showed support to the country led by Vladimir Putin. This fact changes the rules of the game, and the expected payoffs for each player of the game. As logic suggests, if third countries increase their trade volumes with the target country, their expected payoff should increase.

To test this hypothesis, it is enough to look at the payoffs for country 4 through the different phases of sanctions, where sanctions get stronger and stronger as phases go by. In Figure 28 we can see how the expected positive trend of country 4 payoffs across the phases is not so clear, as benefits seem to increase during Phase 2 and then decrease in Phase 3 after the strengthening of the sanctions. As a result, *Hypothesis 3* is found to be false, as not always third countries benefit from sanctions to the target country.

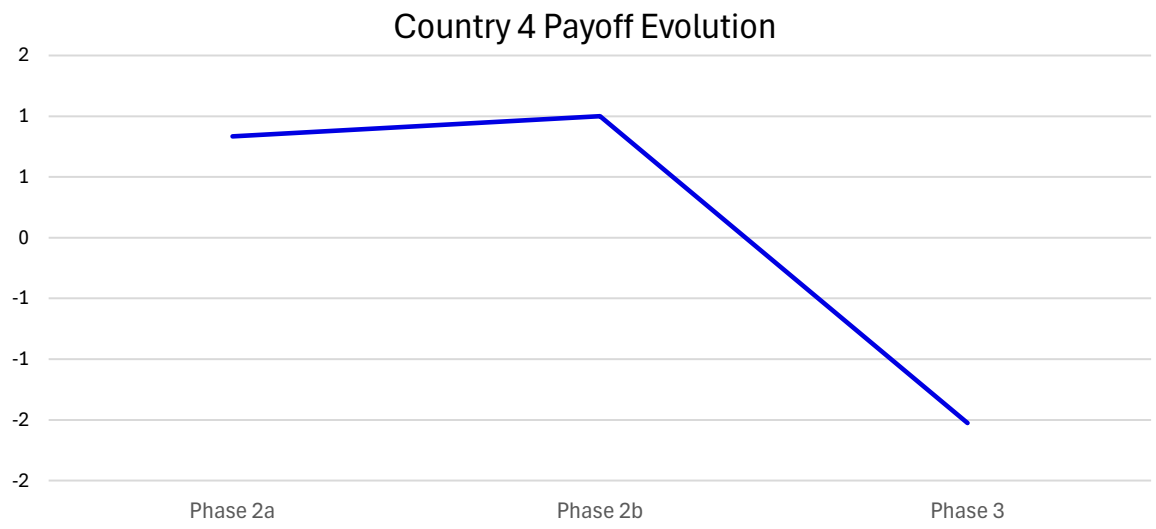

Figure 28. Payoff Evolution of Country 4 through the Sanction Phases. Source: self-elaboration, 2024.

Hypothesis 4: *Benefits for third countries appear in the medium term after the imposition of sanctions.*

Hypothesis 4 is a reformulation of Hypothesis 3, given that the previous hypothesis was proven false. Hypothesis 4 aims to specify the circumstances under which third countries benefit from increasing trade with the target country, who must find new trade partners due to the limitations imposed by its current ones. The logical foundation behind this hypothesis is that, once sanctions are imposed on the target country, there is a gap of time between the sudden reduction in trade with its current partners until this country finds new partners, develops agreements and trade begins between them. As a result, the reduction in the cost of sanctions for country 3 and the benefit from increased trade for country 4 does not appear straight away, but in the medium term after sanction imposition.

Figure 28 serves as proof of this hypothesis, as we can see that the payoff for country 4 in Phase 2b is greater than in Phase 2a. In Phase 3 the payoff for country 4 decreases again, due to the imminence of sanctions in 2022. Given that country 4 payoffs were calculated using data from China, one may think that this hypothesis is not applicable to other countries and that this behavior is only specific to this country. Nevertheless, it can be extrapolated to any other country that is in this position. For instance, if we take the example of Turkey, and we apply the normalized payoffs for country 4 calculated based on China, we get very similar utilities as the real utilities calculated with Turkish bilateral trade evolution (Figure 29). As a result, this hypothesis is proven.

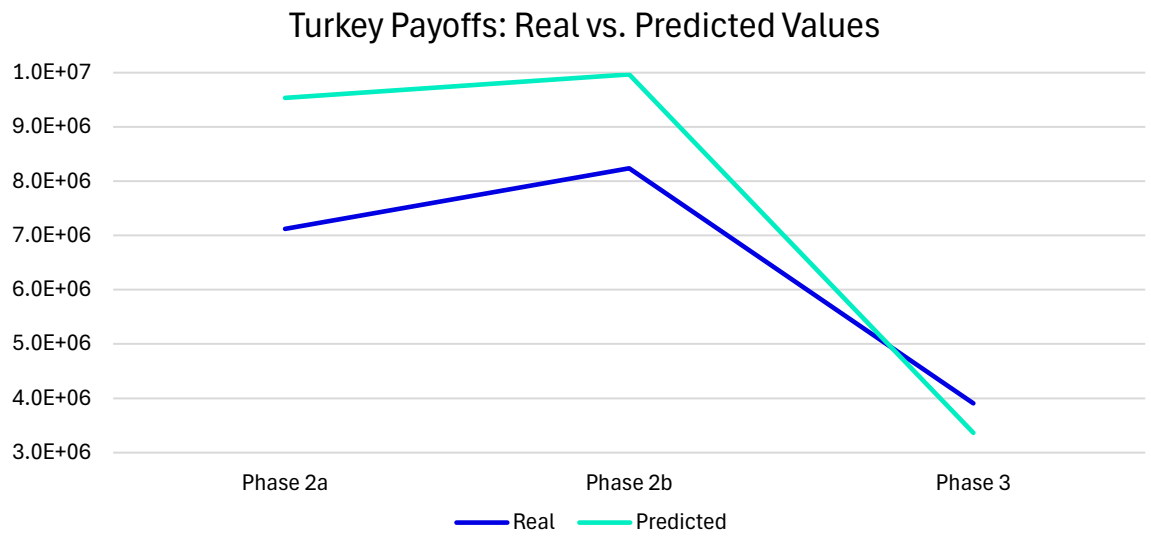

Figure 29. Turkey Payoffs: Real vs. Predicted Values. Source: self-elaboration, 2024.

Hypothesis 5: *When third countries are in play, the payoff of the target country is affected.*

As suggested in the explanation of the previous hypothesis, the fact that trends in bilateral trade shift affects both players involved in this trade. As a result, if payoffs from third countries increase due to augmented trade with the target country, the cost of sanctions for this country should decrease. This is because the reduction in trade with the United States and the EU is expected to be compensated by an increase in trade with third countries.

The way to test this hypothesis is to look at the evolution of country 3's payoffs and analyze whether they increase in Phase 2b compared with Phase 2a. Figure 30 depicts the evolution of these payoffs, and it is easily observable that the payoffs for country 3 increase slightly from Phase 2a to Phase 2b, which indicates that the introduction of third countries in the game clearly serves as a mitigator for the cost of sanctions for Russia. This proves the veracity of this hypothesis.

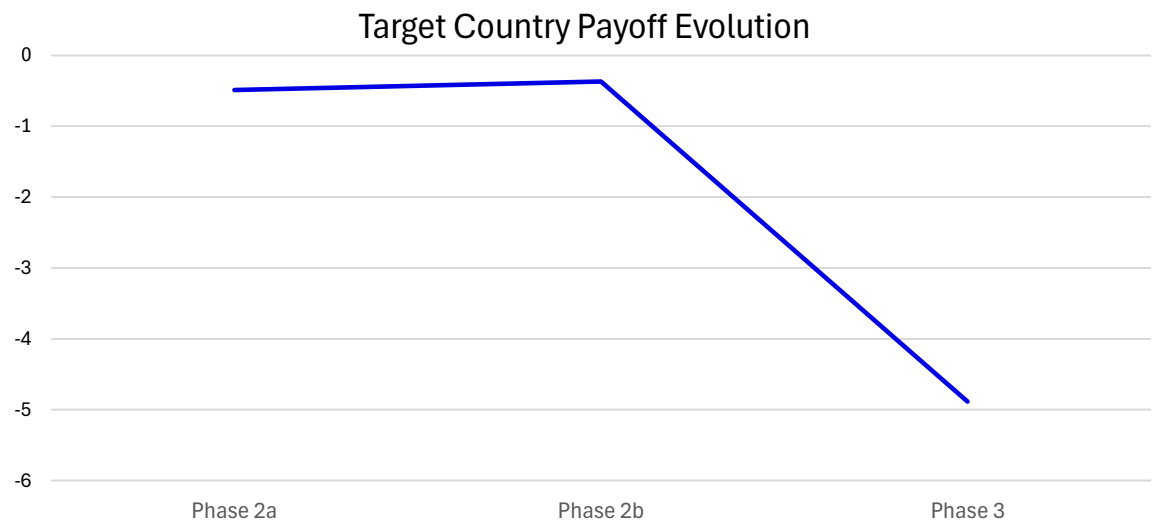

Figure 30. Country 4 Payoff Evolution in Normalized Terms. Source: self-elaboration, 2024.

Hypothesis 6. *Market volatility increases in sanction periods and increases even more when third players enter the game.*

This sanction is related to the effect of increased trade between Russia and China or Turkey on Europe and the United States. Logically speaking, a mitigation of the cost of sanctions for Russia and a benefit for China or Turkey should be detrimental for the sanctioning countries.

The way to prove this is by analyzing the evolution of market volatilities, which serve as a proxy for the cost for countries 1 and 2 of the situation: increased market volatility reflects a more unstable economy, with more uncertainty that is highly damaging for these countries.

In Table 60 we can clearly see how sanction episodes increase volatility in both markets and how in Phase 2b volatility increases more with the addition of two new players in the game, meaning that trade agreements between the target country and third parties negatively affect sanctioning countries, making sanction effectiveness decrease.

Figure 31 and Figure 32 depict the assumption stated: after sanction enforcement, volatilities in Eurostoxx50 and S&P500 increase. This increase will be more pronounced once countries 4 and 5 enter the game, after 2018.

Metric	Phase 1: 2007-2014	Phase 2a: 2015-2017	Phase 2b: 2018-2021	Phase 3: 2022
S&P Volatility	3.355.761.534.594,91 USD	3.204.803.708.370,09 USD	7.527.604.660.125,39 USD	9.741.656.623.360,87 USD
Eurostoxx Volatility	1.580.215.544.181,12 USD	1.226.618.078.865,21 USD	1.401.552.518.767,87 USD	1.886.697.396.096,82 USD

Table 60. Market Volatilities in each Phase. Source: self-elaboration, 2024.

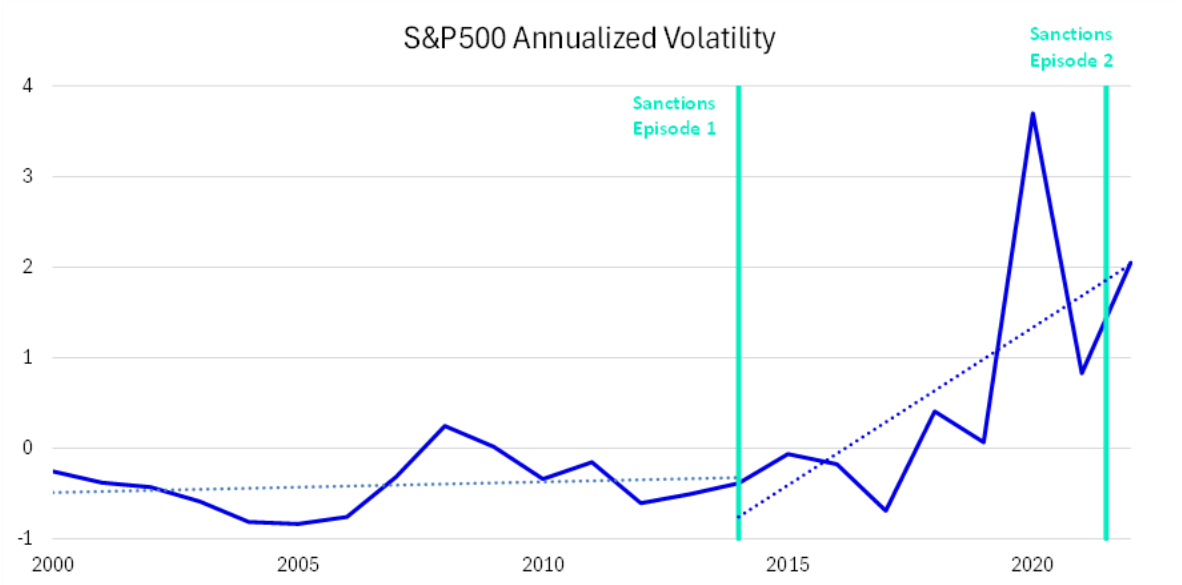

Figure 31. S&P500 Volatility Evolution. Source: self-elaboration, 2024.

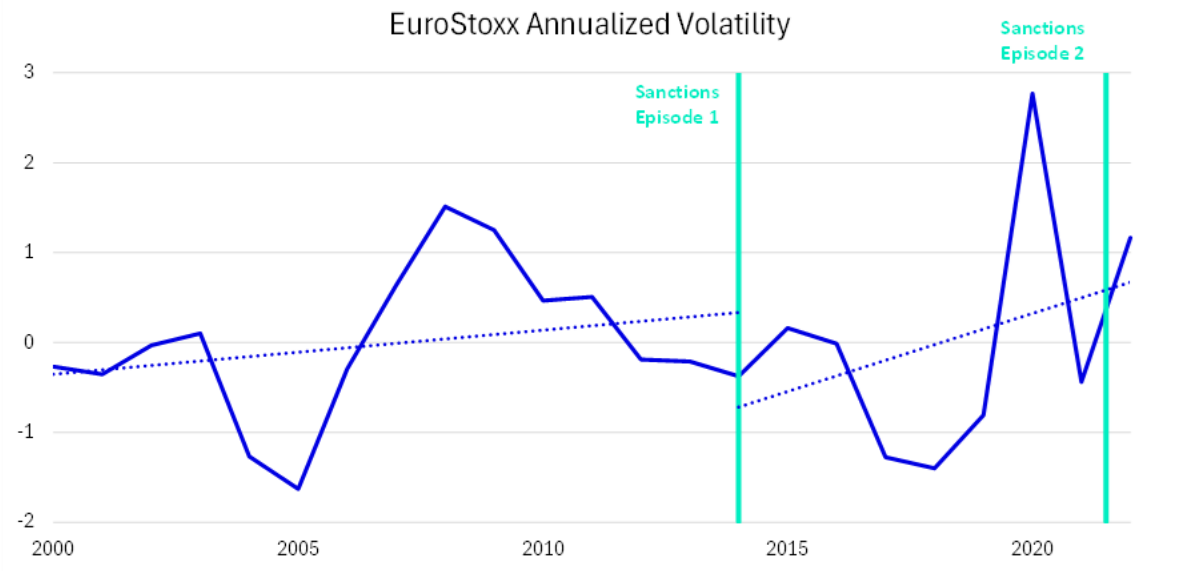

Figure 32. Eurostoxx50 Volatility Evolution. Source: self-elaboration, 2024.

This study has enabled us to get a wholesome perspective of the overall effects of sanctions, not only on the target and sanctioning countries but also on the overall world economies. Our findings suggest that sanction imposition affects the payoff of the target country, as it reduces the benefit this country gets from pursuing a certain activity. Nevertheless, this effect implies a very high cost assumed by sanctioning countries, depicted in high costs associated with trade reduction, as well as a sharp increase in market volatility of sanctioning countries. Moreover, the rules of the game change when third countries are included: by forging new economic partnerships, some of the economic pressure that sanctions exert over target countries is

mitigated, reducing, even more, the effectiveness of these measures. Additionally, in the medium to long term, these third countries get a benefit from sanctions. As a result, these conclusions raise the question of whether these punitive measures are the most appropriate to reach the goal of shifting the target country's behavior, or if their design should be reconsidered to target their goals more specifically and without involving such a strong effort from sanctioning countries.

7.1. Recommendations for future studies

This research serves as a starting point to lay the groundwork for further studies that analyze the effect of sanctions on the multiple players involved. We understand that the scarce reporting of data for the most recent years results in limitations in the study of the effects of the latest sanction packages. Moreover, a broader set of variables would also enrich the perspective of the conclusions, as these will refer to a more wholesome analysis. Finally, an adaptation of Game Rasputin to include variable payoffs would describe real situations more accurately. With all of these, we make three propositions for future studies:

First, updating and expanding the data sets is essential. This includes incorporating the most recent data as it becomes available, particularly for 2022 and beyond, to ensure the analysis reflects current economic conditions and the latest sanctions effects.

Second, improving variable selection is necessary. The current reliance on specific proxies, such as market volatility and trade flows, can be broadened to include a wider range of economic metrics like employment rates, foreign direct investment flows, and sector-specific performance indicators. Exploring alternative proxies will address potential inaccuracies and offer a more nuanced understanding of sanctions' effects, beyond just trade volumes. Additionally, it could be interesting to add more countries as third countries to see the overall compensation for the cost of sanctions by establishing new trade agreements.

Third, Game Rasputin assumes static payoffs, while in reality, the interactions between countries are dynamic and evolve over time. Incorporating models that take this into account can better capture the evolving interactions between countries over time, providing deeper insights into the long-term impacts of sanctions. For instance, in the case of country 2 (United States) in Phase 2a, we saw a cost of sanctions of 0 for this country. This is because in the first couple of years after the sanctions, the United States still had high amounts of bilateral trade with Russia, and although the trend was dramatically decreasing, the average was higher than in Phase 1, indicating that the US traded more with Russia than before. If instead of modeling the cost as an average we could model it as a dynamic variable, we would be able to analyze its trend and not its value to draw conclusions.

These steps will collectively enhance the robustness and accuracy of future research on the economic impacts of sanctions.

8. Economic Viability of the Project

In this chapter, we will develop an economic analysis of our project, modeled as a consultancy job for an international institution. Our mandate is to produce a report that examines the impact of sanctions. This report will be valid for 10 years and will be assigned the name Rasputin.

Our consultancy project aims to provide an in-depth analysis, leveraging both game theoretic models and qualitative analysis to understand the repercussions of sanctions. This task requires a thorough understanding of economic theories and empirical data to predict both short-term disruptions and long-term economic impacts.

Furthermore, our report will consider real-world complexities by including a case study with a numerical implementation of Game Rasputin. With this, this study aims to serve as a resource for policymakers, providing them with the knowledge to navigate the landscape of international sanctions and their impacts.

We will first introduce the allocated team for the project. We will assign a team suited to the needs of the project that will coordinate at different levels with the required areas and countries. Figure 33 depicts the members of the team and their annual time percentage allocated to the project.

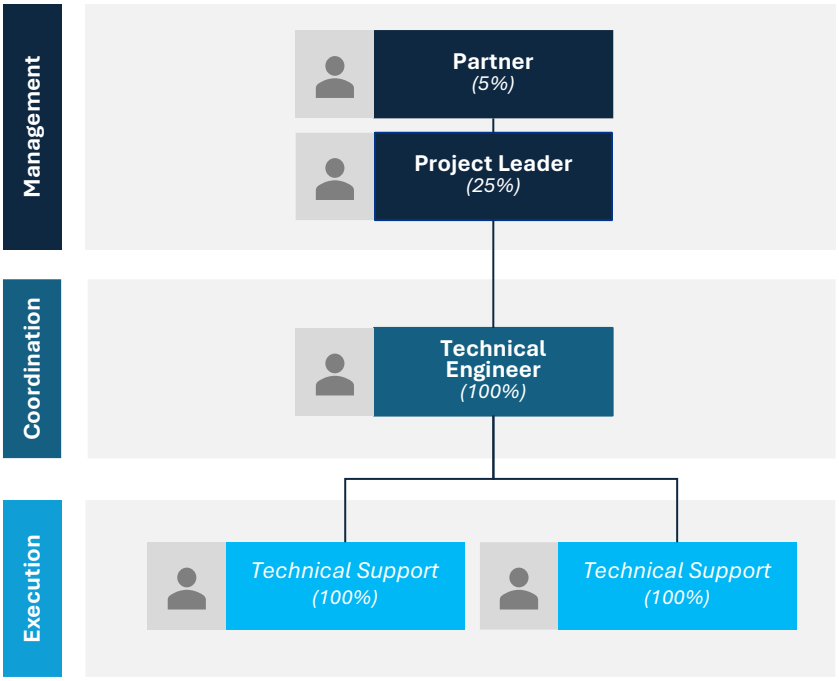

Figure 33. Team members, level structure and time allocated to the project. Source: self-elaboration, 2024.

This team gathers the required experience to ensure a successful execution of the project:

Figure 34. Team members and relevant experience. Source: self-elaboration, 2024.

In terms of the economic viability of the project, Table 61 provides a breakdown of the income streams and cost sources, as well as the frequency of the payments, which can be divided into:

- Income:
    - Employe fees: these are calculated using the hours allocated for each employee to the project and the fee each employee charges per hour.
    - Communication plan and infographic: service provided that includes the development of an infographic with the key takeaways from the report and the design of a communication plan for the public.
- Costs:
    - Data recollection fees: these include the cost of access to data providers used to feed Game Rasputin with data, such as Refinitiv and Capital IQ
    - Web licenses: Windows
    - Computing equipment: electronic devices required for the project.

Income						
Total Employee Fees						**248,640.00 €**
Employee	**% of Time Allocated**	**Time Available (h)**	**Total Working Hours**	**Fee (€/h)**	**Payable**	**Total Fee**
Partner	5%	1680	84	250	Quarterly	21,000.00 €
Project Leader	25%	1680	420	150	Quarterly	63,000.00 €
Technical Engineer	60%	1680	1008	80	Quarterly	80,640.00 €
Technical Support	100%	1680	1680	50	Quarterly	84,000.00 €
Communication Plan and Infographics						**12,000.00 €**
Task				**Fee (fixed)**	**Payable**	**Total Fee**
Development of Communication Plan				8,000.00 €	Monthly	8,000.00 €
Design of Infographic				4,000.00 €	Monthly	4,000.00 €
TOTAL INCOME						***260,640.00 €***

Costs						
Software Costs						**45,500.00 €**
Source	**Description**	**Cost**	**Amortization (Years)**	**Project Time (years)**	**Payable**	**Incurred Cost**
Data Recollection	Cost of access to data providers	44,000.00 €	1	1	Yearly	44,000.00 €
Web Licenses	Microsoft, Windows	1,500.00 €	1	1	Yearly	1,500.00 €
Hardware Costs						**2,000.00 €**
Source	**Description**	**Cost**	**Amortization (Years)**	**Project Time (years)**	**Payable**	**Incurred Cost**
Computer Equipment	5 Computers + 2 Tablets	6,000.00 €	3	1	Yearly	2,000.00 €
TOTAL COSTS						***47,500.00 €***

Table 61. Project Rasputin Income and Cost Breakdown. Source: self-elaboration, 2024.

Finally, to obtain the profitability of the project we have developed a cash flow statement, depicted in Table 62. The results show that we obtain a very high return on the project, given the low costs associated with this type of project, and the high fees charged for employee. Additionally, the Net Present Value of the project assuming a 5% discount rate is 140.000€.

	Month											
	ene-24	**feb-24**	**mar-24**	**abr-24**	**may-24**	**jun-24**	**jul-24**	**ago-24**	**sep-24**	**oct-24**	**nov-24**	**dic-24**
Revenues	**1,000.00 €**	**1,000.00 €**	**63,160.00 €**	**1,000.00 €**	**1,000.00 €**	**63,160.00 €**	**1,000.00 €**	**1,000.00 €**	**63,160.00 €**	**1,000.00 €**	**1,000.00 €**	**63,160.00 €**
Employee Fees			62,160.00 €			62,160.00 €			62,160.00 €			62,160.00 €
Communication Plan and Infographics	1,000.00 €	1,000.00 €	1,000.00 €	1,000.00 €	1,000.00 €	1,000.00 €	1,000.00 €	1,000.00 €	1,000.00 €	1,000.00 €	1,000.00 €	1,000.00 €
Costs	**(47,500.00 €)**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Software Costs	(45,500.00 €)											
Hardware Costs	(2,000.00 €)											
Free Cash Flow	***(46,500.00 €)***	***1,000.00 €***	***63,160.00 €***	***1,000.00 €***	***1,000.00 €***	***63,160.00 €***	***1,000.00 €***	***1,000.00 €***	***63,160.00 €***	***1,000.00 €***	***1,000.00 €***	***63,160.00 €***

IRR	44.2%
NPV	138,387.95 €
Interest Rate	5.0%

Table 62. Expected Cash Flows of Project Rasputin. Source: self-elaboration, 2024.

To conclude, we can affirm that the project is economically viable, with the majority of its revenues coming from the fees of the workforce, and the majority of its costs associated with the software required to pursue the project. Looking at the numbers, and as can be expected from a consultancy project, we can affirm that the project is not very capital intensive, and this is the main reason why the expected returns are this high.

9. References

Afesorgbor, S. K. (2016). The impact of economic sanctions on international trade: How do threatened sanctions compare with imposed sanctions? *European Journal of Political Economy*, 11-26.

Andreoni, J., Harbaugh, W., & Vesterlund, L. (2003). The Carrot or the Stick: Rewards, Punishments, and Cooperation. *American Economic Review*, 893-902.

Bapat, N. A., & Kwon, B. R. (2014). When Are Sanctions Effective? A Bargaining and Enforcement Framework. *International Organization*, 131-162.

Becker, G. S. (1968). Crime and Punishment: An Economic Approach. *Journal of Political Economy*, 169-217.

Bianco, W. T., Ordeshook, P. C., & Tsebelis, G. (1990). Crime and Punishment: Are One-Shot, Two-Person Games Enough? *The American Political Science Review*, 569-586.

Brown, M. (2019). *The Art of Sanctions: A Game Theoretic Approach to Sanctions Against the Powerful*. Fort Worth: Texas Christian University.

Caia, L., Caia, W., Zhub, C., Chenc, S., & Mengting, Z. (2016). An optimal penalty in an environmental pollution game with the suspension of production. *Journal of Intelligent & Fuzzy Systems*, 2321-2333.

Caprile, A. D. (2023). *EU sanctions on Russia: Update, economic impact and outlook.* European Parliamentary Research Service.

Central Bank of Turkey. (2000-2022). Central Bank Interest Rates. Retrieved from https://www.tcmb.gov.tr/wps/wcm/connect/en/tcmb+en/main+menu/core+functions/monetary+policy/central+bank+interest+rates

Congressional Research Service. (2022). *U.S. Sanctions on Russia.*

Council of the European Union. (2024, June 17). *European Council*. Retrieved from Timeline - EU sanctions against Russia: https://www.consilium.europa.eu/en/policies/sanctions-against-russia/timeline-sanctions-against-russia/

E. Alt, J., Calvert, R. L., & Humes, B. D. (1988). Reputation and Hegemonic Stability: A Game-Theoretic Analysis. *The American Political Science Review*, 445-466.

Eaton, J., & Engers, M. (1992). Sanctions. *Journal of Political Economy*, 899-928.

Endres, A. (2004). Game theory and global environmental policy. *Poiesis Prax*, 123-139.

European Central Bank. (2000-2022). Euro Exchange Rate Charts: EUR/USD. Retrieved from

https://www.ecb.europa.eu/stats/policy_and_exchange_rates/euro_reference_exchange_rates/html/eurofxref-graph-usd.en.html

European Central Bank. (2000-2022). Key ECB Interest Rates. Retrieved from https://www.ecb.europa.eu/stats/policy_and_exchange_rates/key_ecb_interest_rates/html/index.en.html

European Comission. (2024, May 17). *Finance - European Comission*. Retrieved from Sanctions adopted following Russia's military aggression against Ukraine: https://finance.ec.europa.eu/eu-and-world/sanctions-restrictive-measures/sanctions-adopted-following-russias-military-aggression-against-ukraine_en#timeline-measures-adopted-in-2022-2023

European Council. (2014). Reinforced restrictive measures against Russia. Brussels.

European Council. (2014). Statement of the President of the European Council on the agreed additional restrictive measures against Russia. Brussels.

Felbermayr, G., Morgan, T. C., Syropoulos, C., & Yotov, Y. V. (2021). Understanding economic sanctions: Interdisciplinary perspectives on theory and evidence. *European Economic Review, 135*.

Filipenko, A., Bazhenova, O., & Stakanov, R. (2020). ECONOMIC SANCTIONS: THEORY, POLICY, MECHANISMS. *Baltic Journal of Economic Studies, 6*(2).

Gaulier, G., & Zignago, S. (2010). BACI: International Trade Database and the Product-Level. The 1994-2007 Version. *CEPII Working Paper*, Nº2010-23.

Han, B. (2016). The role and welfare rationale of secondary sanctions: A theory and a case study of the US sanctions targeting Iran. *Conflict Management and Peace Science*, 01-29.

Investing.com. (2024). S&P 500 Historical Data. Retrieved from https://www.investing.com/indices/us-spx-500-historical-data

Janeba, E. (2022). Extraterritorial trade sanctions: Theory and application to the US–Iran–EU conflict. *Review of International Economics*, 49-71.

Kilgour, D. M., Fang, L., & Hipel, K. W. (1992). Game-theoretic Analysis of Enforcement of Environmental Laws and Regulations. *Water Resources Bulletin*, 141-153.

Lacy, D., & Niou, E. M. (2004). A Theory of Economic Sanctions and Issue Linkage: The Roles of Preferences, Information, and Threats. *The Journal of Politics*, 25-42.

Langlois, C. C., & Langlois, J.-P. P. (2010). Costly Interference: A Game Theoretic Analysis of Sanctions. *Peace Economics, Peace Science and Public Policy, 16*(1).

Martin, L. L. (1992). *Coercive Cooperation: Explaining Multilateral Economic Sanctions.* Princeton: Princeton University Press.

Moret, E., Giumelli, F., & Bastiat-Jarosz, D. (2017). *Sanctions on Russia: Impacts and Economic Costs on the United States.*

Nosenzo, D., Offerman, T., Sefton, M., & van der Veen, A. (2014). Encouraging Compliance: Bonuses Versus Fines in Inspection Games. *The Journal of Law, Economics, and Organization*, 623-648.

Pradiptyo, R. (2007). Does Punishment Matter? A Refinement of the Inspection Game. *Review of Law & Economics*, 197-219.

Refinitiv. (2024). Eurostoxx50 Price Performance. Retrieved from https://workspace.refinitiv.com/web/Apps/Index/?s=.NMRAMUSA&st=RIC

Roberts, G. (2013). When Punishment Pays. *Plos ONE, 8*(3).

S&P Global Market Intelligence, S&P Global Commodity Insights. (2024, June 4). *S&P Global*. Retrieved from Sanctions against Russia – a timeline: https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/sanctions-against-russia-8211-a-timeline-69602559

Simon, M. V. (2008). When sanctions can work: Economic sanctions and the theory of moves. *International Interactions*, 203-228.

Smith, A. (1995). The Success and Use of Economic Sanctions. *International Interactions*, 229-245.

Tsebelis, G. (1990). Are Sanctions Effective? A Game-Theoretic Analysis. *Journal of Conflict Resolution*, 3-28.

Tsebelis, G. (1990). Penalty has no Impact on Crime. *Sage Social Science Collections*, 255-286.

U.S. Department of Treasury. (2022, February 24). *U.S. Department of Treasury*. Retrieved from U.S. Treasury Announces Unprecedented & Expansive Sanctions Against Russia, Imposing Swift and Severe Economic Costs: https://home.treasury.gov/news/press-releases/jy0608

United Nations. (2015). *17 Sustainable Development Goals*. Retrieved from https://www.un.org/sustainabledevelopment/

van der Weele, J. (2012). The Signaling Power of Sanctions in Social Dilemmas. *The Journal of Law, Economics, and Organization*, 103-126.

Walentek, D. (2022). Reputation or interaction: What determines cooperation on economic sanctions? *International Interactions*, 1121-1143.

Wang, Z., Huo, J., & Duan, Y. (n.d.). The impact of government incentives and penalties on willingness to recycle plastic waste: An evolutionary game theory perspective. *Front. Environ. Sci. Eng., 14*, 29.

World Bank. (2022). Inflation, consumer prices (annual %) - United States. Retrieved from https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?locations=US&most_recent_value_desc=true

World Bank. (2022). Market capitalization of listed domestic companies (current US$) - United States, European Union. Retrieved from https://data.worldbank.org/indicator/CM.MKT.LCAP.CD?locations=EU-US

World Bank, International Monetary Fund. (2000-2022). Lending interest rate (%) - United States, China, Russian Federation. Retrieved from https://data.worldbank.org/indicator/FR.INR.LEND?end=2021&locations=US-CN-RU&skipRedirection=true&start=1960&view=chart

Zhu, J. (2012). Do Severe Penalties Deter Corruption? A Game-Theoretic Analysis of the Chinese Case. *Chinese University Press*, 1-32.

Zhukovskiy, V. I., & Zhukovskaya, L. V. (2023). On the Concept of Equilibrium in Sanctions and Countersanctions in a Differential Game. *Mathematics, 11*, 4402.

10. Appendix

10.1. Appendix A – EU Sanctions

Russian activity targeted by sanctions	Type of sanction*	Legal basis**	Date initially adopted	Renewal***	Scope
Violations of Ukrainian sovereignty	Individual; geographical	Council Decision 2014/145/CFSP; Council Regulation (EU) 269/2014	17.3.2014	Every 6 months	Close to 1 800 individuals and entities
Violations of Ukrainian sovereignty	Economic; geographical	Council Decision 2014/512/CFSP; is Council Regulation (EU) 833/2014	31.7.2014	Every 6 months	Finance, transport, defence, energy, technology, export-import restrictions
Violations of Ukrainian sovereignty (Crimea)	Economic; geographical	Council Decision 2014/386/CFSP; Council Regulation (EU) 692/2014	23.6.2014	Every 12 months	Trade and financial restrictions
Violations of Ukrainian sovereignty (Donetsk, Kherson, Luhansk and Zaporizhzhia)	Economic; geographical	Council Decision 2022/266/CFSP Council Regulation (EU) 2022/263	23.2.2022	Every 12 months	Trade and financial restrictions
Chemical weapons	Individual; thematic	Council Decision (CFSP) 2018/1544; Council Regulation (EU) 2018/1542	15.10.2018	Every 12 months	Russia: 17 individuals, 1 entity. Total: 22 individuals, 3 entities
Cyber attacks	Individual; thematic	Council Decision (CFSP) 2019/797; Council Regulation (EU) 2019/796	17.5.2019	Every 12 months	Russia: 6 individuals, 2 entities. Total: 8 individuals, 4 entities
Human rights abuses	Individual; thematic	Council Decision (CFSP) 2020/1999; Council Regulation (EU) 2020/1998	7.12.2020	Every 12 months	Russia: 44 individuals, 13 entities (incl. Wagner group & associated); Total: 62 individuals 20 entities

Table 63. Overview of EU sanctions against Russia. Source: EU Sanctions Map

10.2. Appendix B – Alignment with the Sustainable Development Goals

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership[57]

Among the 17 different SDGs, this project aligns perfectly with some of them, contributing positively to the prosperity of people and the planet. The objectives that this project contributes to fulfill are:

- **Goal 16: Peace, Justice, and Strong Institutions**. This goal is based on the promotion of peaceful and inclusive societies for sustainable development, the provision of access to justice for all and the building of effective, accountable, and inclusive institutions at all levels. However, ongoing and new violent conflicts around the world are derailing the global path to peace and the achievement of Goal 16. Alarmingly, the year 2022 saw a more than 50% increase in the number of conflict-related civilian deaths, the first since the adoption of the 2030 Agenda, due in large part to the war in Ukraine[57]. In particular, this project aligns with the following sub-points of the goal:
    - Reduction of all forms of violence and its corresponding morality rates
    - From here to 2030, reduce the flows of illegal weapons.

Figure 35. Sustainable Development Goal 16. Source: United Nations, 2015.

- **Goal 10: Reduced inequalities.** As its name suggests, this goal aims to reduce inequality within and among countries. It is based on ensuring equality of opportunities and promotion of social, economic, and political inclusion of all

[57] United Nations, 2015.

individuals, regardless of age, sex, religion, race or any other condition. In the end, armed conflict always results in augmented inequality, and with this study, we aim to contribute in the design of a punitive method that doesn't require violence and that affects specifically the individuals and institutions it is targeted for, without damaging populations as a whole and increasing poverty rates and inequality.

Figure 36. Sustainable Development Goal 10. Source: United Nations, 2015.