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# A notion of equilibrium in relational form games and politics

Sylvain Pâquet

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Za Orhanu i Taliu,

moje prekrasne male boginje!

# Abstract

This dissertation consists of a development of the notion of equilibrium in non-cooperative games (introduced by John Nash in his doctoral dissertation submitted in May 1950) from the point of view of games played by complex adaptive systems (such as States) who adapt to an asymmetric distribution of bargaining power. The main ingredient of this dissertation is the notion of the contextually normalized solution, that implies that players routinely repeat strategies that work, and that an asymmetric complex game will be in a stable state so long as the set of normal strategies consists of the stronger players' most preferred and the weaker players' least disliked strategies. There is no other generality in rational behaviour; all else is relative to the frame of reference.

**Keywords:** complex adaptive system, contextually normalized solution, game equilibrium, relational form game, State behaviour.

# Statement of Originality

I hereby certify that all of the work described within this thesis is the original work of the author. Any published (or unpublished) ideas and/or techniques from the work of others are fully acknowledged in accordance with the standard referencing practices.

Sylvain Pâquet

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# Preface

1. The world is a circus.
2. At the centre of this circus stands a puppet theatre. There we show political spectacles, where games of power are played every day and night.
3. In this puppet theatre, each puppet is also a puppeteer.
4. No one, not even the puppets themselves, can see clearly who pulls what strings behind the curtains, and they do not even know how long the strings really are.
5. The show may be different every time, but puppets are used to their ways and have limited leeway to move anyway as their strings have finite elasticity and length.
6. Each puppet has its own will and can make its choices, but it cannot go further than the extent of its strings.
7. Although each puppet makes choices, their movement does not necessarily represent their own intentions, but rather the combination of the puppet's pull in its desired direction with the effect of the pull of other puppets on its strings.

8. We could understand the show better if we could imagine what is going on behind the curtains by observing the puppets' movement rather than trying to guess their intentions.

"These will be the first words of my Ph.D. dissertation," I told Abdoulaye Diop, one of my best friends, on the patio of a Mexican restaurant on a warm spring day as my undergraduate studies drew to a close. "You're crazy... I totally agree with you, but people will understand nothing of your theory, and they won't take you seriously if you talk about puppets," he replied. Yet the puppeteer allegory, which was the culmination of my pondering on politics back then, withstood my subsequent studies and it summarizes and constitutes the theme of the theory that is proposed here. I hereby present the result of approximately ten years of hard work, although I am afraid that my friend was right all along.

At the time, I was still a gentle idealist who naively believed that academia was a community of intelligent researchers who sought to innovate and to find practical answers to difficult questions, rather than a business where professionals seek to publish as many papers and books as possible on as little matter as possible. So we find intelligent people who are caught in a publishing and course-selling scheme because they want jobs, and who are afraid to deviate from trends and to say that they (or the popular opinion) have been wrong because of reputation concerns. Alone in my bubble, I was trying to find the answer to a problem that completely ruined the credibility and utility of theories of international relations in my view: the coexistence of contradictory assumptions and hypotheses. I learnt that this problem, which is commonly diagnosed as "paradigm incommensurability" in that field, was addressed in various ways: some of them celebrate it as proof of the diversity of interpretations and recommend to stimulate the inter-theoretical dialogue without trying to reconcile theories; some others use the problem as an argument to ignore general theories and to focus on intuition and empirical studies; and some researchers suggest to synthesize theories or to use any combination of theories freely, in spite of logical incompatibility.

This is why I decided to focus my Master's research on the topic of paradigm incommensurability in the field of International Relations: to look for a good solution to this problem. I had recently learnt from Sextus Empiricus that you should not believe anything blindly and that you should reassess the truth and logic of every proposition yourself, an so I started with a re-evaluation of the diagnosis itself, of hermeneutics, and of pragmatism, before evaluating the relevancy of pragmatism and post-modern hermeneutics separately as potent solution. The conclusions of that research can be summarized as follows:

> "The starting point is the observation of the paradigmatic incommensurability problem in International Relations. It appears that it is rather a problem of theoretical incompatibility because of the assumptions used for research. The difference in diagnosis considerably changes the prescription: it is not enough to stimulate the inter-theoretical dialogue, it is rather necessary to reconcile the logical incompatibilities with a rigorous framework.
>
> This research aims to evaluate the competence of the pragmatic method in International Relations to solve this problem. After having studied inductively

> the conceptual schema around the concepts of paradigms and incommensurability, the state of meta-theoretical debates in International Relations, philosophical pragmatism and the pragmatic method adapted to the discipline of International Relations, we will proceed to an abductive examination of the pragmatic method.
>
> We will find that the pragmatic theory of truth and pragmatic pluralism are interesting leads, but tend towards arbitrariness because they are insufficiently rigorous. By giving the interpreter too much freedom, we accidentally open the door to relativism, although that is not the intention. Pragmatic pluralism is also useful to stimulate dialogue, but it does not solve logical incompatibilities and it actually creates more by suggesting to ignore epistemological contradictions. In other words, pragmatism does not seem relevant in science and it can produce results contrary to its mission, unless we find a way to limit the scope of acceptable interpretation and solve its logical problems. Pragmatism is useful in guiding concrete actions with beliefs, but it appears useless as an instrument to find the truths we need for the discipline of International Relations to become a credible science.
>
> We must therefore find a better solution to solve the logical problems that are the basis of the incompatibility between the theories of international relations. The best thing would probably be to tackle the concordance between presuppositions and reality, in order to determine whether a theory is applicable or not."[1][118][p. vii]

The commonly accepted diagnosis was wrong in the first place: there is no paradigm incommensurability in this field, but rather logical incompatibilities between theories. Thus, the commonly prescribed remedies were not adequate, as they did not address the right problem: the celebration of the diversity of interpretations leads to relativism and a lack of rigour; the focus on empirical studies and the ignorance of meta-theoretical problems leads to lesser ambitions, as they abandon both the scientific method and rigorous phenomenology altogether and let researchers follow their intuition in research

[1]My own translation from French to English.

that "looks" scientific, at best[2]; and theoretical synthesis or eclecticism are very likely to suffer from logical problems because of the incompatibility of underlying assumptions.

I sought to find a solution—I have been looking for it for more than a decade—and the theory presented in this Ph.D. dissertation is the best that I could find[3]. This study thus serves to challenge the non-falsifiable assumptions on the state of nature and rationality that are prevalent in International Relations theories and that contradict each other.

These pseudo-scientific assumptions damage not only the usefulness of International Relations theories, but also their credibility. As an anecdotal proof: political scientists

[2]Using a precise technical vocabulary accurately, excluding first-person pronouns, and adopting text structures akin to rigorous scientific works may give an aura of credibility to any text, but style is not a guarantee of quality. In contrary, a messy and incomplete paper on a seemingly absurd idea (according to popular contemporary beliefs) may hold more truth and be more rigorous despite looking less professional. For example, compare Paul Dirac's Nobel-worthy handwritten Ph.D. dissertation on quantum mechanics[51] to Alan Sokal's bogus paper titled "Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity"[142].

Empirical studies are no truer than purely theoretical studies either, as the propositions in purely theoretical research may be true despite the lack of data, whereas the improper interpretation or manipulation of data—or even the proper interpretation and manipulation of poorly governed data—may lead to nonsensical and false conclusions. It can also be argued that most empirical research in some fields is actually false because of various reasons (such as bad experiment design, improper choice of variables, etc.) and this is why results seem to contradict each other over time even in rigorous fields such as pharmaceutics[83], whereas some theoretical research with no data to support it can be proven true decades after the publication of the seminal papers, just because the logic was right (such as Einstein's theory of general relativity[54][132][131] and Higgs' boson[78][1]).

Finally, using a lot of citations and references may be an astute facade to convince the reader of the veracity of statements, while the critical reader will be surprised to find out that many citations are actually either false or inaccurate, or that statements misrepresent the cited authors' intentions. For example, See Dario Battistella's discussion of post-modernism in his textbook "Théorie des relations internationales"[23]; and compare this to John Nash's Ph.D. dissertation on non-cooperative games, which cites only three references, including one of Nash's papers[106].

In other words, when evaluating the credibility of research, it is preferable to suspend judgement and to evaluate the arguments carefully. Style is not substance, and following conventions is not the same as doing scientific research.

[3]I did not intend to propose a theory at first, as too many researchers claim to be theorists, but I had no other choice as I could not find a single published theory that was adequate to solve this problem. I sought comfort in game theory, network theory, and complexity science with the hope of finding a good solution, but all of them had flaws, unfortunately, as explained in the first part of this dissertation.

often cite researchers from other fields, but are rarely cited by the latter; and policy makers often consult economists, sociologists, and other specialists, but rarely consult political scientists when they seek advice.

This matter of facts, which appears to be either unknown or ignored by many academics in the field political science, echoes old prejudices from natural scientists against social scientists, but is becoming increasingly strong within social sciences against political scientists. The following quotation is a good illustration of such prejudice against social sciences in general from a Nobel laureate in physics:

> "Because of the success of science, there is, a kind of a pseudoscience. Social science is an example of a science which is not a science; they don't do [things] scientifically, they follow the forms—or you gather data, you do so and so-and-so and so forth but they don't get any laws, they haven't found out anything. They haven't got anywhere yet—maybe someday they will, but it's not very well developed, but what happens is, at an even more mundane level. We get experts on everything that sound like they are sort of scientific experts. [...]
>
> I may be quite wrong, maybe they do know all these things, but I don't think I'm wrong. See, I have the advantage of having found out how hard it is to get to really know something, how careful you have to be about checking the experiments, how easy it is to make mistakes and fool yourself. I know what it means to know something, and therefore I see how they get their information and I can't believe that they know it, they haven't done the work necessary, haven't done the checks necessary, haven't done the care necessary. I have a great suspicion that they don't know, that this stuff is [wrong] that they're intimidating people. I think so. I don't know the world very well but that's what I think."[66][p. 22]

This prejudice is actually unfair, as social scientists from all fields have developed a great wealth of knowledge on the social realm. Illustrious characters in pure and natural sciences, such as John von Neumann[4], have also acknowledged that social sciences are still in their infancy and cannot transpose the methods of pure and natural sciences directly, as the social realm is more complex and cannot be described with deterministic models. Such prejudice is common from natural scientists against social scientists, but it is also increasingly common against political scientists from other social scientists and even people who work in politics.

If political scientists' research is not used by practitioners because it is not respected outside their academic circle, then what is the purpose and value of their research? I have been told by a Ph.D. candidate of the George Washington University, in a conference, "why would we seek to have an impact? We only want to have a job and study what we like." Then, why would physicists want to have an impact on physical engineering? Or why would medical research focus on curing illnesses? Some may say that academic research and politics should be separated, but when you study politics and your research has no impact on real-world politics because you lack credibility, then perhaps you should

[4] In the first chapter of *Theory of Games and Economic Behavior*, it is argued that:

> "The importance of the social phenomena, the wealth and multiplicity of the manifestations, and the complexity of their structure, are at least equal to those in physics. It is therefore to be expected—or feared—that mathematical discoveries of a stature comparable to that of calculus will be needed in order to produce decisive success in that field. (Incidentally, it is in this spirit that our present efforts must be discounted.) *A fortiori*, physics will do for social phenomena, too. The probability is very slim indeed, since it will be shown that we encounter in our discussions some mathematical problems which are quite different from those which occur in physical science."[152][p. 6]

As of writing this dissertation, although I looked everywhere for such development, there was no breakthrough similar to that of calculus that would be fit for the study of social phenomena yet.

re-orientate your approach, and this should begin with your assumptions and methods as they are the factors that currently hurt political scientists' credibility.

When I started my Ph.D. studies, my approach was purely philosophical, but I had still not found the solution to my problem; I spent many nights awake, scribbling and drawing on my whiteboard, testing new methods to analyze international relations with incomplete data on the decision-making process. Although I studied physics and mathematics as a hobby, I still held the conviction that social and political affairs were too subjective to be quantified, that the human experience was far too complex to be reduced to simple models, and I would rely solely on rhetoric and symbolic logic in my research.

I finally changed my mind.

I do not believe that my dissertation will have any impact on the fields of game theory and political science, but I am not risk averse so I decided to take a chance, for better or for worse.

I would like to warmly thank my two Ph.D. advisors—Drs. Roland Pongou and Daniel Stockemer—for providing much needed feedback and guidance and supporting someone as stubborn, vague, and difficult to work with as myself. I know I can easily get lost in my thought and that, as a result, what I write is often vague, sometimes nonsensical, and always different from what they expect. Without their unwavering support and smart recommendations, this document would probably be no more than an unbearable cloud of ideas that run anarchically in every direction. Thank you very much Roland

and Daniel—your help is really appreciated. I would also like to thank Drs. Benjamin Ferland, Kevin McMillan, Csaba Nikolenyi, and Robert Sparling for their reviews and helpful feedback, as well as Drs. Walter Dorn, Abdelkader Filali, Dalie Giroux, David Grondin, Patrick Leblond, Fares Said, and Hesameddin Abbaspour Tazehkand for their precious help and advice. Finally, but most importantly, I would like to thank my wife and my daughter—Orhana and Talia—for their love and their forgiveness of my absent-mindedness.

Let the games begin!

# 1

# Introduction

*Suppose that you invent a good guess, calculate the consequences, and discover every time that many of the consequences you have calculated agree with experiment. The theory is then right? No, it is simply not proved wrong [. . . ]*

*Another thing I must point out is that you cannot prove a vague theory wrong [. . . ] then you see that this theory is good, because it cannot be proved wrong! Also if the process of computing the consequences is indefinite, then with a little skill any experimental result can be made to look like the expected consequences [. . . ]*

*It is usually said when this is pointed out, 'When you are dealing with psychological matters things can't be defined so precisely'. Yes, but then you cannot claim to know anything about it.*

Richard Feynman[65, p. 157-159]

## 1.1 Challenges in game theory and social studies

Game theory has evolved considerably in recent decades; not so much on the fundamental level of theory, but thanks to experimental findings and subsequent refinement. Given all the experimental data, it appears that the predictions of game theory are good approximations in laboratory-controlled iterated games, less so in real-life and informal experiments. Not all is great in Wonderland, and we still need to fix some theoretical problems in order to explain anomalies. Behavioural game theorist Colin Camerer thus identified ten important questions that need to be answered:

- "How do people value the payoffs of others? [. . . ]
- How do people learn? [. . . ]
- How do social preferences vary across people and environments (e.g. cultures)?
- What happens when people confront “new” games? [. . . ]
- How exactly are people thinking in games? [. . . ]
- What game do people think they are playing? [. . . ]
- Can experiments sharpen the design of new institutions? [. . . ]
- How do teams, groups, and firms play games? [. . . ]
- How do people behave in very complex games? [. . . ]
- How do socio-cognitive dimensions influence behaviour in games [. . . ]"[36, p. 473-476]

While Camerer had game theory in mind, answering these questions would actually fix many logical problems in international relations theory. It could improve political scientists’ understanding of how and why coalitions form and dissolve, how and why political players make their choices, and in particular explaining and forecasting the result of the interaction between complex players such as States[5] and various organizations, who do not 'think' like individuals do.

## 1.2 International relations theory and the reason of the State

Traditionally, the study of international relations focused on the factors that condition inter-State relations. The State was considered to be the primary actor in international relations. Classical schools (classical realism, classical liberalism, etc.) and conventional schools (neo-realism, neo-liberalism, constructivism, etc.) paid particular attention to the reason of the State. The State, an abstract artificial actor, was caricatured as an anthropomorphic entity capable of reasoning according to its own interests. Answers to these questions of how bargaining works would improve our understanding of the interaction of political players.

The classical schools in Western International Relations studies were inspired by philosophy, in particular the theses of Hobbes, Locke, Rousseau and Kant, in order to pose the hypothesis of a human nature and to transpose it to political players such as States. The political players were assumed to be warmongering or peaceful, egoistic or altruistic, and so on. It was then assumed that there was a normal political reason and attempted to define it. This tradition posed a problem: it presupposed a purely hypothetical and unfalsifiable state of nature.

[5] In order to differentiate political entities called states from sets of conditions called states, because both words will be used extensively, we will hereinafter call the political entity a State with a capital S.

The state of nature is an hypothesis that is unfalsifiable (it is impossible to prove or to disprove it), so it is not a solid foundation for a science.

In order to avoid the pseudo-scientific character of a theory based on a hypothetical state of nature, many researchers have taken the path of formal analysis. At a time when realists and liberals were debating the nature of the international system and political (especially the State) players, the behaviouralists proposed another path. Contrary to the classical approach, which was closer to philosophy and history, behaviouralism proposed to imitate the natural sciences by reifying political behaviour in order to explain it from a neutral point of view. This approach has led to a new way of determining the reason of the State: by using the experimental method and the theoretical developments in psychology, the aim was to discover the premises of normal rationality of the political players.

It was at the end of the debate between the classical schools and the behaviouralists that neo-liberalism and neo-realism appeared. The supporters of these schools wanted to make the study of international politics more academic, more scientific, and more positivist, while retaining a part of the legacy of liberalism and realism. To this end, game theory seemed useful because it allows to examine probable or ideal behaviour according to rules. Since game theory is more a general methodological framework than a true theory, it requires that hypotheses be formulated to interpret the players' reason. It is on this ground that the "neo" schools have opposed each other. A behaviour that seemed rational for one school of thought might seem irrational to the other. The premises of rationality led to folkloric and contradictory interpretations of games.

Game theory also required capricious assumptions: players must be rational, there must be a normal reason, and rational choice must lead to a stable equilibrium. Otherwise, if a player has an interest in changing strategy, then their previous choice was probably not the most rational, which is why the co-ordination of strategies has not kept pace. Since, the Cold War equilibrium has been broken and several critics have shown that the subjectivity and diversity of the players make them irrational, and many have preferred to reject game theory as incompetent and overly restrictive theoretical framework, in particular among the post-moderns but also among other non-positivists and even among some positivists who reject game theory and rational-choice theory.

The reason of the State could no longer be reduced to the national interest; it was now thought necessary, by many political scientists, to open the black box of the State, to explore the experience of the individuals composing it. It was also thought that the richness of human experience is too vast to be reduced to simple models, that inter-subjectivity and identity issues make rational calculation much less objective than expected by positivist theorists. The set of facts retained by one analyst does not represent the whole reality of a phenomenon, and several truths can therefore be said about this phenomenon from a different point of view. Another “debate," between positivists and reflexivists, led to the popularization of the constructivist approach, which attempted to bridge the two camps. Today, nothing is regulated and the two currents develop in isolation. Those who still use game theory in the field of International Relations usually ignore criticisms that could help them make their models more credible and continue to refine equilibrium models, while critics increasingly reject formal modelling in favour of discourse analysis or pragmatic interpretations, for example, even among pure empiricists and quantitative scholars.

In the margins, a promising prospect has gradually taken its place over the last three years in international relations theory. Echoing game theory, complexity science spread in various disciplines before penetrating this field of study. It also provides a general framework for interpreting relationships between interdependent agents.

The framework of complexity science, like that of game theory, is not a rigid framework with fixed assumptions and premises. Rather, it is a conceptual language and a set of methods and models that share the objective of building a general science of systems. Essentially, the idea of complexity can be summarized as follows: a system is not simply the sum of its parts, but rather consists of the set of structures and relations between interdependent parts. Thus, one cannot really isolate a unit or part of the system to understand it, because it is then detached from the conditions that influence it in nature. Based on the idea that inter-State relations are not part of a closed system, but rather a complex network of relations between a multitude of players that adapt to their context, complexity science looks at the possible repercussions of changes at one level throughout the system.

Complexity science thus addresses the main criticism of game theory: linearity and determinism[6]. In doing so, it opens a door: a game, as a closed box, becomes an instrument of impertinent analysis because it neglects external factors that can influence decision-making.

This study will explore the possibility of merging game theory as an analytical tool with notions of complexity science to explain and anticipate the likely behaviour of complex players like the State.

Yet, the idea of studying the interaction of complex players like the State (or any complex adaptive system, for that matter), raises an important epistemological problem: the State is to be treated as a unit, although it is a complex network of nodes that can potentially change if one of its components is perturbed. This is where we begin our adventure in thought.

## 1.3 General question

Can we study the State as a rational unit?

[6]We recognize, however, that evolutionary game theory is arguably non-linear, and that some notions such as rationalizability open the door to relativism.

 

## 1.4 Contribution

This dissertation presents a new theory that is complementary to utilitarian game theory, in that it allows you to analyze non-economic games and games for which the utility value of each strategy is negligible or subordinate to power relations.

Unlike utilitarian game theory, the proposed theory:

- does not rely on the traditional estimation of the ordinal or cardinal utility of a choice as an objective value of the chosen option—which was traditionally the core of the expected utility hypothesis and utilitarian game theory—but rather estimates utility according to frequency of choice with exponential smoothing biased towards more recent choices;
- does not assume symmetry, but rather considers symmetric games as special cases of an asymmetric universe;
- proposes a method to evaluate the influence of asymmetry over decision-making;
- proposes a method to interpret the behaviour of players without rationality assumptions, whereas rationality assumptions were essential to game theory since the publication of John von Neumann and Oskar Morgenstern's seminal book *Theory of Games and Economic Behaviour*[151];

- contends that the reason why the Nash equilibrium and further developments of this notion fail to predict human behaviour accurately is that the associated method is prescriptive;
- contends that useful prescriptions ought to rely on good prediction, in order to allow players to manipulate using their knowledge of what may happen to influence future decisions and avoid sub-optimal outcomes;
- in return, proposes a new solution concept*the contextually normalized solution*and a probabilistic method that can be used as a predictor of human behaviour;
- proposes a new general formula to evaluate the probability of a coordination of strategies as a result of asymmetric power relations.

As for international relations theory, this dissertation:

- suggests that the reason why each major theory is incompatible with one another does not mean that one is better than the other, nor that they are all equal with different points of view, but rather that each theory is a special case that is true if and only if its assumptions correspond to reality for a given case;
- suggests, as a result of the previous proposition, that each major theory with rationality assumptions has a corresponding rationality profile that may be used to conceptualize a typology of complex adaptive players' reasons;

- suggests that various notions of equilibrium in international relations theory, such as uni-polar vs bi-polar vs multi-polar equilibria, and that various behaviours, such as the balance of powers and bandwagoning, may be normal in the case of the interaction of some specific types of players and not in other cases, because of the difference in how they reason their behaviour and adapt to their context;
- suggests that every player may behave differently, but that most follow some observable trends and that the more rigid is a system, the less flexible is the agency of players within;
- thus, most approaches in the field of International Relations that rely on sets of assumptions regarding normal behaviour and approaches that try to synthesize them are inadequate as general approaches, but may be good to study social cases. Most current hypotheses in international relations theory correspond to special rather than universal theories because every player behaves differently and that, for an hypothesis to be true, its premises need to correspond to the matter of facts of the specific case at hand;

As a result, the new theory is proposed as a means to fix some ontological problems and epistemological questions in international relations theory, but also as a way to reunite contradictory theories under a rigorous framework.

 

We are also conscious that social players' behaviour and social phenomena are usually not deterministic, and we were careful not to make improper epistemic transfers from deterministic theories.

Therefore, we believe that this dissertation brings an interesting theoretical contribution to both game theory and international relations theory.

## 1.5 Outline

### 1.5.1 Can we study the State as a rational unit?

Chapter 2 deals with the implications of studying the State as a rational unit, as a black box that seeks to satisfy its interests rather than a complex network of players that may manipulate it according to their own agenda.

It is shown that the State is not a thinking entity and, consequently, we have no reason to believe that it will act rationally to optimize its gains according to interests defined in terms of survival, stability, or power. As a complex adaptive player, the State adapts its behaviour according to the dynamics on two distinct levels: the internal game between all players that manipulate it (e.g. politicians and lobbies), and the external game with players that interact with it (e.g. other States).

As the State is seen as a unit in its relations with external players, it takes the *de facto* shape of a unit in external games; then, the State and other players may adapt their behaviour not only to the pressures of unseen internal players, but also to the perceived resulting behaviour of other meta-players on their level of abstraction.

Yet, what is at play within the black box of the State is what sets the conditions of its behaviour. The reality of any complex adaptive system such as the State is that of a socially constructed entity, where individuals and factions socialize and normalize their behaviour according to sets of rules and conventions. As the constitution of the group and its conventional behaviour is socially constituted—rather than determined by rigid rules—the behaviour of any complex adaptive system is flexible within the boundaries of what is accepted within the community.

Consequently, the behaviour of the State, as a unit, is the reflection of what is going on inside its black box and in its interactions with other meta-players. The State can then be seen as a rational player that follows a normalized rationality, even if we know nothing about its internal game, but it should never be considered as a utility-optimizing anthropomorphic player.

### 1.5.2 Is the State a rational unit?

Chapter 3 deals with some challenges of utilitarian game theory; we coin "utilitarian game theory" the entire range of game-theoretic studies that analyze the behaviour of player as a result of utility considerations. All game theory prior to the redaction of this dissertation is considered "utilitarian" in that sense, be it classical, evolutionary, or behavioural game theory.

It is argued that the notion of utility is beautiful as it gives great explanatory power to game theory with a very simple notion, but that it also constitutes its Achilles heel: because it is too wide-encompassing, and because the analyst has ultimate freedom in granting utility values for any variable that is not objectively quantifiable, it can lead to problems such as relativism, scientific cheating (e.g. setting utility values that prove an hypothesis), and arbitrariness. As a result, game theory is unfalsifiable whenever utility is not objectively quantifiable.

Moreover, multiple equilibria can be seen over time in international relations, and so we may explain why they are temporarily stable as a result of normalization, rather than utility optimization.

#### 1.5.3 Can we understand the State using a formal model of rationality?

Chapter 4 deals with the challenges of forecasting a complex adaptive player's behaviour.

As each player may behave differently as a result of a different worldview and different considerations of what is rational and what is desirable, then we cannot define laws of normal behaviour. In other words, we cannot build a working positivist general theory of social and political behaviour because every player's behaviour may follow different patterns and even change over time.

Additionally, as a complex adaptive system such as the State adapts its behaviour according to internal and external games, its behaviour may be difficult to predict according to concepts of linear solutions; but because it may be difficult to see what is really going on, and because we cannot inquire into the psyche of a non-thinking entity, it is best to observe patterns of behaviour and thus assess the likelihood of foreseeable choices.

#### 1.5.4 Towards a typology of international relations theory?

Chapter 5 deals with the problems of a general theory of interactive behaviour in international relations.

Positivist International Relations theories usually defend assumptions on what is rational and what is not, and what is the normal reason of the State (e.g. seeking power or stability, absolute or relative gains, etc.) However, theories and interpretations in social sciences are rarely neutral, and often reflect the values and prejudices of researchers. As a result, what may seem normal or rational to one interpreter may seem abnormal or irrational to another, and a theory whose rationality assumptions do not correspond to a player's reason is not adequate to explain that player's behaviour. For a theory to be true, its assumptions need to correspond to the observed reality.

Then, if each positivist theory of International Relations can correspond to some—not all—player's reasons or given games, then these theories may be used as special rather than general theories of interactive decision-making. And if a theory is based on a given rationality profile, then that theory may correspond to a type of player.

If we could create special theories for each major type of major players in international politics, then we could create a typology of International Relations not unlike the typologies that we see in psychiatry, psychology and criminology. This would be a way to reconcile in a logical manner theories that may seem irreconcilable because of their contradictory assumptions, and therefore fix the presumed problem of "paradigmatic incommensurability" in the field of International Relations.

#### 1.5.5 How can we explain the behaviour of the State?

Chapter 6 presents the main research question, the hypothesis, and the verification strategy. It also discusses some logical implications and the relevance of this study.

#### 1.5.6 Relational form games

Chapter 7 presents the core mathematical model of the theory.

We present relational games as games between players where norms are socially constituted and where players thus follow patterns with some flexibility to deviate from them. The assumption is that observing the patterns in players' behaviour would provide more insight into the player's reasoning and likely future behaviour than utility calculations.

 

We also present a new solution concept: the contextually normalized solution. An equilibrium is never stable in Nash's sense; it is the result of a temporary normalization of behaviour that will be stable until a perturbation re-normalizes the game differently, on another saddle point.

Then, behaviour is rational if it is consistent with the player's patterns, rather than utility-optimizing.

### 1.5.7 Philosophical considerations

Chapter 8 discusses some philosophical considerations of the theory, more precisely:

- What is the purpose of knowing the contextually normalized solution?
- Rationality and the likelihood of deviation.
- Qualitative forecasting.

### 1.5.8 Implications and empirical results

Chapter 9 presents some variables that may influence the behaviour of complex adaptive systems such as the State, with intuitive explanations.

Four variables are presented: the level of political stability, the hierarchy and the openness of decision-making, the similarity of regimes and ideologies, and the relative bargaining power.

This is not a comprehensive list of all factors that influence their behaviour, but only the most common and important ones.

#### 1.5.9 Experimental tests

Chapter 10 presents the expected contextually normalized solution for a series of games, and compares its predictive and explanatory power to that of the most commonly used solution concepts in game-theoretic literature in light of experimental results.

#### 1.5.10 Diagrams

Chapter 11 presents a pen-and-paper method to apply the theory with a minimal amount of data, using the proposed mathematical model, with a test study of the motivation behind Japan's efforts to conclude regional agreements with East Asian partners.

#### 1.5.11 Test case study

Chapter 12 presents a data mining method to apply the theory with a large data set, using the proposed mathematical model, with a test study regarding the relative power of the USSR or Russia and the USA at the United Nations General Assembly.

## 1.6 Preview of the proposed mathematical model

The model summarized below is described in more complete detail in chapter 7.

 

A relational form game $\Gamma$ is a model of interaction where interdependent players try to influence—with possibly unequal relative power—the behaviour of one another and that of the group as a unit-player. It is defined as follows:

$$\Gamma = (\mathcal{M}, \mathcal{S}, \mathcal{R}, \mathcal{P}) \tag{1}$$

In this game, $\mathcal{M}$ (for marionettes) denotes the set of players for an $m$-person game, where we label the players from 1 to $m$.

$$\mathcal{M} = \{1, 2, \ldots, m\}. \tag{2}$$

The strategy powerset $\mathcal{S}$ of a relational form game contains the strategy space of every player as its elements. There is a finite pure strategy space $S_i$ for every player $i$, which includes all pure strategies $s_i^{i^k}$ that are available to that player for a given iteration of a given game according to the player's capabilities(where the subscript is the player's identifier and the superscript is the strategy's identifier, so $s_i^{i^k}$ is a given strategy for a given player $i$). We label the strategies from 1 to n.

$$\mathcal{S} = S_1 \times S_2 \times \ldots \times S_m \tag{3}$$

$$S_i = \{s_i^1, s_i^2, \cdots, s_i^n\} \tag{4}$$

$$\mathscr{s}^* = (s_1^{1^k}, s_2^{2^k}, \ldots, s_m^{m^k}) \in \mathcal{S} \tag{5}$$

where $\mathcal{S}$ is the powerset of all strategy sets, $S_i$ is the set of all pure strategies available to player $i$, $s_i^{ik}$ is a given pure strategy $i^k$ of player $i$, and $\jmath^*$ is a given strategy profile. The lack of decision is still a given strategy in the strategy set and the strategy profile.

We assign a probability value, rather than a simple scalar, that varies through time according to the statistically observed trend in the use of each strategy.

$$u(s_i^{ik}) \equiv P(s_i^{ik}) \tag{6}$$

We evaluate three distinct probabilities:

$$\mathcal{P} = P(s_i^{ik}), P^{dom}(s_i^{ik}), P^{res}(\jmath) \tag{7}$$

where $P(s_i^{ik})$ represents the probability of player $i$ choosing strategy $s_i^{ik}$, $P^{dom}$ is the probability that a given strategy will be part of the chosen strategy profile, and $P^{res}\jmath^*$ is the probability that a strategy profile $\jmath^*$ is the result of an iteration of the game, respectively.

We evaluate three distinct probabilities:

$$\mathcal{P} = P(s_i^{ik}), P^{dom}(s_i^{ik}), P^{res}(\jmath^*) \tag{8}$$

We now define two rates to measure the influence of a player over the solution of a relational form game:

$$\mathcal{R} = (\rho^{perso}, \rho^{rel}) \tag{9}$$

The personal success rate of player $i$—$\rho^{perso}$—can be estimated as the ratio of a player's success in agreeing with the final group decision over the sum of all tries, smoothed such that more recent iterations reflect shifts while reducing the bias of noise and exceptions:

$$\rho_i^{perso} = \frac{\sum_{t=1}^{\tau} 2^{t-1} v_t (v_t + w_t)^{-1}}{2^t - 1} \cdot 100\% \tag{10}$$

where t is the point in time (from 1 being the farthest observation in the past to $\tau$ being the latest one), $v_i$ is a success and $w_i$ is failure, so the sum of all $v$ and $w$ is the sum of every iteration of a game where a player chooses an option.

Using each $\rho^{perso}$, you can then find their relative bargaining power by dividing the personal success rate of a player by the sum of the personal success rates of all players:

$$\rho_i^{rel} = \frac{\rho_i^{perso}}{\sum_{i \in \mathcal{M}} \rho_i^{perso}} \cdot 100\% \tag{11}$$

$P^{dom}(s_i^{ik})$ is then the product of $u(s_i^{ik})$ by $\rho_i^{perso}$.

$$P^{dom}(s_i^{ik}) = \rho_i^{rel} u(s_i^{ik}) = \rho_i^{rel} P(s_i^{ik}) \tag{12}$$

Let $\mathscr{s}^* = (s_1^{1^k}, s_2^{2^k}, \ldots, s_m^{m^k}) \in \mathcal{S}$ be a given strategy profile. The probability that $\mathscr{s}^*$ is the result of an iteration of a game is equal to the ratio of the sum of the probabilities of domination of each strategy in that profile over the sum of the probabilities of domination of all strategy profiles. We denote this by $P^{res}(\mathscr{s}^*)$. We define the probability of domination of $\mathscr{s}^*$ by:

$$P^{dom}(\mathscr{s}^*) = P^{dom}(s_1^{1^k}, s_2^{2^k}, \ldots, s_m^{m^k}) \tag{13}$$

$$= P^{dom}(s_1^{1^k}) + P^{dom}(s_2^{2^k}) + \ldots + P^{dom}(s_m^{m^k}) \tag{14}$$

We now define $P^{res}(\mathscr{s}^*)$ by:

$$P^{res}(\mathscr{s}^*) = \frac{P^{dom}(\mathscr{s}^*)}{\sum\limits_{s \in \mathcal{S}} P^{dom}(s)} \cdot 100\% \tag{15}$$

Probabilities are updated following every iteration of an event. This means that the probability of an event may change from one iteration to another, either as a result of the reinforcement of a normalization or as a counter-reaction to the result of the previous iteration. The transformation of the mapping from one iteration to the next has therefore the potential to move the point of gravity of the strategy powerset.

We define the contextually normalized solution $\varepsilon$—the key ingredient of our theory—as a normal coordination of strategies that lasts as long as the dominant direction of the group is not perturbed; it is not necessarily a stable saddle point. A complex adaptive system will move in the direction of the dominant player's most preferred and the weaker players least disliked strategies (that is the direction of the strongest pull on its strings). The contextually normalized solution $\varepsilon$ is such a solution that would repeat itself through multiple iterations.

$$\varepsilon = \underset{\mathcal{s}^* \in \mathcal{S}}{\operatorname{argmax}}[P^{res}(\mathcal{s}^*)] \tag{16}$$

It follows that players will adapt their behaviour until it normalizes, and then follow their normal tendency as long as there is no perturbation to trigger a deviation. It also follows that, in an interaction between two or more unequally powerful players, the solution should include the stronger players' most preferred and the weaker players' least disliked strategies. Thus, an equilibrium need not be a co-ordination of least invadable strategies, as it is conventionally thought; any normalized solution is stable as long as all players accept it.

# Part I

# What we 'know'

*In general we look for a new law by the following process.*

*First we guess it. Then we compute the consequences of the guess to see what would be implied if this law that we guessed is right. Then we compare the result of the computation to nature, with experiment or experience, compare it directly with observation, to see if it works. If it disagrees with experiment it is wrong.*

*In that simple statement is the key to science. It does not make any difference how beautiful your guess is. It does not make any difference how smart you are, who made the guess, or what his name is. If it disagrees with experiment it is wrong. That is all there is to it.*

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RICHARD FEYNMAN[62]

# 2

# Can we study the State as a rational unit?

## 2.1 Of complexity: the State is a complex adaptive system that does not follow pre-determined rules of behaviour.

*It is not because a State does not necessarily have a conscious, consistent or coherent reasoning that it is irrational. Like an ant colony organizes and carries out tasks that are beyond the faculties or will of each ant in the group, the behaviour of a group can express a reason that results from the interaction of its units, either by accident or by design. As the actor-network theory suggests, any network can be seen as an actant if it produces* *actions; this is the case of the State*[7]*. Every part of the network that constitutes the State adapts to the stimuli of the network and the State itself adapts to other systems on various levels (notably the national system and the international system). This is why the State's choices vary, but are not completely unpredictable. Such a group is labelled a "complex adaptive system" in the language of complexity science. A system is said to be complex if its dynamics cannot be explained nor predicted adequately in terms of deterministic rules describing their behaviour; it is said to be adaptive if it adapts to its context rather than following a linear path[69]. So a CAS is characterized by regularities in the data, that can be compressed into a package of information about them, their environment and the interactions between their units and outsider systems.*

[7]The core of the problem addressed here is not a matter of identity. The State is only one case of complex adaptive systems to which the model may apply (international organizations and firms being other examples), so it was deemed more important to discuss the definition of complex adaptive systems than the definition of the State, or its nature, especially in consideration of the pyrrhonist and existentialist framework that is used (meaning that we should not assume a nature of the State). So, the State is implicitly seen as a large group with internal and external dynamics that exhibits political actions. It is not the government, but rather the abstract entity that makes actions on its behalf. Most social scientist have embraced Max Weber's definition of the State, defined as a human community that successfully claims the monopoly of the legitimate use of physical force within a given territory. Before even Max Weber's definition of the state, many theorists before him had contributed to the definition of what is the state. In a book called *The Laws*[115], Plato also explained that the State is an evolution of tribalism, where some families or groups form an entity to manage and govern the community, or the city. The ideal State would be one led by reason rather than passion, and would therefore be more rational. Of course, there is extensive contemporary literature on the topic, too. However, in general, most scholars agree that the State and the government are two distinct entities; the government is the body that participates to deliberations and that makes the official decisions, whereas the State is the machine that makes recommendations, commits the actions, and plays the symbolical role in interactions with external players. This definition is implicitly adopted in the dissertation, beside the State being one case of complex adaptive systems.

### 2.1.1 Explanation

Consisting notably of the general systems theory and the chaos theory, complexity science is a family of theories that study non-linear phenomena. It focuses on problems that are dynamic and that may appear unpredictable according to a linear, deterministic or one-dimensional approach. Assuming, as chaos theory suggests, that a minor stimulus at one level can have major repercussions at another level, it focuses on the analysis of relationships and networks as a non-divisible whole. The approach of the black box, or the closed network *ceteris paribus*, becomes an absurdity because it isolates the actants from their factors of influence. Complexity science thus probabilistically evaluates the likely results of the interdependence of the nodes of the networks.

It is on this ground that complexity science takes over international relations theory. In order to avoid determinism, James Rosenau[124] proposed a complete re-conceptualization of international relations theory in light of complexity science. In particular, he proposed abandoning the Cartesian metaphor of the machine, according to which every system can be understood as a machine that produces results that can be predicted following the initial factors; a system then becomes a set of interconnected relationships, such as a spider's web, that cannot be predicted in a deterministic manner by linear functions. It also proposed rejecting the state-centric perspective, since foreign policy would also be outside the yoke of States and that a tiny change at the micro level could potentially have major macro-level implications: this is the effect of turbulence. Finally, in order to understand the policy of a State, one would have to understand both what is going on inside and outside it, which would render inadequate any perspective centred on the reason of the State.

Network theory and the actor-network theory, two parts of the family of complexity science, are useful because they make it possible to schematize the links (social relations and possible relationships of influence) between the nodes (actants or actors) of a network. Thus, they are useful for observing social relations in their context, depending on the set of variables that are considered influential, rather than in an overly simplistic imaginary context. As part of complexity science, they are also useful in observing how weak individuals or nodes can exert influence on much more powerful nodes, considering abilities.

### 2.1.2 Caveat

Now, two common criticisms can be made of these theories. First, interdependence and network density are considered to be determinants of behaviour. It is difficult to tie considerations of density and centrality of nodes in networks with considerations of asymmetric power and deviant will; it is possible, nevertheless, in many but not all cases. Second, in reality, units may deviate from the normal trend, or even imposed rules, if they so desire and have that capacity. Thus, it is not enough to observe the links between political players in order to understand the games of power, where wills and interests are contrary or common. There, we have relational form games, rather than strategic form games: the impact of relations between players over decision-making is no less negligible than utility, and player's interdependence must therefore take into account indices of relative power in conjunction with the probability that each player prefers any given strategy, rather than the probability of success of a given utility.

While game theory is useful in understanding players' reactions to one another, complexity science allows you to study the dynamics of interdependence that condition these reactions. While game theory offers a simple method for evaluating the interaction of a few players in symmetric games, it does not offer as an effective method for evaluating complex relationships as complexity science does. However, complexity does not make it possible to evaluate in a simple way the interactions between complex players such as States or communities (in the sense of unitary entities that maintain relations together). There is currently no method, either, to evaluate relational form games. It is this void in the theory that the present dissertation aims to fill.

### 2.1.3 Consequence

The reason why game theory has so much difficulty predicting the behaviour of the State and change in international relations is actually because the State is a complex adaptive system.

## 2.2 Of the interaction of complex players: when two complex adaptive systems interact, their representatives usually recognize their counterparts as agents of the systems. When the latter evaluate the available strategies, they think about the relationships between these systems.

*The State remains a unit within the international system on two levels: on the one hand, the representatives of one State represent and must defend the interests of the nation and, on the other, the State remains symbolically the entity that interacts with other institutional players.*

### 2.2.1 Justification

If a representative of a permanent member of the UN Security Council uses the right of veto, it is symbolically the State they represent that uses that right. If diplomats and ministers negotiate or ratify a treaty, it is the States they represent that matter and do the action, not the individuals who have played the game. Moreover, although these individuals make choices that may result from subjective or sub-optimal reflection, political structures and the surveillance of other individuals in their environment prevent them from making completely abnormal or arbitrary choices. Thus, although at the practical level we are witnessing complex and confidential relations between a multitude of individuals, the State remains a symbolic and instrumental unity.

As Rebecca Adler-Nissen[5] explains, diplomats often have a bad opinion of International Relations theorists because the latter focus on the substance of phenomena rather than continually evolving relations between agents. While the "real world" of diplomats is that of relations between States and their agents, academic theories often tend either to the over-reduction of the interests of macro-players or to esotericism of little use to practitioners.

The State takes on the appearance of a unit through its actions, though it is not a conscious being. Such a conception echoes conventional perspectives: Kenneth Waltz[154], for example, remarks that a State usually appears to other States as a unit. If the leaders of one State perceive the actions of the leaders of another State as those of the State itself, then inter-State affairs can be regarded pragmatically as non-cooperative games between unitary State entities. This abstraction remains useful if and only if we do not pretend that States are anthropomorphic thinking beings.

It happens, moreover, that States remain dominant players in war and peace. States are still threatening and armed forces are deployed against both State and non-State opponents. States are still those who negotiate international peace, and it is they who must ensure peace on their territory in a context of peace; at least for now. Thus, considering recent developments in security studies, it is always useful, if not necessary, to study the State as a unit in its relations with other State and non-State players. Inter-State relations are composed of relational adaptations, not linear mechanisms.

### 2.2.2 Consequence

Since the State is still a useful category in diplomatic thinking, it can be studied as a decisional unit in matters of diplomacy, the choices of which result from its internal deliberations. In terms of security, in particular, the interests of a diplomat or head of State must reflect the interests of the group they defend.

## 2.3 Of the unity of the State: the State, as a complex adaptive system, is a practical unit in its relations with other States and non-State players.

### 2.3.1 Justification

Since the ratification of the Treaty of Westphalia, the State is in principle the principal and most powerful player on the international political scene. Ratified in 1648 and concluded at the close of the Thirty Years War, it served to stabilize international politics in Europe by declaring equality between sovereign States and the monopoly of the legitimate force of a State on its territory.

Since then, the reign of the sovereign State has been consecrated throughout the world. Almost any land territory is subject to the authority of a State; only the State has a legitimate right to use force to wage war or maintain peace; only the State has the power to define the law and to sign international treaties; officially, at least.

### 2.3.2 Caveat

Today, as in the past, several players are opposed to State power or infringe upon it. Several non-State players, both members of civil society and companies, organize lobbies aimed at diminishing State control in the market; the World Economic Forum is an example of such action. Others deny the State monopoly of force; for example, rebellious and secessionist militias, the ISIS assault in the Middle East, or the use of private mercenaries and firms by corporations to protect their interests in Africa and Latin America.

The monopoly of force has never been perfect and the typical ideal presented in textbooks has never existed all over the world simultaneously. Whether the power of the State is eroded or transformed, it is evident that it no longer has the monopoly of force, whether legitimate or not. In some cases, as in several African countries, the State has never even taken the ideal-typical form of the Westphalian system; it has adopted some modern institutions, which are sometimes overridden asymmetric by older political traditions.

### 2.3.3 Consequence

Whether the State is weak or strong, Westphalian or not, it remains an important player in international politics and it is essential to understand how its behaviour works. Yet, we need to consider the influence of non-State players, too, in order to properly understand the dynamics of power.

## 2.4 Of non-State players: some non-State complex adaptive systems, such as international organizations, also play games of bargaining with States

*At the time of their creation, international institutions are given a certain degree of autonomy to ensure that they can exercise their functions without the political interference of outside players. They are not innocent or apolitical: they serve a political purpose, which is either elaborated from within or by external actors. Although some schools of thought argue that international organizations reflect the interests of their agents and others assume that they are units, the reality is still more complex: each organization has a different level of autonomy that may change over time, and they are both manipulated and manipulative to varying degrees. Authority in the age of globalization is thus diffused through the political games that take place, in particular, in the context of international institutions.*

### 2.4.1 Justification

International organizations exert significant power over political and economic players. For example, the policies required by the World Bank and the IMF often drastically change the political and economic environment of countries that accept assistance.

It is not only universalist or humanist projects that are put forward through international institutions. As noted by Robert Axelrod[16], the majority of international interactions take place in the context of international institutions. International politics, in the era of globalization, is now taking place on a global scale through institutions that govern, normalize, and structure relationships. In the sense that international organizations can exercise legal or political authority over States and contribute to the social world, it may be fair to consider them as agents rather than mere structures.

There are various dynamics of power where one player can exercise their power over another[20]. There are, on the one hand, direct relations of power, in which an actor can impose his authority directly, or through the manipulation of systemic structures: there would be, on the other hand, diffuse relations of power, where actors can indirectly control distant players by playing with institutional rules and arrangements, or through the social production of subjects through hierarchies and interdependence. In any case, each of these power relations assume that a player can manipulate games in their favour. This presumption is just on condition that we retain its bi-directional character: if a player may try to manipulate a game in their favour, it must not be forgotten that the other players can also do the same, they are not only subjects or agents. In contexts where there is no player privileged by a structure (for example, a right of veto or an incontestable power), there is therefore no direct authority of a player because the struggle for power diffuses authority.

It is true that States delegate a share of power and autonomy to international organizations to serve their own interests. Some research suggests that while some international organizations actually obey the expectations of mandatory States, others have an important level of autonomy[76]. International organizations thus appear as puppets, manipulated by other players, but the former can also manipulate the latter to varying degrees. It all depends on the players and the games we are dealing with.

In this case, global governance and governmentality, for example, are games where power is more or less diffuse depending on the level of control of one player over the others. The more a player dominates the others in terms of strategy and power, the more they are able to control the game. Since there is no supranational authority or State empire that dominates the world, these dynamics remain diffuse and weakly controlled.

### 2.4.2 Consequence

States, therefore, are not the absolute masters of global governance, but they continue to influence and manipulate it. Moreover, in practice, international law and political workers always regarded the State as a legal person, acting on behalf of its nation, having relations with other players and taking part in international negotiations (through individuals who represent it). It remains useful to study the State as a unit, as a legal person representing the interests of its parts (chiefs, ministries, lobbies, etc.)

## 2.5 Of anarchy and international organizations: authority on the international stage is diffuse, but the State still has a final legitimate authority.

*The State grants authority and autonomy to international organizations, but it does not retreat. It is not only a transfer of competencies, but rather a transformation of the logic of authority[134]. International organizations then become manipulative and manipulated to varying degrees, as do States. Authority in international institutions is diffused because it results from games played between players who try to influence other players and the game itself in their favour. Since the game is practised between players who may have divergent preferences, interactions in international institutions play in the narrow corridor between harmony and discord, where interests can rejoin. No one controls international politics, let alone global governance, since it takes place where the political authority of one entity is insufficient at present.*

### 2.5.1 Of security: security is a response to a threat, a choice to identify a phenomenon as a national or international security issue. The reason of State and the national interest are therefore subjectively determined by agents of the State.

*Security policy is a choice that is made from a range of options in response to the conditions of our social environment. Everything is a matter of choice: We choose our interests and identities which accompany them[102, p. 11-21]. Security depends on our choices of interests and identity. Players always make a choice even when the options are limited to conforming or resisting the structural constraints[102, p. 216]. Military conflicts are political choices that result from rational calculations, which may be subjective as well as objective, and reason is not necessarily objective: the structures and the social environment are subjectively interpreted and then objectified in order to incorporate them into the reason for the choices.*

### 2.5.2 Justification

Whether the concept of security is essentially contested or underdeveloped[18], there is still no consensus on the nature of security. Today, security studies nevertheless tend towards the notion of security as a response to what is interpreted as an existential threat. Contrary to the state-centric and national security perspectives, which were favoured by conventional approaches until the end of the Cold War, critical approaches argue that a multitude of actors and dimensions must be taken into account. War, peace and security are not the business of the most powerful States only, but of all States, for the power of a State is often built at the expense of another State which is exploited or dominated[19]. They are not only the affair of States, they are the affair of all those who are affected by the stakes. An ontological pluralism is thus privileged.

Strategic studies traditionally adopted a state-centric approach. Game theory and the hypothesis of rational choice were then at the heart of research.

Security studies today tend to adopt a broader perspective: the safety of every player would be a condition to the security of all[32]. From this perspective, national security is only one dimension of security. Since security is not the exclusive business of the State, it becomes apparent that it extends beyond national security. Traditionally, international relations theory attached security to the State in a symbiotic relationship: it was assumed that the State serves to ensure the safety of individuals by structuring social life with a set of rules made to exit the "state of nature." This conception presents paradoxes. For example, disciplinary mechanisms are normally aimed at ensuring national and collective security, but they can constitute a major threat to freedom[31] and even to the lives of individuals. Anyway, since it is traditionally postulated that the State is meant to secure society and that, on the other hand, a climate of instability could be detrimental to the security of the State, it may appear that national security encompasses all objects of security. It is this idea that is challenged by recent criticism.

The field of strategic studies during the Cold War were aimed at discovering the objective factors that cause war and peace. As exemplified by Robert Jervis in his article "Co-operation Under the Security Dilemma"[86], an attempt was made to model international politics, including security issues, as formal games. Similarly, attempts have also been made to determine the variables that condition political games. The result has been an array of interesting, coherent and credible interpretations, albeit contradictory with respect to the premises of rationality and anticipated equilibrium.

Assuming that the State defends national security interests, it is assumed that individuals who determine its interests conceive of the State's interest in a similar way. Yet, history shows that awareness of a threat may differ from one leader to another, which invalidates this idea. David A. Welch[155] raises two difficulties that plague rationalist state-centric analyzes. On the one hand, while States were rational entities that always sought to promote their security, it was necessary to determine the security interests of each State. On the other hand, he recalled that it is difficult to argue that the State has a static reason, since political orientations can change radically over time. At best, a state-centric explanation can explain the reason for one or more given States at a given time, in a given set of situations.

Today, the increasing role of private military firms in the development of security discourses and conflict management should not be overlooked. Several non-State groups have security interests. Each level of analysis is important because it offers a different understanding of individual and collective interests behind national interests[33].

It was in this spirit that Bill McSweeney proposed a theory of social action in international politics. Social action would be reflexive in the sense that actors observe their behaviour and that of others. They then adjust their strategies according to the social environment. Players play within the bounds of rules and social norms in order to conform to consensus or play skillfully in other directions. Reflexivity would be partially unconscious and the self would become an element of inquiry[102, p. 140-141].

### 2.5.3 Consequence

Many theorists of International Relations maintain, to this day, that an a-historical theory of politics is vain: a theory is logically attached to its context by its assumptions. Such criticism is not only destructive; it is constructive in the sense that it forces us to open the black box of the State and broaden our perspective in order to better understand the possible impact of a multitude of factors. It is here that complexity science assumes its importance: since it is not sufficient to study inter-State relations as linear mechanisms, we must take into account a multitude of both subjective and objective factors and the relationships between these factors in order to better understand a complex reality, where several factors are interrelated.

## 2.6 Of the economy: the delegation of power is a conscious re-organization of games; therefore, when the State adopts more liberal policies, it manipulates the rules of the games rather than concede defeat to non-State players.

*The State maintains control over the currency, regulation, and deregulation. It is the State that sets the rules and market standards, sign regional agreements and negotiate in international economic institutions. If one moves away from post-modernism or even post-structuralism, those who defend a state-centric conception also argue that these changes must be interpreted as a transformation or a delegation and not as a diminution of the power of the State. Robert Gilpin[70], for example, considers that globalization has not contributed to a weakening of the State, nor to an effacement of its power over its borders. In fact, States would always be the masters of their economic policies and the policies they adopted showed only a change in their means. For example, economic regionalism would be a response of States to defend their common interests in an increasingly integrated and economically competitive world. The State thus remains, in political economy too, a useful category to be studied as a unit.*

### 2.6.1 Justification

For the classical economists, the economy was naturally political. Adam Smith[137], the father of the notion of the"invisible hand," did not believe the market would be perfect and balanced in the absence of State intervention. His conception of the invisible hand assumed that sectors of the economy that are weak because they are neither profitable nor competitive are doomed to disappear; thus, profitability naturally brings a state of equilibrium: the invisible hand of the market would make it possible to relocate the resources where the market is more profitable, according to the principle of the survival of the fittest[8]. State intervention against this phenomenon would be sub-optimal given that it would not solve the problem at its core. The aim is to promote and facilitate the exploitation of comparative advantages and to abandon disadvantageous sectors, so as to maximize the gains of the exchange[123]. All that is prescribed is that the State does not intervene in the market directly, but that it helps and promotes the exploitation of comparative advantages. Here, the economy is political in the sense that it depends directly on the State, which establishes the conditions of its existence and its rules, and because it provides power.

Robert Gilpin[70, pp. 28-30] notes three broad approaches in economics that serve to interpret political behaviour: the public choice approach, which assumes that indi-

[8]The principle of the survival of the fittest was coined and popularized by Herbert Spencer in *The Principles of Biology*[143], first published in 1864, as an interpretation of Charles Darwin's *On the Origin of Species*[45]. Adam Smith's work therefore predates the coining of this principle by many decades, although the idea of the invisible hand is related in essence.

viduals manipulate political devices in a way that promotes their interests of economic development; neo-classical institutionalism, which assumes that economic policies and institutions are the result of intentional actions chosen by rational individuals to maximize their economic interests; and the new political economy, which assumes that economic policy is the result of distributive policies and competition between groups and individuals seeking to promote their private interests. What is unique to each of these approaches is that they tend to reduce players to the ideal type of a *homo œconomicus rationalis*, a rational player who chooses according to a reason that seeks utility optimization. There is consequently an ideological bias that neglects the social and political aspects, as well as the possibility that a player argues against values that are not selfish.

Susan Strange[146] argued that the rhythms of the international political system and the international economic system do not follow each other, creating an imbalance in the relationship between politics and the economy. According to her, three types of changes in international economics disrupt international relations; there are the direct effects of State intervention on the economy on the States themselves, which modify the conditions or the conjuncture of their economy; there are also barriers, that is, coalitions of interests between national economies that diminish the effectiveness of economic policies; finally, there are competitive policies, whereby the economic interests of a State lead it to adopt measures which directly harm the interests of other States. In the face of change, States can respond both through co-operation, in order to distribute and promote collective gains, or through defence, focusing primarily on their domestic interests.

In this vein, she argued that the real power over the international economy is gradually escaping from the control of the State[147], that the State still controls the structure of the system, but that the progressive erasure of economic barriers reduces its sphere of authority. This interpretation is interesting because it leads to a reassessment of the power of the State on the international stage, without involving a loss of control of politics.

In turn, Georg Sørenson[148] argues that globalization is disrupting the old benchmarks of modernity and that we are going through a transitional phase. Henceforth, the power of the State would be defined not as the capacity to impose its order in the international sphere, but rather to influence the other players to accept its projects. There would thus be no retreat of the State and its political power, but rather a transformation and adaptation to a new environment.

Philip Cerny[39] adds that economic globalization leads the nation-State to become a "competitive State," which focuses on improving its international competitiveness. From this point of view, globalization would be a political phenomenon that changes the rules of the game. It would notably have the effect of calling into question the primacy of the State but, beyond the observable facts, the discourses structure the relationship of the

State between globalization and the State and the other players and each reacts in order to adapt their strategies.

### 2.6.2 Consequence

These recent developments are interesting because they lead us to understand the changes of the power of the State on the international economy as a result of contextual dynamics and games between a multitude of players. A problem arises: the surplus of information to be evaluated and the complexity of the networks to be taken into account make it almost impossible to represent political activities by simple models. These considerations make complexity science more relevant.

Regarding the power of the State on the economy: the economy is essentially political. As long as the State remains at the top of the political hierarchy, it is the State that will determine the rules of the market, even when these rules diminish its control over it.

## 2.7 Of stability: States follow relatively stable paths that depend on their previous decisions.

*The behaviour of large groups is path-dependent and evolves as a function of its past because of the constraint of institutions on a group's behaviour and routine. Why would you look for new strategies if routine works well? And how do you change institutions?*

### 2.7.1 Justification

In the Japanese language, verbs have no future tense; when discussing the future, you use the present tense. This logic has some interesting value: the present is no more than that infinitesimally small juncture between the past and the future, it is almost an illusion. In the present, you keep going into the future, always advancing deeper into it without any interruption. As the future is no more than the present to come and pass, there is no meaning to the present other than that of a future past. The future is therefore the same as the present, and every action done in the past has some effect on the near future, because it sets the path that you follow.

At the same time, there is a famous philosophical mantra, namely the Gottfried Wilhelm Leibniz's principle of sufficient reason[92], that says "nihil est sine quo ratione"; in other words, "nothing is without reason" or "everything has a reason" (for a deeper discussion of the implications of both expressions, read Martin Heidegger's *Principle of Reason*)[77]. This statement sets the foundation of modern science: if everything has a reason, then we can explain this reason, find the cause, and explain the causality.

Then:

- For all $x$ that exist in the real universe, there is a sufficient reason to explain their existence.

- For all propositions $p$ that are true, there is a sufficient reason to explain why they are true.

This logical foundation is evident in evolutionary theories. Path dependence theory, notably, is an historical analytic framework that was originally developed by economists to explain various phenomena such as the entrenchment of standards and congregation, and that is now used in political science and sociology to explain continuity and the persistence of institution using comparative-historical analyses.

Akin to chaos in the fields of mathematics and physics[71] and imprinting in ecology[9] and later in sociology[10] that we follow as long as it works as a result of entrenchment in routine and the context (or institutions).

Critical junctures are points of origin, in other words events that launch a "revolution" and a new period trend-wise in the behaviour of a group[3]. In-between two critical junctures, groups follow rather stable paths, as if locked in by the institutions and bound to previous decisions. Then, it can be said that a critical juncture is an event that had enough impact to deviate a group from its previous path and launch it in a new direction. A good example of this is when a new high-rank public servant or politician exerts a great

[9] Animals usually follow the first living individual they see and their lifelong behaviour depends on what they became used to when they were young[95][27], and "the influence of early experience resists extinction to a high degree"[82, p. 22]

[10] Organizations and types of organizations adopt a form that is dependent on the culture, social structures and technologies that are available at the time when they are created (which explains why organizations created in the same context are often similar) and, as this form becomes institutionalized, the organization is entrenched in its basic structure and its form becomes relatively stable. The notion of path dependence is attached to the notion that adaptation to initial conditions sets a trajectory[145]

influence over the decisions of a state, to the point that we can observe a shift in its policy or discourse.

Path dependence theory has been used extensively in economics, political science and sociology to explain the stable evolution and sudden changes in history as a result of historical entrenchment, and the thesis here follows the same core argument: once the behaviour of a player is set in once direction, it can be difficult to steer it in another because of many constraints such as reputation, rules, and social structures and expectations. However, this dissertation will propose a more formal method, distinct from Path dependence theory's.

In other words: path dependence theory considers current events as consequences of the past, as players' behaviour is dependent to a certain degree to the path that they adopted, but the theory is by no means deterministic and allows for shifts through what is called a critical juncture.

### 2.7.2 Consequence

If the State's future behaviour depends on its past choices, then trends should be observable and there should be enough stability to enable us to predict its future behaviour as a continuity of past trends. Critical junctures are more difficult to assess, however, and therefore any deterministic theory is expected to be wrong at some point.

## 2.8 Concluding remarks: the State is a useful category

The State remains a useful category, instrumentally and symbolically, and it is pertinent to study it as a unity so long as one does not attribute it a consciousness. The State is a legal person that has relations with other legal persons, and the representatives of each legal person usually consider the others as units in their relations. Thus, in the practical sense, the State is a *de facto* unit in its international relations, although it is not a conscious being who thinks of its interests.

Moreover, this useful category remains an essential unit in the relationships between complex adaptive systems, even when these relationships are maintained with firms, international organizations or non-governmental organizations. At the micro level, they are individuals who meet behind closed doors. However, failing to know what they are saying, we can observe the results and some power relations at the macro level.

Now that we attested of the practical unity of the State in its relations with other players, let us test the second part of the question: is this unit rational?

# 3

# Is the State a rational unit?

## 3.1 Some definitions

### 3.1.1 Of game theory

Game theory, or the theory of interactive decision-making, has become entrenched in several scientific fields, from economics to physics, going through psychology and biology. Research on game theory technically began in the mid-nineteenth century, but it is usually considered that it was the book *Theory of Games and Economic Behaviour*[151], by John von Neumann and Oskar Morgenstern, that really launched this field of research.

This offshoot of decision theory aims to study optimal or rational behaviour, or to explain the evolution of social behaviour. It focuses on four notions: rationality, solutions, equilibria and norms.

### 3.1.2 Of rationality

Rationality is the quality of being reasonable according to the desirability criteria of a choice. A rational choice should be optimal depending on the reason of a player, i.e. their set of preferences and rules of reasoning. By convention, more rational choices are those that maximize utility.

### 3.1.3 Of utility

John von Neumann and Oskar Morgenstern's theory holds as its cornerstone the general model of expected utility, in which rationality depends on four axioms: the preferences must be complete, transitive, continuous and independent. For a choice to be rational, it must follow these rules of logic and seek the options that maximize utility.

Utility is evaluated on the basis of the expected gain (or loss) and its probability. Moreover, since the players evaluate the product of gains and their probability, Von Neumann postulated that the most rational strategy is a minimax strategy, assuming that players are risk averse and that they try to maximize their likely gains while minimizing their potential losses.

Utilitarian game theory is based on the assumption that players are rational: they aim to maximize the utility of their actions. There is no premise as to what is more useful: the determination of the utility of a choice depends on the preferences of each player and, consequently, the utility given to a choice by a player can be different from the utility granted by another player. As a result, a strategy deemed more useful by a perfectly rational player may be deemed less useful by another player who is also perfectly rational if they have different preferences.

Traditionally a value $u_i$ is attributed to each option available to player $i$, either as a function of its objective value (e.g. dollars) or as a function of the revealed preference[11] (in this case, the degree of utility corresponds to the rank of an option in the order of revealed preferences of a player, the preferred choice having the highest degree of utility).

Utilitarian models concentrate on evaluating the expected utility of strategies, and then on finding the equilibrium positions of games according to these utilities: an equilibrium, according to the traditional definition, is a solution from which no rational player would have any interest to deviate (under conditions defined by each given solution concept).

[11] The notion of revealed preferences was proposed by Paul Samuelson in 1938[126] as an increment to Jeremy Bentham's notion of marginal utility[24]. Utility may be difficult to quantify in many contexts, but Samuelson believed that consumers tend to repeat some purchasing patterns as long as the products and their price satisfy the consumers' preferences. Then, we would see "revealed preferences" thanks to the observed trends, without speculating about the consumers' true inner preferences. So you can measure these "preferences" by observing purchasing behavior.

Utility depends on intention. Depending on the player's intention, a strategy $s^1$ may be more useful than a strategy $s^2$, while the strategy $s^2$ may be more useful than the strategy $s^1$ for a player who has a contrary intention (or utility function). However, actual intent is not always knowable, especially when a player is unaware of the exact intent they had at the time of a choice, or when the chosen option is not the best to fulfill an intention. In the case of complex adaptive systems, it is all the more difficult to guess the intentions of the players handling the meta-player analyzed. In light of the puppeteer allegory, to seek the intentions of a puppet is to try to enter the heads of those who pull the strings of the observed puppet, while the curtains veil their play and their identity. This is often impossible. Since intention determines the utility of an option, utility determination is merely a chimera in games where the intention is not objectively quantifiable, as is the case of many political games where utility may be assigned subjectively by unknown agents of a complex adaptive system. Moreover, what is unique in such games is that a player can choose an option that does not have an optimal utility according to their preferences and interests, other players incite or force them to make that choice.

The von Neumann-Morgenstern utility function is generalized as follows:

$$E(s) = \sum_{s \in S} p(s) u_i(s) \tag{17}$$

where $E(s)$ is the expected utility of the strategy $s$ for the player $i$ and $P(s)$ is the success probability of $s$. In this case, the expected utility of s does not necessarily and entirely depend on its absolute utility, but rather on the combination of its utility and its probability. Contrary to the conventions of highly standardized sciences such as physics and chemistry, the measure of utility is entirely detached from the units of measure of its variables and is measured in "utils". Since there is no possible utility standard, given that each player can give a separate value to each choice, this value is arbitrary and is only a hierarchy scale without a proportionality criterion.

### 3.1.4 Of the solution and the equilibrium

The solution concept is the formal rule that predicts the expected outcome of a game. The solution is the expected result of the interaction. The equilibrium is a stable and continuous co-ordination of each player's strategy; and the solution concept usually predicts an equilibrium. The norm is the tendency that the majority of individuals follow, or an implicit rule that guides behaviour.

A game may have multiple points of equilibrium. There are also various types of equilibria, according to different solution concepts:

- the Pareto optimum, where improving a player's fate affects the fate of another player;

- the Nash equilibrium[106], where each player has no interest in unilaterally changing their strategy;
- the trembling hand perfect equilibrium[133], a refinement of the Nash equilibrium where players normalize a solution with a weakly dominated strategy based on error or risk taking;
- the evolutionarily stable equilibrium, where no minority strategy can disrupt the majority strategy[139];
- the correlated equilibrium[12], where each player has an interest in not deviating from the most equitable co-ordination reported by the other players;
- the Folk theorem, which postulates that every strictly individually rational and feasible payoff profile in a basic game is a point of equilibrium in the iterated game.
- the quantal response equilibrium, where players can make mistakes based on incomplete information and where the balance is the result of achieving the rational expectations of each player[101];
- and many others, such as the Cournot[44] and Stackelberg[153] equilibria, which apply to particular types of games.

### 3.1.5 Of the Nash equilibrium

In the previous scenario, players choose directly a pure strategy. This scenario is relevant in the case of a cooperative game, where each player is aware of the strategies used by other players, or he/she assumes to be able to guess these strategies. However, in real world games, this is rarely the case. This is why John F. Nash introduced the concept of mixed strategy in his famous doctoral dissertation, entitled "Non cooperative games," which presented a method for determining the equilibria of non-cooperative games with imperfect information.

It begins with the notion of the mixed strategy. A mixed strategy $\sigma_i$ is a distribution of probabilities to pure strategies, such that we grant each pure strategy a probability of being chosen by a player $i$. A mixed strategy $\sigma_i$ is a set of non-negative probabilities assigned, one by one, to each pure strategy available to the player $i$, hence $\sigma_i s_i$ is the assigned probability to $s_i$ by $\sigma_i$.

Considering that two players $i$ and $j$ have the probability distributions $\sigma_i$ and $\sigma_j$ respectively, the utility function is generalized as follows:

$$u_i(\sigma) = \sum_{s \in S} \left( \prod_{j=1}^{i^k} \sigma_j(s_j) \right) u_i(s) \tag{18}$$

This equation is only an amendment of the previous one. Here, the emphasis is on the likelihood that a player will adopt a strategy, rather than its likelihood of success. In fact, most specific utilitarian equations and models are adaptations of the von Neumann-Morgenstern function for special cases or specializations of the Nash equilibrium. This is why this dissertation will not concentrate on specific models, but rather on the logic of a general theory of the behaviour of complex adaptive systems, of which the State is an example.

A Nash equilibrium is a strategy profile from which any unilateral deviation would be less beneficial for the deviant player, such that no player would be interested in modifying his strategy alone. A strategy profile $s* \in S$ is a Nash equilibrium if, for any $i$,

$$s_i \in S_i =: f_i(s_i^*, s_{-i}^*) \geq f_i(s_i, s_{-i}^*)$$ [12]

### 3.1.6 Of evolutionary stability

Evolutionary stability is a special case of Nash equilibrium. In a set of two pure strategies $S_i = \{s^1, s^2\}$, $s_1$ is evolutionarily stable if it is less likely to be invaded (dominated) than $s^2$:

$$[E(s^1, s^1) \geq E(s^2, s^2)] \wedge [E(s^1, s^2) > E(s^2, s^2)]$$

Evolutionary stability is a sustainable co-ordination of strategies that are progressively stable. It is a special case of a contextually normalized solution that requires a sustainable context. Because it is a sustainable balance in a special context, the evolutionary stability

[12] The variable $-i$ represents all entities other than $i$.

is always a special case of contextually normalized solution, but not all contextually normalized equilibria are evolutionarily stable, as some may result from a collective agreement—voluntarily or not—to normalize sub-optimal strategies, as in the prisoner's dilemma (this case will be explained later). A contextually normalized solution may seem stable in a given context because the majority of players ensure its dominance and punish deviations. A perturbation of the context of an contextually normalized solution may break stability and make way for a re-normalization with different strategies.

A Nash equilibrium is usually a contextually normalized strategy, but a contextually normalized strategy is not always a Nash equilibrium. It happens that these two solutions concepts are logically independent, and they lead to very different conclusions, both in forecasting and explanation. While the Nash equilibrium can help us understand why some strategies seem more rational than others in non-cooperative games and from an individualistic perspective, the contextually normalized solution can help us understand some sustainable co-ordinations that do not correspond to a Nash equilibrium. The contextually normalized solution is a new solution concept that explains how co-operation or competition can become stable as a result of power relations and adaptation, even when the strategies are sub-optimal and thus less useful according to utilitarian game theory.

When a strategy becomes hegemonic, either by coercion or normalization, it can become stable in the sense that any deviation is likely to cause undesirable consequences, such as marginalization or punishment. Therefore, even if a deviant strategy may seem more rational according to Nash's model, it may be rejected by the majority of players.

Since a contextually normalized equilibrium results from the normalization of certain strategies in a given context, and even from the reasons for it, the key to breaking such a balance is to upset the context and the rules of the game in a powerful way to break the norm. This strategy is effective provided that the equilibrium is not evolutionarily stable (unless the disturbance is so strong that it decreases the viability of stable strategies and increases the viability of deviant strategies). The notions of contextually normalized strategies and equilibria thus explain trends and shocks that are more difficult to explain using the conventional notion of the Nash equilibrium and its refinements.

### 3.1.7 Example

In the prisoner's dilemma, reciprocal co-operation is a Pareto optimum and reciprocal defection is a Nash equilibrium; the two solutions can be evolutionarily stable equilibria depending on the context. Thus, contrary to the conventional and widespread interpretation in International Relations that the normal equilibrium of this game is the defection of both players, Robert Axelrod and William D. Hamilton[15] argued that a repetition of the game with disinterested players can lead to an equilibrium where the two co-operate, knowing that their mutual co-operation would result in better individual gains. The problem is then to know what equilibrium and therefore which strategies are normal.

## 3.2 Of rationality: the perfectly rational player is a chimera, but players usually try to intuitively maximize gains according to their utility function.

### 3.2.1 Justification

Herbert Simon[135] offered an interesting amendment in order to address the quasi-impossibility of the perfectly rational player: the hypothesis of bounded rationality. It postulates that the normal players cannot be perfectly rational since they do not (normally) have perfect information and that the perfectly rational calculation is superhuman (players do not tend to make series of calculations in order to make each of their choices). Thus, they would tend to adopt satisfactory rather than optimal strategies. The hypothesis of bounded rationality is a useful contribution because it eliminates a logical condition that is inadequate empirically (perfect rationality as being necessary to make optimal choices).

For his part, John Harsanyi[75] was more ambitious in proposing a general theory of rational behaviour. He suggested a range of axioms that he considered "natural" and "obvious" about what is rational, such that interpretation is not dependent upon on rationality premises. According to this general theory, every rational player aims to defend their personal interests rather than those of the community (they defend the collective interests if and only if it is advantageous to them) and adapt their strategies according to their rational anticipation of the strategies chosen by the other players (they anticipate according to the subjectively estimated probability that each player accepts or rejects an option). Depending on these premises, they have established optimal decision rules, so as to define what a "perfectly rational" player would choose. The most rational strategy varies according to the type of game being played, rather than according to fixed rules of rational behaviour.

## 3.3 Of the diversity of strategies: players have different utility functions and they neither have the same aversions, nor the same reactions.

### 3.3.1 Justification

There are various types of strategies: there is the strategy based on the expected utility (players consider on the expected utility of each option and choose the ones that appear to offer the greatest utility); the maximax strategy (without considering the probabilities, an optimist player chooses the option that offers the best payoffs and the least risks); the maximum strategy (regardless of probabilities, a player chooses to evaluate the worst of each possible case and chooses the option that offers them the greater gain in the worst cases), the minimax strategy (an opportunistic player minimizes its losses in the event of failure); and the evolutionarily stable strategy (a strategy that is not strictly dominated by any of the opponents' possible strategies and that is most likely to lead to long-term survival or gains).

As a result, different players, with different utility functions may react to the same stimuli with different strategies, each of them judging their strategy as the best response at the moment.

The majority of theoretical research in game theory suggests refinements of the Nash equilibrium, either to make it more appropriate to describe special cases (especially in Economics), or to make it closer to empirical observation. For example, the prospect theory of Amos Tversky and Daniel Kahneman[87] improved the empirical correctness of the von Neumann-Morgenstern general model by altering the aversion premises; experimental results of psychology experiments suggest that the normal individual would tend to have an aversion to risk when it comes to earnings and an aversion to losses when it comes to losses rather than a mere risk aversion as it was assumed before.

The most recent refinement of the Nash equilibrium, derived from behavioural game theory, is called the quantal response equilibrium. The latter aims to compensate for the discrepancies between theoretical predictions and empirical observations by adding a lambda factor ($\lambda$), which roughly represents the level of rationality of the player; the closer $\lambda$ is to zero, the more irrational a choice is considered (because it deviates from the prediction of the theory) and if it tends towards infinity, the player is considered perfectly rational because their choice corresponds to the rational choice according to the theory.

This contribution is interesting because it allows to evaluate the level of rationality of a player according to the distance between their choices and the choices judged rational. Now, it is thought that any choice which deviates is necessarily less rational than that expected by the researcher, which prevents the falsification of the model.

## 3.4 Of equilibrium models in international relations theory: there is no consensus.

*As a result of the divergence in the instrumentalization of game theory by theories with contradictory rationality and normativity assumptions, many competing hypotheses have been defended regarding the most natural equilibrium of the international system and the factors of convergence and deviation. These hypotheses are logically incompatible because of their assumptions as well as their implications.*

### 3.4.1 Explanation

In International Relations, more specifically, several popular assumptions arising from game theory have been proposed, especially by neo-liberals and neo-realists. We can think, in particular, of the balance of powers, bandwagoning, deterrence, neo-liberal explanations of international co-operation, and so on. Also, several theories have proposed different interpretations of classic games, depending on their own theoretical assumptions; for example, using games like the prisoner's dilemma, neo-liberals argued that co-operation is possible because it maximizes absolute gains, while neo-realists have argued that it is difficult because players prefer to increase their relative payoffs. Thus, students of International Relations have used game theory primarily to support intuitive assumptions, rather than to formulate them.

Most game-theoretical developments in international relations theory occurred before the end of the Cold War. Since then, the former hypotheses have been revised to better reflect the observed reality. Recent contributions in International Relations continue the utilitarian tradition and utilize the notion of utility to explain interactions, particularly war and economic bargaining. For example, an abundance of work follows Thomas Schelling[127] by explaining the preventive effect of deterrence[50], or explaining war as a commitment problem on the part of warlords[61], as the result of resource allocation based on the structure of the system[116], or as the result of predation[42].[13] Most of

[13] The literature review here focuses primarily on core notions rather than their refinements. Because we criticize the core of utilitarian game theory—namely the notion of utility and the rationality axioms—it was considered best to avoid spending too much time discussing refinements in order to go straight to the point. Much game-theoretical literature in International Relations was therefore neglected here because it recycled conventional concepts and modelling from utilitarian game theory, despite the interesting innovations.

Here are, nevertheless, some scholars who would deserve credit for their praiseworthy theoretical contributions:

- Graham Allison wrote two influencial books: *Remaking Foreign Policy*[7] and *The Essence of Decision*[6]. Allison criticized the expectation that States consider all options and act rationally to maximize their utility, as believed by many game theorists and rational choice theorists. He argued that decisions should actually be examined in light of two parallel models: the organizational process model and the government politics model. The first model argues that the weight of an organization makes it more difficult to shift plans, and so leaders are often forced to implement pre-existing plans as a result of the lack of time or resources. The second model argues that most decisions are taken by top leaders, as a result of politicking and personal interests.
- Robert Bates worked on rational choice institutionalism and the political economy of growth, with an empirical specialization on Africa and agricultural development. He explained that political order requires coercion, and that trigger chaos in Africa today because private citizens use violence

to control the state and the means of production of wealth. This decentralization of the monopoly of violence leads to the failure of the State in Africa. He also worked on analytic narratives, a method to add rigour to case studies by combining historical narratives and rational choice theory. It involves defining the puzzle, building a model to explain it, then using the narratives to explain the rules, preferences, and dynamics of the game.

- Steven Brams worked on envy-free cake-cutting (where all players subjectively feel that they have a fair share) and proposed the Brams-Taylor procedure, which proposes that a player will have an irrevocable advantage that will not cause envy. He also worked on approval voting, where voters can vote for as many candidates as they wish. He showed that this form of voting is the fairest, as it ensures that the winner is the one that is the most preferred by all voters even if voters have dichotomous preferences.
- James Buchanan and Gordon Tullock co-authored a book called *The Calculus of Consent*[30], with a focus on voting systems, explain that symmetry in sharing does not lead to Pareto optimality, but that side payments (any side transaction to incite another player to accept a main transaction) create marketable property rights of the individual political vote. This may involve bribes, clientelism, or the adoption of policies, for example.
- Barbara Geddes worked on the politician's dilemma, a game where politicians have to choose whether to use state resources to serve the national interest, or in a clientelistic fashion to ensure their reelection. She explains that institutions are more effective if they are protected from lobbying and clientelism.
- James Morrow focused on non-cooperative games, more specifically regarding the causes of war, the relation between trade and conflict, and the role of international organizations. Notably, he offered a different explanation to the democratic peace hypothesis: at war, democratic leaders are more inclined to shift extra resources into the war effort than autocrats because their survival (in office) with larger winning coalitions hinges on successful policy. This makes democrats unattractive targets as they are more likely to mobilize resources for war, and thus they are more likely of being successful. In parallel, he also worked with Bruce Bueno de Mesquita, Allastair Smith, and Randolph M. Siverson on a book called *The Logic of Survival*[48], which answered the question of why good leaders are often turned out of office while corrupt and arguably bad leaders endure. They explain that it has to do with resource allocation and how institutions create incentives to pursue good or bad public policy.
- Robert Putnam worked on two-level game theory[117], a political model of international conflict resolution that suggest that international negotiation is done at two levels: at the intra-national level (i.e. domestic politics) and at the international level (between States). The chief negotiator needs to absorb societal and political demands at the intra-national level, and to seek a satisfying agreement in the international negotiation. So, an international agreement is good only if it brings satisfying results for domestic politics.
- General Rupert Smith wrote a book called *The Utility of Force: The Art of War in the Modern World*[140]. He explains that war has changed and that we now see war among the people—rather than between States—and he explains why industrialized armies are not adequate to adapt to these conflicts because the conflicts are more timeless and independent of leadership, so attacking a structured and leader-oriented group only decentralizes the conflict even more. All of this is explained conceptually, rather than mathematically.
- George Tsebelis worked on nested games, which explains the cohesion of coalitions, and developed the theory of veto players. Essentially, when two coalitions play a game together, there is a balance

the time, these scholars assume, consciously or not, a Hobbesian state of nature, which brings us back to the epistemological problem of classical theories.

### 3.4.2 The balance of power

This is an idea dear to neo-realists, especially. This is the idea that players form alliances so as to prevent another player, several, or another coalition from being able to dominate them. Thus, we see a balance in the sense that a coalition of players associate their power to counterbalance the power of other players.

They can do this either to ensure their survival (in this case, it is an evolutionary stable strategy) or in the interest of increasing their relative bargaining power in order to be able to dominate in return. In this case, we can end up with a weapons or coalition race, which results in a game similar to the prisoner's dilemma, or even the chicken game: each player would be better not to make that choice, because of long-term costs or dangers, but each one continues to avoid dominance.

of forces between these coalitions as well as within them. The games within coalitions are what Tsebelis calls nested games. He explains that apparently irrational strategies in inter-coalitional games are actually rational if you consider nested games. Regarding the theory of veto players, Tsebelis argues that in all games where some players have the right to veto—be it an absolute right or not—the status quo will only change if it is weakly preferred by all veto players. So it will change only if the *status quo* is not Pareto efficient for all veto players; otherwise, a disadvantaged veto player may use the veto to prevent the change to the *status quo*.

- Finally, Thomas Schelling won a Nobel Memorial Prize in Economics Sciences for his work on conflict and cooperation. He notably wrote three renowned books: *The Strategy of Conflict*[127], *Arms and Influence*[128], and *Micromotives and Macrobehavior*[129]. Essentially, he argues that conflict is a game with opportunities to cooperate, and that, to win in a competition, you must convince your adversaries that you are willing to take more risks, while actually putting yourself in a dominant position. He also explains that kinship may lead to conflict between groups if we focus too much on differences that forge identities.

The idea of the balance of powers leads to the idea that the international system would be in its most stable state in a bipolar equilibrium with two hegemons, thus avoiding the rise of a disturbing power and avoiding the revolutionary coalition against a single menacing hegemon.

### 3.4.3 Bandwagoning

This idea is favoured by some realists and more so by neo-conservatives. It is the idea that it is advantageous to ally with the strongest, so as to increase the gains that this one grants us and to avoid the losses related to being their rival. It is a rational strategy in the sense of utilitarian game theory: a rational player aims to maximize gains and minimize losses, so it allies with the player or the camp that seems dominant, so as to diminish the risk of loss (being dominated by the strongest player or camp) and increasing the likelihood of potential winnings.

The idea of *bandwagoning* leads to the idea that the international system would be in its most stable state in a unipolar equilibrium, with a single hegemon, since no state would be in a position to disrupt the system.

### 3.4.4 Deterrence

This idea refers to the notion of "mutually assured destruction." Players may use threats to dissuade other players from taking given actions. If each threatens the other player in an intense way, for example by the nuclear threat, the mutual threat can result in a balance, since each player wishes to avoid the losses.

The notion of nuclear deterrence has long served as an explanation of the bipolar equilibrium of the Cold War. Since the Union of Soviet Socialist Republics and the United States of America were both equipped with a large quantity of weapons of mass destruction, which were always better, neither had any interest in slowing down the arms race (so as not to be dominated), nor to attack the opponent. This is a game similar to the prisoner's dilemma, with a Nash equilibrium where each player chooses a solution that does not offer a maximum of winnings, but which no one has to deviate from.

### 3.4.5 Commitments

This idea is related to the concepts of *free rider* and reputation. A player has an interest in having a good reputation with other players in order to maximize their chances of co-operating with them and reaping the rewards of co-operation. If players fear that a particular player will benefit from their efforts without participating in them, then they risk marginalizing or reprimanding the player. Depending on utility models, a rational player should choose the options that improve their reputation in order to maximize their long-term earnings unless they judge that the short-term gains from cheating outweigh the long-term gains from co-operation and discipline.

This idea explains co-operation and discipline in international relations, although the system is anarchic and there is therefore no supranational authority in a position to control deviant states. It is used mainly by liberals and Kantians.

### 3.4.6 Scholium

All these ideas therefore relate to the notion of utility, assuming that the players are rational and that they understand what is in their interest. Some of these ideas, for example the greater stability of the unipolar equilibrium because of the strategy of *bandwagoning* or the bipolar equilibrium because of the strategy of equilibrium of powers, are in opposition. We therefore face a problem of hermeneutical divergence due to a contradiction of the theoretical assumptions.

The State may be a rational unit, but there are no standard criteria of rationality other than von Neumann and Morgenstern's rationality axioms and the principle of utility maximization, because each player may rationalize strategies according to a different utility function and a different reaction to risk. Should the State be studied scientifically as a rational unit, some hermeneutic problems need to be addressed first.

# 4

# Can we understand the State using a formal model of rationality?

Is the State a rational player? Since there is no objective criteria for rationality, the question needs to be rephrased: can we understand the State using a formal model of rationality?

## 4.1 Of rationalizability: strategies may or may not be rationalizable, depending on the utility function of the player.

*The strategy of a player depends on their reason (the logic that guides the choice). In other words, various strategies are linked to various reasons.*

### 4.1.1 Justification

Several strategies can be rationalizable for a given game, provided that it is not strictly dominated by an available strategy of an opponent. It is assumed that a rational player will never use a theory that is highly likely to be dominated by an opponent in order to increase their chances of higher gains or to reduce the risk of losses. Assuming that their opponent will not use any strictly dominated strategy either, we solve the problem of the infinite chain of common knowledge (I believe my opponent knows that I know that...) that was raised by David Lewis[93] and Robert J. Aumann[13].

### 4.1.2 Consequence

Rationalizability makes it possible to circumscribe the set of strategies that are viable options for a player who aims to win in a cooperative game with incomplete information about opponents. We are already opening the door to a more flexible definition of rationality.

## 4.2 Of forecasting: the study of normality and equilibrium does not allow to predict *a priori* or to explain correctly *a posteriori* the abnormal cases or the breakdown of an equilibrium.

*Game theory has no claim to universality. It nevertheless conveys the belief that rational behaviour tends towards equilibrium when a game is repeated.*

### 4.2.1 Justification

In the field of International Relations, the reaction to this question is mixed. Theories inspired by game theory have failed empirically to predict and explain important events such as the fall of the USSR, in addition to contradicting each other about anticipated equilibrium and normal reason. These problems have allowed the rise of anti-quantitative critical approaches that focus chiefly on the subjectivity of the players and the impossibility of predicting the behaviour according to social laws. Despite its shortcomings, game theory has offered several useful insights into the dynamics of international politics and these are increasingly supported or improved through experiments in the fields of experimental psychology, statistical sociology, and behavioural economics.

Critics of game theory attack primarily the generalizations made in terms of behavioural norms and linear assumptions. We have criticized, for example, the tendency of formal theorists to prefer theoretical elegance over empirical robustness, which creates a discrepancy between the theoretical implications and the empirical observations[114]. The problem of inappropriate generalization has also been denounced[72]). We have criticized the fact that the rational actor model reduces the psyche arbitrarily according to hypotheses long discredited by experimental research[97, 90, 161], and thus neglects the importance of choice, perception and personality by generalizing abusively[80]. In addition, many point to the role of preferences[104] and the fact that they cannot be objectively classified in a stable hierarchical order, so that the choice is not conditioned in advance[10]. There is still the problem of the premises: for example, although all researchers who adopt the rational choice approach accept the idea that the actors are rational, there are disagreements regarding their rationality criteria and how to interpret them[96]. One may even question the first principle according to which players act according to rational calculations[43]. Some, for example Graham Allison[6], even object to the proliferation of research related to rational choice theory, which reduces the State to the image of a rational unitary actor seeking to maximize utility.

### 4.2.2 Caveat

*Different players have different utility functions. The lack of information the analyst has about the utility function of a player may lead to inaccurate modelling and hypotheses. There is also a tendency for academics to look for universal laws and trends that do not* *exist in reality. Consequently, most of these epistemological problems are the fault of the analyst's inadequate expertise and methods, they are not inherent to game theory.*

The great complexity of deliberations within States and with lobbies and other States prevents us from knowing what is really happening behind closed curtains. Too much complexity, accompanied by a lack of information, undermines the thorough investigation of the reason of each State individually.

Many defend the rational actor model using the instrumentalist argument that any theory that produces correct predictions is useful even if it does not correspond to reality, Stephen Krasner[89] goes further by arguing that the theoretical framework proposed by Graham Allison in his famous book *The Essence of Decision*[6] is dangerous because it dilutes the responsibility of senior leaders by giving more credit than necessary to bureaucracy and organizational constraints. Others, such as Michael Oppenheimer[111], focus on considerations of preferences and choices, but argue that generalizations can be made about politics and that these generalizations are useful as premises for producing a scientific study of politics. Finally, some advocate the use of games as analytical rather than descriptive tools: a game does not describe reality as it is, but it helps you understand its likely dynamics[141].

Researchers are not immutable objects and they take criticism into account, to which they try responding to, sometimes by adjusting their hypotheses or theories. With respect to the State, we may wonder whether formal models are appropriate because of several difficulties: the State is not a conscious being; there is, therefore, no sufficient reason to assume that it is capable of reasoning as a collective entity. Of course, each member of the State is capable of reasoning, but there is no sufficient reason to assume that the reason of the State is optimal. Moreover, it is not certain that the State acts on the basis of the memory of previous games; although studies can be made to adapt the behaviour of the State according to the experience of the past, the individuals composing the State and the government constantly change, which can reduce the capacity and interest to take into account Experience. Moreover, there is no sufficient reason to believe that all players reason in the same way, whether it be the States or the individuals who compose them. There is no sufficient reason to believe that a player maintains the same reason over time and in all contexts, either. In this case, it may be questioned whether there can be a normal reason for such players.

# 5

# Towards a typology of international relations?

## 5.1 Of theoretical assumptions: assumptions are the building blocks of worldviews

*All successful theories rely on assumptions. Without assumptions, your hypotheses have no foundation to start from. In an ideal world, speculative assumptions would not have to exist, because our predecessors would have discovered all the fundamental truths that we need, and that knowledge would be true without a doubt. However, this Wonderland* *of science does not exist: it is almost impossible to prove anything, as you never know when someone may refute your beliefs with more convincing arguments than yours.*

## 5.2 Of the diversity of equilibria: how to find the right one?

*The problem is that there is not always a unique equilibrium in a game; actually, there are often many, and players who participate in experiments may take a long time to converge to one equilibrium or another. This is true of evolutionary biology, and it has been proven by John Nash that every non-cooperative game has at least one equilibrium, sometimes more.*

### 5.2.1 Explanation

Behavioural game theorist Colin Camerer said that, as a student of economics in the late 1970s, one of his teachers "explained cynically how Von Neumann and Morgenstern had both solved one problem (by giving a method to measure utilities, which was not needed after the ordinal revolution) and failed to solve the hard problem (uniqueness of equilibrium in all games)."[36, p. xiii]

As Colin Camerer notes about experimental findings on the continental divide game, where players may be attracted to one equilibrium point among many depending on their initial conditions:

> "The experiment has two important findings. First, people do not always gravitate towards the high-payoff equilibrium even though players who end

> up at low numbers earn half as much. [...] Second, the currents of history are strong, creating “extreme sensitivity to initial conditions.”[36, p. 15]

This is in agreement with psychologist Solomon Asch’s findings on conformity. In a series of experiments, Asch studied how and why individuals conformed to or defied norms or the opinion of the majority. In one experiment, he asked a series of simple questions about perception to a control group made of 37 subjects in a control group and 50 subjects in an experimental settings where they would be under the influence of a majority group of “confederates," participants who knew about the intent of the experiment and were there to incite subjects to give a wrong answer. The results are interesting: while participants in the control group answered correctly 99% of the time, 36.8% of subjects in the experimental group followed the “confederates” influence and chose the wrong answer in average. Among the experimental subjects, only 25% never followed the majority (the “confederates”). This shows that the opinion of the majority is able to sway the opinion of most individuals, even when the majority is wrong and the right answer should be obvious. He also found, notably, that presence of a “true partner," that is a player who always gives right answers, conformity decreases dramatically; inversely, the removal of the true partner halfway through the experiment greatly increases conformity.

So we have many possible equilibria, to which different players converge according to the original configuration of the group. That configuration depends directly on the nature of the players’ reason, because there are different types of players who reason differently.

## 5.3 Of the diversity of worldview and reasons: we all think differently, so what seems naturally rational to me is not always naturally rational to you.

$\mathbb{N} \neq \mathbb{R}$*: what is natural is not exactly what is real. In international relations theory, we tend to think of what is natural to us as what is most logical, which actually distorts reality we are studying because reality is often counter-intuitive. Natural abstraction is useful but it has the following defect: what is natural varies from one individual to another, it is relative to your worldview. Common sense is not universal: you only have to compare the common sense of the Japanese to that of the Senegalese and you will find major differences, although both common senses work well as practical guides in real life. Since common sense is relative, our natural interpretation of reality differs. Each worldview in International Relations has a natural reason and that is the root of conflicts of interpretation. We have different reasons and must be aware of this matter of facts in order to judge the correctness of an interpretation. What may seem natural to you is not necessarily real.*

### 5.3.1 Explanation

How are decisions made? Who makes what decisions? Confucius repeats multiple times in the *Analects* that virtuous or honest men do not reason the same way as common men (notably in verses II-14, IV-2, IV-16, XIII-23, XIII-26, XIV-4, XIV-23, XV-8, XV-21, XV-34, XVI-8, XVI-9, and XVII-23; and indirectly when he discusses the nature of a given type of men). It appears that the wise man was right about one very important point: two different individuals may make different decisions if their interests and ways of reasoning are different. If we apply this to politics, it follows that political decisions can be based on different interests, which are determined by countless factors. Decision makers make decisions and it is this set of decisions that determines international relations, not laws of nature, nor pseudo-scientific assumptions on a presumed human nature. Yet, Confucius's notion of the "honest man" and the "common man" thinking and acting differently because of their nature hides a more profound idea.

Your view of the world depends on your interpretation of it, as two interpreters may perceive the same set of facts differently. Each interpreter has a worldview. A worldview is constructed from a set of hypotheses and propositions, either taught or acquired by experience, that allow the interpreter to give meaning to the world.

The worldview is a simplification, a caricature of reality that does not take all complexity into consideration. One is more eager to consider two apples as two units, as if they are both equal to "one" apple, although one may be bigger, better, more nutritious, etc. As a result, one of these apples may be equal to 1.13 times the other apple in some sense. In reality, they are not equal, but our intuition incites us to simplify notions; it is more natural to us. Yet, this extends far beyond measures: many people believe that people who do not think like them are either wrong or weird because their way of thinking is so natural to them that it cannot conceivably be wrong.

Because a worldview orientates thought according to accepted premises, it is also governed by a mode of thought. For example, some individuals can adopt a relatively more selfish and individualist mode of thought if they believe that everybody is selfish. Some may be relatively more co-operative and generous if they believe that everybody is good and trustworthy. While these are naive caricatures, your mode of thought is usually the result of an adaptation to the world as a function of your experience and worldview.

Yet, each person adapts differently to the same stimuli, and therefore it must be recognized that each person may have a different worldview and mode of thought; this is why there exists murderers and martyrs, and people like Adolf Hitler and Mohandas Gandhi. As a consequence to the recognition that every individual may adapt differently to social and political life, and that each of them may have a distinct worldview and mode of thought, you may conclude that human nature does not exist. And if human nature does not exist, general theories of human behaviour are vain artifices.

This allows us to throw out the window a panoply of theories and philosophical investigations about who we are and how we behave. This is most unfortunate because it prevents us from having a firm grip on reality using a simple theory. Even worse, it exposes a deep problem regarding the interpretation of social matters: it can be difficult for you to understand a reason that is not compatible with yours. At worst, an incompatible reason may seem irrational to you, while it is rational to someone else.

$\mathbb{N} \neq \mathbb{R}$: what is natural is not equal to what is real. In mathematics, the set of naturals consists of positive integers 0, 1, 2, ..., the numbers that are the most natural to us for counting objects. It is natural to affirm that there is one cat, two cats, three cats; it is not natural, however, to assert that there are 5.3 cats. The set of real numbers is a superset of the naturals that includes all numbers, whether negative or positive, rational or irrational, to infinity. In this case, we can consider an apple as being equal to a fraction of another one, according to their respective sizes. What is natural is part reality, but not all of reality is natural to us. Actually, some things are quite unintuitive, for example the number $i$ in mathematics (which is equal to $-\sqrt{1}$), the dilation in physics, or the fact that humans do not behave according to game theory's rationality assumptions. What is natural is only an abstraction that reduces real facts to simple expressions to better understand them.

What is natural to us may not reflect what is real, but can we even grasp reality directly? Would it be better to adopt a purely realist perspective to study international relations? No, because the objects of reality in international politics are often subjective, subject to interpretation, and they are often hidden from plain view.

Would it be better, then, to use formal logic to avoid the problems of informal logic? Common sense is a source of interpretative errors, certainly, but formal logic is difficult to apply to the study of international politics because it depicts a sleek world emptied of meaning, that does not really exist in reality. Formal logic provides interesting abstractions to reduce everything to the simplest elements, but it is not sufficient to explain the behaviour of players who engage in an informal logic. At best, it may recommend rational behaviour but as the players do not all adopt this ideal behaviour, it is useless to describe reality accurately. Besides, if a player decides to use formal logic to guide their behaviour, another player can take advantage of the fact that the behaviour of their rival is easier to predict as a result of being a known utility function, and they can therefore manipulate the situation in their favour.

Because of that, the pragmatic logic of Charles Sanders Peirce may be one of the most useful logical approaches to study international politics. A pragmatic logic should interpret the signs of reality but, as these signs are prone to be interpreted differently, we must return to practical considerations to obtain conclusions that are useful to us and plausible. We may not know the real truth, but we can still find probable inferences; we must then compare hypotheses to assess which ones are most likely, in order to better guide our actions. If we cannot directly explain the reality of international politics, we can still play with semiotics.

What may seem natural is only an assumption that results from the theoretical framework that the researcher has likened to rationality. Thus, an individual who scientifically studies a phenomenon can conclude that an hypothesis among a set of possible hypotheses is better than the others in consideration of certain predispositions and experience, while another individual who observes the same reality differently can accept another hypothesis. Worldviews are based on assumptions. Like the Cartesian cogito, assumptions are used to support the logic and validity of theories that result. Speculative assumptions are the main source of errors, since they presuppose a consistency that is possibly non-existent in our political world in constant motion.

Thus, it is best to avoid the pitfalls of what seems natural, to look beyond common sense in what can be counter-intuitive while suspending judgement, and to find the most likely and practical hypotheses based on what is known, not what we like to believe.

### 5.3.2 Thought experiment: reasonable trust issues

Let us explore a psycho-social example. Let there be a woman who underwent many deeply negative experiences with men, such as compulsive lies, unfaithfulness, domestic violence, and rape. If this woman has had many traumatizing experiences with men, she may believe that all men are violent, and disloyal perverts. Thus, if she met a good and trustworthy man, it might be very difficult for her to understand him and to trust him because this man's behaviour does not correspond to the premises of the woman's worldview.

In this context, the woman has a reasonable rationale to believe that this man must be evil, based on her experience. Yet, if you concentrate without any presupposition on the relation between her and this specific man, you must admit that she is wrong to attribute to this man an evil reason. The woman's worldview, while it is justified by experience, induces error in this specific case and leads her to interpret this man's behaviour and reason erroneously.

### 5.3.3 Thought experiment: being naturally irrational

Let us now explore a prisoner's dilemma in which each player has a different mode of thought. The first player chooses to co-operate, because that player is conscious that bilateral co-operation is collectively more advantageous than defection. Also, the first player trusts the second player. Meanwhile, the latter chooses to defect, because of the belief that everybody is selfish and he expects his partner to betray him, without a doubt. Following the first iteration of this game, each player considered that the other players was irrational. Why? Because each of them did not follow the other's expectations and reason.

What seems natural and rational to one player is not necessarily so to another. Each player's worldview and mode of thought may induce a different reason, such that a behaviour can be rational as a function of one player's reason premises and irrational according to other reason premises. Symbolically, $a, b, c$ may be the set of conditions for a choice to be rational according to player 1, while it is $c, d, e$ for player 2. How to assess which is more rational? That depends on your reason. As for which is more optimal, that depends on what you seek.

For example, it can be natural to simplify the quantification of apples according to their number or their mass. Yet, these two scales have distinct implications. "1 kg" of apples may not mean much to you, while "3 apples" holds a more significant meaning. Simplification helps you understand the world. Theory serves this purpose: it is an reductive abstraction that simplifies a complex reality.

However, sometimes, simplification may be misleading. It might be more advantageous to buy ten apples than twelve to make apple pies if every apple costs the same price and you pick bigger ones. One apple is not always equal to another. What is natural is not necessarily real.

In mathematics, the set of real numbers $\mathbb{R}$ is the set of all numbers that exist, and the set of natural numbers $\mathbb{N}$ is the set of all non-negative integers. First observation: the set of naturals is a simplified and easy to grasp subset of the reals: $\mathbb{N} \subsetneq \mathbb{R}$. Second observation: the more you follow a complex chain of inferences, the more the simplified estimate of the naturals can mislead you. We will keep a maximum of four significant numbers in the following example:

$\mathbb{R} : 2.8^{2.7} \approx 16.12 \cdot 100 = 1612 \div 1.7 \approx 948.2 \cdot 0.1 = 94.82$

$\mathbb{N} : 3^3 = 27 \cdot 100 = 2700 \div 2 = 1350 \cdot 0 = 0$

In this example, the second line renders the same operations as the first, with every value rounded to the nearest natural number. At every stage of the process, you can observe a significant margin between the resulting values. Yet, the problem of the chasm between reality and abstraction in the case of oversimplification is not unique to the realm of mathematics: it is almost unavoidable for any matter that cannot be measured precisely.

According to your method of simplification, your interpretation risks being biased in a some way. This is why theoretical assumptions are so important, but also dangerous in science: they orientate the domain of what is natural and pertinent. A social theory that presupposes that every player is selfish by nature, for example, cannot be used to adequately explain the behaviour of a player that is not selfish. Assumptions are a double-edged sword; in our case, it would be best to avoid assuming anything regarding what is rational, as rationality is relative to your notion of utility, and what is normal, as that is relative to the frame of reference.

## 5.4 Of the natural bias in international relations: the problem in IR is that most theories are biased towards a notion of what is normal, natural, or constant.

*Considering that theorists tend towards the theories that seem most natural to them, according to their own worldview, inter-theoretic dialog is difficult because of the incom-*

*patibility of theoretical premises. The partisans of each school of thought argue that their worldview corresponds to reality,* $\mathbb{N} = \mathbb{R}$*, but if worldviews diverge, such that* $\mathbb{N}_1 \neq \mathbb{N}_2$*, then both conceptions of what is natural cannot be equally true simultaneously unless they complement each other. If they complement each other, then they may be used symbiotically. If they contradict each other, then one is less true than the other.*

### 5.4.1 Explanation

Schools of thought and research programmes in the discipline of International Relations, as in other disciplines, are based on sets of normative assumptions. These normative assumptions seem natural for supporters of those currents, who consequently do not call them into question. However, what seems natural for an individual is not necessarily natural to another, since what seems natural is not necessarily real. To avoid misinterpretation, you should always question the assumptions on which your reasoning depends. Similarly, whenever we are not sure about something, it is better to suspend judgment instead of pretending that something may be wrong. Finally, because each individual has a different reason, it is not logical to argue that all political actors have a similar rationale. It is best to interpret the facts in order to elucidate the probable reason of political actors studied if we really want to understand their behaviour. Such an approach, which is not based on normative assumptions, is less prone to meta-theoretical debates. This is a pluralist approach that suggests using theories from different backgrounds when their axioms correspond to the reality of the phenomenon that is studied. Most theories can be just on some occasions and inadequate on others; you have to determine whether any given theory is adequate to interpret a given case given the correspondence or not of its assumptions to the given state of affairs.

In *Man, the State and War*[154], Kenneth Waltz examines three "images" of international politics, three perspectives that may help elucidate the causes of war: the human, the internal structure of states and the international system. On the first image, according to Waltz, the majority of theories tend to blame human nature: humans are essentially selfish, aggressive, impulsive and stupid. They wage war because their nature leads them to act so. If the first image is right, we should try to change human nature, draw the human to become a peaceful being. The second picture suggests that, in order to understand the dynamics that cause the decision to wage war, we must understand the game of the internal organization of States. States that are unstable or torn from within would be more likely to wage war to stabilize themselves, since war may promote unity and cohesion. In this case, to avoid war, we should reform the unstable and fragile states and to adopt measures that foster cohesion. The third picture, the international system with an anarchic structure, in which the State would tend to wage war to defend interests that are dearest to them. The interpretation of each of these images depends on the presupposition of an axiom that is considered a fact. But if we change these assumptions preserving the perspective of the image, it completely changes the interpretation that follows. For example, if we assume that humans are naturally good and co-operative and if it is desired to understand the causes of war from the first image, the interpretation may be very different from that which would result from the assumption that humans are naturally selfish and bellicose. Most hypotheses of international relations theory are based on axioms. These axioms guide the interpretation and are useful for this purpose but the big problem is that they distort interpretation when they are wrong. Beware of speculative assumptions: instead of using beliefs and generalizing them as if they were truths, it would be better for you to be skeptical. Instead of making false generalizations, it is better to assess, case by case, whether what you believe is true or not, considering the facts.

Politicians can sometimes act in ways that may seem irrational, in the sense of rational choice theory, for example. Rational choice theory usually focus on the optimal reason that players may adopt, but it is only one among many hypotheses on that question. Most hypotheses of international relations theory assume a normal reason.

Depending on the assumed normal reason, political actors are expected to act in a particular way. Let us now ask this question: if researchers do not all think the same way, why would all political players think in the same way, then? After all, the reason of an aggregate political player such as the State is the sum of the interests, reasons, and interactions of the individuals who are behind it. These individuals set the reason of the State, voluntarily or involuntarily, by the policies they establish and they defend. In international relations theory, theorists claim that the State has a reason that is similar to theirs. However, theorists all have different reasons, therefore individuals behind the State may also have different reasons. Considering that individuals in the government, the public service, and the diplomatic sphere are replaced continually and that the games of power are in constant motion, it should be expected that the tendencial reason of the State changes through time and each State has an underlying reason that is different from that of others. It is the same for international organizations, multinational corporations, etc. In short, instead of pretending that political players all have the same or a similar reason, we should try to understand the games of power that guide the tendencial reason of each player in the context where it is studied.

Robert Keohane also notes that the tendencies of international politics do not follow the most pessimistic predictions of the Nash equilibrium for many political games. In his own words: "If international politics were a state of war, institutionalized patterns of co-operation on the basis of shared purposes should not exist except as part of a larger struggle for power. The extensive patterns of international agreement that we observe on issues as diverse as trade, financial relations, health, telecommunications, and environmental protection would be absent."[88, p. 7]

However, this does not mean that the Nash equilibrium is wrong per se; if the utility function is such that co-operation can be more beneficial than defection, or if there is a high probability of high costs for defection, then players may be incited to cooperate more. It all depends on the utility function. That is one of the reasons why interdependence and institutions may influence decision-making greatly.

Because each abstraction leads to a different $x \in \mathbb{R}$, and because one $x$ should be closer to reality than the other (unless each theory provides an equally wrong interpretation for different reasons), then one should be closer to reality, therefore more true. But it is not true that every theory is good to study any subject, contrary to what many political scientists believe today.

## 5.5 Of the correspondence of theories to types of reason: each general theory on normal political reason is actually a special theory on one type of reason.

*Theories are applicable when and only when their premises are true. Then, let the rationality assumptions of a theory circumscribe the thought pattern of a player, and let every theory set its own thought pattern of reason this way. We get as a result a typology of player types, where players differ according to their thought pattern. We have thus done a full circle, from Confucius to experiments in game theory to IR theory: different types of players behave differently, and theories can serve to study classes of players. We can use realism to study the behaviour of realist players, liberalism for liberal players, etc. This extends far beyond the classic idea of hawks vs doves and owls, which was already used in political science to describe different types of players.*

### 5.5.1 Explanation

Why should we try to model behaviour "old-style" when machine learning is evolving to the point that computers can generate their own predictive models from data? In an ideal future world, humans would be lazy creatures, and computers would be geniuses (or is it really ideal?) However, to this day, machine learning software needs carefully thought-out rules and calibration from experts, who prepare basic algorithms to help the process start. Moreover, there is a critical trap in the planning stage that is commonly called the bias-variance dilemma: if there are not enough variables, the model may be biased because it overestimates the importance of the chosen variables and underestimates the "hidden" ones, and if there are too many the model may underestimate key variables relatively to all others.

Game theory has been used extensively in international relations, notably by neo-realists, neo-liberals, constructivists, rational choice theorists and quantitativists in general, to model political behaviour and interaction. In order to make models that can be operationalized, many tried to use objective and quantifiable variables, such as material military power (number of troops, weapons, vehicles, number of military alliances in dyads, etc.) and economic power and assets (national debt, GDP, PPP, levels of economic inequality, number of ratified economic partnerships in dyads, etc.). Meanwhile, others recognized that many objective facts, such as a State being a democracy of not or a market being capitalist or not, cannot be quantified; a few such observations have led to "discoveries" such as the theory of democratic peace and the McDonald's peace theory, for example. The great advantage to these objective variables is that they are easy to operationalize within the standard framework of utilitarian game theory: by estimating the costs and benefits of available options, you can more easily predict or explain behaviour quantitatively as a result of a rational reaction to a defined payoff function.

Yet, there are many non-objective or non-material variables that may influence behaviour, that have been the focus of much research in game theory as well as international relations theory in the recent decades, though both epistemic communities went in starkly different directions. Perception of threat, the propensity to take or avoid risk, reputation, honour and shame, for example, are only a few variables that have been shown, in social and natural experiments, to exert an influence over decision-making. As such, a player's personality, culture, values, and worldview can be as important as a material factor, although they are much more difficult — if not impossible — to quantify.

In international relations theory, theorists who decided to focus on subjective and non-quantifiable variables have moved away en masse from positivism and formal models; they have ridiculed these as utopias, or fragile sand castles that were to be swept away by the next wave of theorists because of their weak assumptions. Moreover, they insisted that it is impossible to predict behaviour, because there are too many facets to the human experience that cannot be reduced to humanly manageable models, and because most humans do not think every decision in calculations, among other criticisms. Meanwhile, many game theorists have kept focus on formal models and subjectivity at once, and that led to many interesting models and experiments on subjective utilities, the role of a reputation in iterated games, and community coercion.

Otherwise, three main approaches from economics are used to interpret political behaviour: the public choice approach, which assumes that individuals manipulate political systems in order to promote their private economic interests; neo-classical institutionalism, which assumes that political and economic institutions are the result of intentional actions chosen by rational individuals to maximize their economic interests; and the new political economy, which assumes that economic policy is the result of distributive policies and competition between groups and individuals seeking to advance their private interests. What is special about each of these approaches is that they reduce the actor model of homo œconomicus, a rational actor who chooses according to a reason that focuses on individualist private interests. So there is an ideological bias that ignores the social and political aspects, as well as the possibility that a player reasons based on values that are not selfish.

But analysts themselves have worldviews, too, that influence and distort how they see things, what appears to be relevant or not, and what seems naturally rational or irrational. This is why it may be rational to co-operate in a given political context for an analyst, who may consider irrational the behaviour of a player who will not co-operate. This is why theorists have fought for decades over what is logical in international politics: their worldviews differ. The rationality assumptions of liberalism cannot explain a realist's reliance on self-help (without wrong arguments), nor can the rationality assumptions of realism explain a liberal's wish to co-operate when the risk of defection from the other players is high.

We therefore have two choices. Either we throw old theories out the window, or we use them as they should, as special cases. Let us choose the latter. Theories may become types of reason in a typology of players, and rationality assumptions may become criteria to make a diagnosis regarding the type of player.

Unfortunately, the project of creating the equivalent of a diagnostic manual with a typology of political players goes far beyond the scope of this dissertation; suffice to understand that this is the breaking point where we part ways with theories of International Relations and sort out the problem of their contradictory assumptions, which were the trigger that launched this research.

Then, the answer to the presumed problem of paradigm incommensurability in international relations theory is that theories with incompatible assumptions become logically compatible if they are circumscribed to clearly defined special cases.

### 5.5.2 Consequence

What we suggest is that an always up-to-date compilation of the frequency at which players of a given type choose a given strategy in a set may be useful to data mine into

States' behaviour. It would allow us to overcome the problem of abusive generalization (by claiming trends without taking each player's reason into account), and that of incomplete information (because we do not see what is going on inside the black box).

If the analyst adequately assesses the tendency of every player, then we may use statistics to study probabilities, which gives us a more solid empirical foundation to make predictions and explanations which would derive directly from the model, rather than the analyst's intuition, and take each player's subjectivity into account even with incomplete information.

### 5.5.3 Caveat

There are three potential error factors to such method:

1. The analyst may assign a wrong type to a player, thus leading to an incorrect interpretation.

2. The typology may not be precise enough.

3. The statistics may be inadequate. This would be the result of one or both error factors stated above.

How to diagnose players' rationality? It is up to the analyst to find out according to each case, like the psychiatrist asserts each client's profile case by case, and this state of affairs represents the most important error factor. The analyst can use discourse analysis, interpretation of the leaders' ideology, or trend analysis, for example to determine whether the player's tendencial rationality corresponds to a type's rationality assumption or not. Note that a player may have a different type when bargaining in security or economic matters, for example, or even when interacting with different players, so the analyst should be careful with type assignment.

Yet, the analyst needs to remain careful and to recognize shifts of types, such as the shift that happens when a state is suddenly led by a very different leader (for example Donald Trump succeeding Barack Obama as the president of the United States in 2017).

We will not undertake the creation of this typology here, because this would necessitate the concerted efforts of innumerable political scientists who are ready and able to dedicate much time to it, like it did in the field of Psychiatry. The importance of the previous discussion to this dissertation is threefold:

- to explain to the reader why we need to move away from inadequate generalization regarding rationality criteria and normal reason;
- to explain why we need to move away from general theories of International Relations in order to better understand what underlies the interactions of political players;
- and to suggest a promising research area—the typology of political players using the diagnostic method—to ambitious readers who seek a challenge.

# Part II

# How we 'play'

*The Mayans were able to calculate with great precision predictions, for example, for eclipses and for the position of the moon in the sky, the position of Venus, etc. It was all done by arithmetic. They counted a certain number and subtracted some numbers, and so on. There was no discussion of what the moon was. There was no discussion even of the idea that it went around. They just calculated the time when there would be an eclipse, or when the moon would rise at the full, and so on.*

*Suppose that a young man went to the astronomer and said, 'I have an idea. Maybe those things are going around, and there are balls of something like rocks out there, and we could calculate how they move in a completely different way from just calculating what time they appear in the sky'. 'Yes', says the astronomer, 'and how accurately can you predict eclipses?' He says, 'I haven't developed the thing very far yet'. Then says the astronomer, 'Well, we can calculate eclipses more accurately than you can with your model, so you must not pay any attention to your idea because obviously the mathematical scheme is better'.*

*There is a very strong tendency, when someone comes up with an idea and says, 'Let's suppose that the world is this way', for people to say to him, 'What would you get for the answer to such and such a problem?' And he says, 'I haven't developed it far enough'. And they say, 'Well, we have already developed it much further, and we can get the answers very accurately'.*

*So it is a problem whether or not to worry about philosophies behind ideas.*

---

Richard Feynman[63]

# 6

# How can we explain the behaviour of the State?

It should have become clear, at this point, that all notions of game theory that are in question here are related to bargaining problems where players may be unequal, have different sets of strategies, and where utility is difficult to quantify.

Bargaining was the primary problem of game theory, and has become even more so after John Nash's seminal doctoral dissertation on "Non-cooperative games"[106], which exposes his famous bargaining theory. In international relations, most interactions are problems of complex relational asymmetry, be it about war (whether to attack or not, which strategy is best, timing), diplomacy (how to negotiate and which options to deal), trade, the interaction between decision-makers and lobbyists, etc. As a result, game theory becomes intrinsically related to the study of international relations.

Yet, as game theory requires a level of abstraction such that players are rational units, we need to either consider complex adaptive systems such as States as units or to open the black box and drill down the decision-making process. This finally leads us to the grand question of this study.

## 6.1 Specific question

How can we explain the behaviour of a complex adaptive player such as the State?

## 6.2 Hypothesis

If a complex adaptive system is rational, then its reason is explicable as an adaptation to contextual stimuli, rather than on the basis of normal premises of rationality. An alteration of the context can change the reason of the players and the co-ordination obtained. Thus, an apparent "equilibrium" is only a contextually normalized co-ordination that can be reversed by a change in context or a subjective shock. This equilibrium is not necessarily stable. If a player's reason was relatively stable because of the normalization and changes according to their adaptation to the stimuli, then one could observe trends, and possibly changes of trend, in the player's choices. The choice should not vary in an anarchic way from one game to another, except if there is an explainable perturbation, such as a change of government with a different ideology or a revolution.

## 6.3 Logical implications

It follows from the hypothesis that players will adapt their behaviour until they do what is normal, then follow their tendencies as long as there is no perturbation to trigger a deviation.

It also follows that, in an interaction between two unequally powerful players, the solution should include the stronger players' most preferred and the weaker's least disliked strategies. Thus, an equilibrium needs not be a co-ordination of non invadable strategies, as it is conventionally thought; any normalized solution is stable as long as all players accept it.

As a consequence of the new solution concept, the political regime of a State may have an impact in the following way:

- The level of political stability: the greater is political unrest within a country, the more likely it is to deviate because of internal and external lower-level games[14].

[14]The notions of lower and higher-level games here do not refer to the notion of sub-game. A sub-game is any manifestation of a game at other instances, other iterations, whereas the use of lower and higher level games here is related to the level of abstraction. To use physics as a caricature, a galaxy would be at a higher level than solar systems, which are higher than stars and planets, in turn higher than molecules, and then atoms, and then electrons and protons and neutrons, and then quarks and anti-quarks, and then strings. So the attraction between strings would be a very low level game relative to the attraction between galaxies—without consideration of the importance of each. Similarly, in politics, the games between bureaucrats would be at a lower level, and the games between two alliances of States such as NATO and the Warsaw Pact would be at a higher level. So we can analyze games at

- The political regime: the more democratic is the decision-making process of a State, the less likely it is to deviate in a short span of time—because deliberations take place over more lower-level games and with more players so it is more difficult to manipulate the games at higher levels.

- Similarity of regimes and ideologies: States that have similar economic or political regimes or ideologies are less at risk of conflict against one another and more likely to make a coalition against players who are different, because there is a normalization between them; the more different two States are, the more likely they are to wage war because of otherness (the opposite of normalization). Normalization is a conflict prevention mechanism through adaptation to one another.

- The relative bargaining power: the greater is the relative bargaining power of a player, the more likely that player is to steer the solution towards their preferred outcome. As for weaker players, they will either adapt to the stronger players, or they will forge a coalition if the latter may perturb the equilibrium. Even if you are much weaker—like a terrorist organization or a rogue state relative to a superpower—creating a perturbation may cause a re-normalization of the game in your favour.

every level independently—given a sufficient amount of information—and so games between States for example can be studied on their own without consideration of lower levels if we do not have sufficient information—just like we can study the game between two galaxies without knowing how many quarks and anti-quarks are contained within each of them. We can do so as long as we do not assume that a given level has intentions that it might not have.

## 6.4 Verification strategy

The new solution concept will be tested in comparison to other solution concepts and experimental data, in order to verify whether it performs better or not in comparison to concurrent solution concepts.

## 6.5 Relevance of this study

Firstly, this study serves to challenge the non-falsifiable assumptions of rationality and nature that are prevalent in international relations theory and that contradict each other. These pseudo-scientific contradictions damage not only the utility of international relations theory, but also their credibility. By proposing a more rigorous theoretical framework that allows for the reconciliation of contradictory assumptions under special circumstances, we hope to help improve the credibility of research in international relations.

Secondly, this study serves to offer and test a new theoretical instrument to analyze the relations of power in the interactions of complex systems like the state (or lobby groups, terrorist groups, partisan groups, ideologies, etc.) This theory could serve as the foundation for new data-centric methods of forecasting and explaining international relations using the quantitative analysis of trends and the qualitative analysis of perturbations. Thus, if the new theory proves to be effective, it could serve to guide negotiations and even provide tools to manipulate politics.

# 7

# Relational form games

The following chapter is the heart of this dissertation: it presents a new model to analyze the asymmetric relations of power and to explain or forecast the result of the interaction between complex asymmetric systems such as the State.

To recapitulate, our question was: how can we explain the behaviour of a complex adaptive system such as the State?

A game is any interaction between two players or more such that their strategies affect their payoffs. This dissertation focuses on relational form games. In these games, some players may exert more power than others over the course of their interaction, and each player will adapt to the context.

The main assumption of this dissertation is the definition of the State as a complex adaptive system. In complexity science, a system is said to be complex if its dynamics cannot be explained nor predicted adequately in terms of deterministic rules describing their behaviour; it is said to be adaptive if it adapts to its context rather than following a linear path. The reason why game theory has so much difficulty predicting State behaviour and transformations in international relations is actually because the State is a complex adaptive system.

There is also a considerable ontological difference between the notion of utility used here and the one used in traditional game theory. Traditionally, a player's utility function is defined on the Cartesian product of all players' strategy sets, where the decisions of others influence one's own payoffs. Therefore, utility in games is considered contingent on the interaction of the players, which is the defining feature of a game. Utility is contingent on the interaction between players and it may even be subjectively assessed by each player depending on multiple factors. However, because we cannot know objectively how the players will assess the utility function, the theory proposed here turns to probability instead of cardinality or ordinality. More precisely, we differ from the traditional model of a game in assuming that a player's utility only depends on his chosen strategy, with this strategy being played with a certain probability.

Otherwise, one of the main tenets of this dissertation is that, in order to avoid interpretation errors due to your subjectivity or worldview, you should always suspend your judgement and only trust well governed data. In return, paradoxically, this suspension of the analyst's judgement and reliance on historical data creates a non-null assumption by design—the belief that future behaviour will follow near past patterns—but this might still be better than the subjective bias and guesswork of an intuition-driven interpreter.

## 7.1 Of quantitative forecasting: a formalization of the proposed theory

### 7.1.1 Relational form games

A relational form game $\Gamma$ is a model of interaction where interdependent players try to influence—with possibly unequal relative power—the behaviour of one another and that of the group as a unit-player. In such games, a player's behaviour is contingent on three sets of attributes: each playerset of strategies, a probability distribution assigned over the set of strategies, and relative bargaining power. Each player may have a different set of strategies that depend directly upon their capabilities; so long as they have the capability to choose a strategy and try to implement it, this strategy has some likelihood described by the probability distribution. It is defined as follows:

$$\Gamma = (\mathcal{M}, \mathcal{S}, \mathcal{R}, \mathcal{P}) \tag{19}$$

In this game, $\mathcal{M}$ (for marionettes) denotes the set of players for an $m$-person game, where we label the players from 1 to $m$.

$$\mathcal{M} = \{1, 2, \ldots, m\}. \tag{20}$$

### 7.1.2 Strategy sets

The strategy powerset $\mathcal{S}$ of a relational form game contains the strategy space of every player as its elements. There is a finite pure strategy space $S_i$ for every player $i$, which includes all pure strategies $s_i^{i^k}$ that are available to that player for a given iteration of a given game according to the player's capabilities(where the subscript is the player's identifier and the superscript is the strategy's identifier, so $s_i^{i^k}$ is a given strategy for a given player $i$). We label the strategies from 1 to n.

$$\mathcal{S} = S_1 \times S_2 \times \ldots \times S_m \tag{21}$$

$$S_i = \{s_i^1, s_i^2, \cdots, s_i^n\} \tag{22}$$

$$\mathscr{s}^* = (s_1^{1^k}, s_2^{2^k}, \ldots, s_m^{m^k}) \in \mathcal{S} \tag{23}$$

where $\mathcal{S}$ is the powerset of all strategy sets, $S_i$ is the set of all pure strategies available to player $i$, $s_i^{i^k}$ is a given pure strategy $i^k$ of player $i$, and $\mathscr{s}^*$ is a given strategy profile. The lack of decision is still a given strategy in the strategy set and the strategy profile.

Players do not necessarily have the same capabilities, so they do not necessarily have the same set of available strategies. Then, strategy sets do not necessarily share the same identity; strategy sets may actually be very different. Thus, in a relational form game, $S_i \not\equiv S_j$.

### 7.1.3 Utility

In order to avoid assuming arbitrary utility values, it is best to use the frequency of use of a strategy by a given player as an indicator of its utility for that player. Hence, without assuming preferences, we assign a probability value, rather than a simple scalar, that varies through time according to the statistically observed trend in the use of each strategy.

$$u(s_i^{ik}) \equiv P(s_i^{ik}) \tag{24}$$

### 7.1.4 Probability

We evaluate three distinct probabilities:

$$\mathcal{P} = P(s_i^{ik}), P^{dom}(s_i^{ik}), P^{res}(\jmath^*) \tag{25}$$

where $P(s_i^{ik})$ represents the probability of player $i$ choosing strategy $s_i^{ik}$, $P^{dom}$ is the probability that a given strategy will be part of the chosen strategy profile, and $P^{res}\jmath^*$

is the probability that a strategy profile $\mathcal{s}^*$ is the result of an iteration of the game, respectively.

In relational form games, strategies are oriented not only by utility considerations, but also by relative bargaining power relations and contextual constraints. It is not a strategic form game, but rather a relational form game with a finite matrix of probabilities of strategies being relationally (rather than strategically) dominant.

### 7.1.5 Influence

We now define two rates to measure the influence of a player over the solution of a relational form game:

$$\mathcal{R} = (\rho^{perso}, \rho^{rel}) \tag{26}$$

### 7.1.6 Personal success rate

The personal success rate of player $i$—$\rho^{perso}$—is used as a stepping stone to evaluate each player's relative bargaining power over the course of the game. $\rho_i^{perso}$ can be estimated as the ratio of a player's success in agreeing with the final group decision (which means that there is a correlation but not necessarily a causation between their personal choice and the group's choice) over the sum of all tries, smoothed such that more recent iterations reflect shifts while reducing the bias of noise and exceptions:

$$\rho_i^{perso} = \frac{\sum_{t=1}^{\tau} 2^{t-1} v_t (v_t + w_t)^{-1}}{2^t - 1} \cdot 100\% \tag{27}$$

where t is the point in time (from 1 being the farthest observation in the past to $\tau$ being the latest one), $v_i$ is a success and $w_i$ is failure, so the sum of all $v$ and $w$ is the sum of every iteration of a game where a player chooses an option. Note that the denominator is a Mersenne number[15], which is reflective of the exponential nature of the evolution of success rate over time.

### 7.1.7 Relative bargaining power

Relative bargaining power is logically equivalent to the probability that a player dominates or is dominated by another player; it is mathematically equivalent to their relative rate of success in choosing the solution. Using each player's success rate $\rho^{perso}$, you can then find their relative bargaining power by dividing the personal success rate of a player by the sum of the personal success rates of all players:

$$\rho_i^{rel} = \frac{\rho_i^{perso}}{\sum\limits_{i \in \mathcal{M}} \rho_i^{perso}} \cdot 100\% \tag{28}$$

[15]Note on Mersenne primes: A Mersenne number, also known as a Mersenne prime, is a number of the form $M \equiv 2^p - 1$ where $n$ is an integer. It is thus part of the set of natural numbers and grows exponentially. You may use the Lucas-Lehmer test to determine whether a number is a Mersenne prime or not. As defined in the *CRC Standard Mathematical Tables and Formulae*[162]:

> Define the sequence $r_{m+1} = r_m^2 - 2$ with $r_1 = 3$. If $p$ is a prime of the form $4n + 3$ and $M_p = 2^p - 1$, then $M_p$ will be prime (called a *Mersenne prime*) if, and only if, $M_p$ divides $r_{p-1}$. This simple test is the reason that the largest known prime numbers are Mersenne primes. For example, consider $p = 7$ and $M_7 = 127$. The $\{r_m\}$ sequence is $\{3, 7, 47, 2207 \equiv 48, 2302 \equiv 16, 254 \equiv 0\}$; hence $M_7$ is a prime.[162][p. 104]

### 7.1.8 Dominance

The probability of dominance $P^{dom}(s_i^{ik})$ is the product of probability magnitude $u(s_i^{ik})$ by player $i$'s relative bargaining power $\rho_i^{perso}$, which is a variation of the von Neumann and Morgenstern expected utility function, at a precise moment in time and for a single player, where the probability of success is replaced by the personal success rate and the quantified utility is replaced by the probability that a player will prefer an option (which is a distant equivalent to the utility as a dynamic ratio of preference over time).

$$P^{dom}(s_i^{ik}) = \rho_i^{rel} u(s_i^{ik}) = \rho_i^{rel} P(s_i^{ik}) \tag{29}$$

One of the implications of that function is that a player may choose an option that has a sub-optimal utility as a result of the influence of other players.

## 7.2 The solution concept

*A contextually normalized solution is a stable state of a game such that players normalize their strategies as they adapt to each other and the context, and then repeat their normal strategies as long as the context is stable.*

A game takes the shape of an $m$-dimensional manifold whose equilibrium point moves over time according to the pull of each player in a given direction and their relative bargaining power, and the equilibrium point may move over time as the group adapts to continually updated probabilities and relative bargaining power. Since one can study a game between players who are all arguably weak or all arguably powerful as well as a game between players of disproportionate forces, what really counts then is the relative bargaining power of each player relative to others, instead of absolute power. Capabilities, in this context, only determine what strategies are available (capabilities affect agency), rather than the impact that a player may have over the outcome of a game.

### 7.2.1 Probability of result

Let $\mathscr{s}^* = (s_1^{1^k}, s_2^{2^k}, \ldots, s_m^{m^k}) \in \mathcal{S}$ be a given strategy profile. The probability that $\mathscr{s}^*$ is the result of an iteration of a game is equal to the ratio of the sum of the probabilities of domination of each strategy in that profile over the sum of the probabilities of domination of all strategy profiles. We denote this by $P^{res}(\mathscr{s}^*)$. We define the probability of domination of $\mathscr{s}^*$ by:

$$
\begin{aligned}
P^{dom}(\mathscr{s}^*) &= P^{dom}(s_1^{1^k}, s_2^{2^k}, \ldots, s_m^{m^k}) && (30)\\
&= P^{dom}(s_1^{1^k}) + P^{dom}(s_2^{2^k}) + \ldots + P^{dom}(s_m^{m^k}) && (31)
\end{aligned}
$$

We now define $P^{res}(\mathscr{s}^*)$ by:

$$
P^{res}(\mathscr{s}^*) = \frac{P^{dom}(\mathscr{s}^*)}{\sum\limits_{s \in \mathcal{S}} P^{dom}(s)} \cdot 100\% \qquad (32)
$$

Probabilities are updated following every iteration of an event. This means that the probability of an event may change from one iteration to another, either as a result of the reinforcement of a normalization or as a counter-reaction to the result of the previous iteration. The transformation of the mapping from one iteration to the next has therefore the potential to move the point of gravity of the strategy powerset.

### 7.2.2 Contextually normalized solution

We define the contextually normalized solution $\varepsilon$—the key ingredient of our theory—as a normal coordination of strategies that lasts as long as the dominant direction of the group is not perturbed; it is not necessarily a stable saddle point. A complex adaptive system will move in the direction of the dominant player's most preferred and the weaker players least disliked strategies (that is the direction of the strongest pull on its strings). The contextually normalized solution $\varepsilon$ is such a solution that would repeat itself through multiple iterations.

$$\varepsilon = \underset{\jmath^* \in \mathcal{S}}{\operatorname{argmax}}[P^{res}(\jmath^*)] \tag{33}$$

The contextually normalized solution is the co-ordination of contextually normalized strategies such that weaker players adapt to the stronger and they have no intention or do not have the capability to perturb the current normalization and to make the stronger players deviate from their tendencies. This is why any equilibrium is contextually normalized that may shift not only because of a change in the utility of strategies, but especially because of a change in the context which changes the power relations. Similarly, stability may be explained by power relations: unless you are strong enough to force the group to shift to another direction, the group-player is likely to keep moving in the same direction and the more it does so, the greater are the chances that it keeps going.

If a complex adaptive system is rational, then its reason is explicable as an adaptation to contextual stimuli, rather than on the basis of normal premises of rationality. An alteration of the context can change the reason of the players and the co-ordination obtained. Thus, an apparent "equilibrium" is only a contextually normalized solution that can be reversed by a change in context or a subjective shock.

So an equilibrium is not necessarily stable: if a player's reason was relatively stable because of the normalization and changes according to their adaptation to the stimuli, then one could observe trends, and possibly changes of trend, in the player's choices. The choice should not vary in an anarchic way from one game to another, except if there is an explainable perturbation. It follows that players will adapt their behaviour until it normalizes, and then follow their normal tendency as long as there is no perturbation to trigger a deviation. It also follows that, in an interaction between two unequally powerful players, the solution should include the stronger players' most preferred and the weaker players' least disliked strategies. Thus, an equilibrium need not be a co-ordination of least invadable strategies, as it is conventionally thought; any normalized solution is stable as long as all players accept it.

## 7.3 Applied examples

### 7.3.1 Example of a non-consensual game

A non-consensual game is a type of non-cooperative game where the players may choose any strategy as there is no means to enforce cooperative behaviour. In such games, players may choose different strategies; they do not need to reach a consensus.

For example, consider a two-player game with players 1 and 2 that have the same strategy set, $S_1 = S_2 = \{s_i^1, s_i^2\}$. Let $u_1 = (10\%, 90\%)$ and $u_2 = (90\%, 10\%)$, and the personal influence of each $\rho_1^{perso} = 75\%$ and $\rho_2^{perso} = 10\%$. Finally, let their preferences be the same as usual (player 1 prefers $s_i^2$ and 2 prefers $s_i^1$) Then, we obtain the following relative bargaining power rates:

$$\rho_1^{rel} = \frac{75\%}{75\% + 10\%} \cdot 100\% = 88\%$$
$$\rho_2^{rel} = \frac{10\%}{75\% + 10\%} \cdot 100\% = 12\%$$

Therefore, the expected probability of each player-strategy pair is:

$$P^{dom}(s_i^{i^k}) = \rho_i^{rel} u(s_i^{i^k})$$

$$P^{dom}(s_1^1) = (88\% \cdot 10\%) = 8.8\%$$

$$P^{dom}(s_1^2) = (88\% \cdot 90\%) = 79.2\%$$

$$P^{dom}(s_2^1) = (12\% \cdot 90\%) = 10.8\%$$

$$P^{dom}(s_2^2) = (12\% \cdot 10\%) = 1.2\%$$

We can immediately observe that the player 1 is likely to impose the strategy $s_i^2$ on the player 2, although the player 2 does not really like it, if a consensus is reached. Using this data, we obtain this table of probabilities of dominance: By calculating the $P^{dom}(s_1^1, s_2^2)$

Table 1: Matrix of the probability of dominance of each strategy profile in a simulated non-consensual game

| | $s_2^1$ | $s_2^2$ |
|---|---|---|
| $s_1^1$ | 8,8%, 10,8% | 8,8%, 1,2% |
| $s_1^2$ | 79,2%, 10,8% | 79,2%, 1,2% |

function for all strategy profiles, it is possible to discover which strategy profile has the highest probability of being the result of the game. If each player can choose a different strategy, then the strategy profile $(s_1^2, s_2^1)$ is most likely at 45%, as we will see below:

Probability of dominance of each strategy profile:

$$P^{dom}(s_1^1, s_2^1) = P^{dom}(s_1^1) + P^{dom}(s_2^1) = 8,8\% + 10,8\% = 19,6\%$$

$$P^{dom}(s_1^1, s_2^2) = P^{dom}(s_1^1) + P^{dom}(s_2^2) = 8,8\% + 1,2\% = 10,0\%$$

$$P^{dom}(s_1^2, s_2^1) = P^{dom}(s_1^2) + P^{dom}(s_2^1) = 79,2\% + 10,8\% = 90,0\%$$

$$P^{dom}(s_1^2, s_2^2) = P^{dom}(s_1^2) + P^{dom}(s_2^2) = 79,2\% + 1,2\% = 80,4\%$$

Sum of the probabilities of all pure strategies:

$$\begin{aligned}\sum_{s \in \mathcal{S}} P^{dom}(s) &= P^{dom}(s_1^1, s_2^1) + P^{dom}(s_1^1, s_2^2) + P^{dom}(s_1^2, s_2^1) + P^{dom}(s_1^2, s_2^2) \\ &= 19,6\% + 10,0\% + 90,0\% + 80,4\% \\ &= 200,0\%\end{aligned} \tag{34}$$

Probability of result for each strategy profile:

$$\begin{aligned}P^{res}(\mathfrak{s}^*) &= \frac{P^{dom}(\mathfrak{s}^*)}{\sum\limits_{s \in \mathcal{S}} P^{dom}(s)} \cdot 100\% \\ P^{res}(s_1^1, s_2^1) &= \frac{19,6\%}{200,0\%} \cdot 100\% = 9,80\% \\ P^{res}(s_1^1, s_2^2) &= \frac{10,0\%}{200,0\%} \cdot 100\% = 5,00\% \\ P^{res}(s_1^2, s_2^1) &= \frac{90,0\%}{200,0\%} \cdot 100\% = 45,00\% \\ P^{res}(s_1^2, s_2^2) &= \frac{80,4\%}{200,0\%} \cdot 100\% = 40,2\%\end{aligned}$$

Table of probabilities of results: If the calculations were done correctly, the sum

Table 2: Probabilities of results in a simulated non-consensual game

| | $s_2^1$ | $s_2^2$ |
|---|---|---|
| $s_1^1$ | 19,6% ÷ 200,0% = 9,80% | 10,0% ÷ 200,0% = 5,00% |
| $s_1^2$ | 90,0% ÷ 200,0% = 45,0% | 80,4% ÷ 200,0% = 40,2% |

of all probabilities of results should be equal to 100%, which means that the solution is certainly among these options.

Thus, in this non-consensual game, if the trends are maintained, the strategy profile $(s_1^2, s_2^1)$ is the most probable and the profile $(s_1^2, s_2^2)$ is also quite probable, but a little less; the probability that one of the other profiles is the solution of the game is small, given the strong tendency of the player 1 to adopt the strategy $s_i^2$, unless the strategy $s_i^2$ suddenly has a utility much higher than usual in the context of this game. If the player 2 wishes to convince the player 1 to adopt the strategy $s_i^1$, they must thus endeavour to increase the relative utility of $s_i^1$ relative to $s_i^2$ in the eyes of player 1.

This is also the way to conclude a compromise or concession.

### 7.3.2 Example of a consensual game

A consensual game is a game where the players need to reach an agreement—intentionally or not—and adopt a common strategy that satisfies everyone's preferences. Therefore, players adopt a common strategy that is at the intersection of every player's set of acceptable strategies. In such games, players must choose a common strategy. In such a game, it is enough to limit the calculations of probabilities to the common junctions.

The probability that a strategy is adopted by all players depends on the relative bargaining power of each player, in combination with the probability that each adopts a given strategy. Thus, in a consensual game, a highly dominant player can impose an undesirable strategy on highly dominated players.

To simplify the example, keep the same data. Again, if the calculations were done

Table 3: Probabilities of results in a simulated consensual game

| | $s_2^1$ | $s_2^2$ |
|---|---|---|
| $s_1^1$ | 19,6% $\div$ 100% = 19,6% | |
| $s_1^2$ | | 80,4% $\div$ 100% = 80,4% |

properly, the sum of all probabilities of results should be equal to 100%, which means that the solution is certainly among these options.

As expected earlier, it is very likely that the strategy $s_i^2$ is adopted by the group, because of the strong influence of the player $i$ and their strong preference for the strategy $s_i^2$. The interaction of influences and preferences indicates a probability of 80.4% that this strategy is adopted by the group, *ceteris paribus*. Now, 80.4% is not 100%: it is possible that the players deviate towards the consensual adoption of strategy $s_i^1$. For example, if their usual behaviour leads to a solution that is unfavourable to the interests of each player, it is possible (and desirable) that they co-operate to make a choice that goes against their tendency. In this case, it can be used to predict harmful situations and to change relationships (e.g. by stimulating peaceful dialogue) or to work to increase the relative utility of another strategy. It may therefore be beneficial to become aware of trends in order to avoid disaster.

# 8

# Philosophical considerations

The purpose of this chapter is to discuss some philosophical considerations of the theory, more precisely:

- What is the purpose of knowing the contextually normalized solution?
- Rationality and the likelihood of deviation.
- Qualitative forecasting.

## 8.1 What is the purpose of knowing the contextually normalized solution?

*If you can explain or predict the expected contextually normalized solution, then you may find a way to make it deviate towards the optimal solution or away from sub-optimal ones, either by using the expected equilibrium as an argument to negotiate mutual deviation or as a clue to influence other players.*

### 8.1.1 Explanation

The type of rationality hypothesized by von Neumann depends, in principle, on the minimax decision rule: the player aims not only to maximize their gains but also to minimize their losses. They would have an aversion to risk. John von Neumann has repeatedly insisted that his theory would have no value without this rule of decision. As noted in the literature review, many researchers have challenged this hypothesis for various reasons. In particular, Daniel Kahneman and Amos Tversky[87] have experimentally discovered that the majority of individuals do not always show an aversion to risk: generally, an individual player would tend to demonstrate an aversion to risk when it comes to earnings and an aversion to losses, with much less consideration about risk, when it comes to losses. Actually, many findings in psychology and studies in behavioural game theory show that the assumptions that underlie the *homo œconomicus rationalis* model are not universal. Any player may follow a minimax, a maximax, a maximin, or a minimin decision rule, for example, in any given game, depending on their own preferences. It all depends on their own rationale for choosing the best options. As for the solutions of the games, they can vary according to the case and they do not always tend towards the same solution concept, after several iterations. Consequently, the new theory must be able to integrate all types of reason in order to have a broader and more accurate scope than the general utilitarian models.

### 8.1.2 Scholium

The research question concerns the reason of the State. The State, as a complex adaptive system, can be broken down into several nodes (e.g. ministries), which are themselves composed of a subset of nodes (e.g. ministers and civil servants) that interact among them and with external players. The notion of the State as a unitary player capable of adopting a unitary and coherent reason is then a logical condition that is difficult to achieve: the cohesion of all the efforts of the nodes of the meta-player around common objectives and according to a specific reason that everyone is aware of. It is possible, but such cohesion is rare.

Moreover, since it is difficult and usually impossible to have information about what is being said and done behind curtains and closed doors, in government offices or in cafes, it is better to study the State at a higher level of abstraction, that is, taking the State's actions as facts and signs of an inherent revealed reason without assuming hypothetical intentions. Whether a choice is consciously reasoned or results from compromise resulting from the dynamics of power, the choice that is observed becomes an objective fact that is useful for reconstructing the reason scheme of the meta-player, despite the incomplete information that you may have about it.

Thus, in cases where cohesion is so perfect that lower-level games matter little, the State may be considered a player with a reason, but it remains a potential puppet and puppeteer relative to external players. In cases where cohesion is imperfect or non-existent, games of power internal and external to the meta-player may orient the choices that are made. The State then has only a tendency of reason, a tendency expressed and observable by the choices that have been made. Echoing Paul A. Samuelson's concept of revealed preference[126], which represents the likely preferences that seem to induce a player's observed choices without sufficient knowledge of their real preferences, we introduce here the concept of revealed reason, that is the observable trend of a player's reason.

When a player repeats a strategy for any given type of game during any time frame, you may observe a tendency in their behaviour. When a series of choices adopts a different orientation from the old trend, a new tendency can be observed. This may be the case, for example, when a new government follows an ideological orientation radically different from that of the former government. A graphical representation would illustrate a discontinuity, a change of direction, and then the new direction would indicate a new trend.

It is not necessarily a reasoning or a mentality: the State is not a conscious thinking being, therefore it does not have such faculty. On the other hand, even the revealed reason for the behaviour of an individual may or may not be reasoned consciously. As a phenomenon related to a behaviour, its existence does not necessarily depend on will. Therefore, it is not necessary to know a player's preferences in order to understand their behaviour: on the contrary, a player may be unaware of their own preferences or even have incomplete, intransitive, or variant preferences. If preferences are indefinite or unknown, it is vain to attempt to discover them; it may be possible to isolate them in controlled experiments, but one can only speculate about them when studying the behaviour of a political player who does not express them. In other words, the study of preferences is a chimera in most cases. A game theory that focuses on the study of preferences may produce plausible interpretations, but there is no sufficient reason to believe that they are verisimilar.

Nor is it a matter of considering the State as an anthropomorphic unit capable of reasoning in accordance with its own interests. On the contrary, this is the key error of orthodox game theory. We must simply consider the State as a player with a *de facto* reason (in the sense of a logic that guides choices), thanks to the internal and external dynamics. What is to be studied is not the nature or the interests of the State, but rather the relations of power, the observable tendencies and the factors of deviation.

Each complex system may be studied as the State by extrapolating reasoning. At the same time, like the State, any complex system does not have an absolute agency[16], since its capabilities and the barriers set by the context circumscribe its potential choices.

Any political player is potentially a puppeteer in the sense that they may manipulate other players in order to serve their interests. They may also unintentionally influence other players, unintentionally pull their strings. However, if each player is a puppeteer, each must also be a potential puppet that other players may manipulate. Each puppet has a certain autonomy: depending on its capabilities, a range of possible choices is open to the player, but each player does not necessarily have the same capabilities (for example, Senegal does not have the same military capabilities as the United States and a lower-level official does not have the same capabilities as a prime minister, so each player has a separate strategy set). The choice of strategy can be made according to the simple expected utility of options for a player, but it can also be done in response to pressures or external influences. Then, the researcher has three tasks: to investigate the revealed reason of each player, to estimate the probability of deviation and to analyze the game of power.

[16]Agency refers to one's capability to make choices, within constraints, and to control their behaviour and the world around them.

The classical von Neumann-Morgenstern utility function may be useful to understand the factors that can lead to a deviation of the trend. Thus, even if a player is dominant and their tendency normally leads them to make a given choice, they may lean towards another choice if the utility of that choice, according to their reason, is high enough to justify the deviation.

By identifying the recent cases where each strategy has been used, for games of a similar nature, probabilities can be assigned to each pure strategy in order to define the mixed strategies of the players.

In the case of games with several iterations, it is thus possible to estimate these probabilities through statistical compilation, *ceteris paribus*. In the case of a rare game, a change of administration or a rotation of the participants, one can try to subjectively estimate the probability of each strategy according to the usual tendencies of each player. In fact, since many events in international relations are unique, the qualitative analysis of the players' subjectivity is usually necessary.

The von Neumann-Morgenstern function has two problems for the study of games where players may manipulate each other: it does not take into account external influences and it assumes that individual utility guides choices when that is not necessarily the case. In a puppeteer context, a player may make a decision that does not meet their personal quantified utility for various reasons, such as to thwart opponents by hiding their real intentions (e.g. in military affairs) or another player waiting for a return of favours (for example in the free trade cases). One can only compensate for these defects by observing qualitatively the games of influence of the lobbies and the reasoning and recommendations of the official communications, and then simulating an interaction of the mixed strategies in consideration of the power relations and the tendencies of the players.

Given the constraints on their behaviour (e.g. social pressures, organizational structure, or higher authorities) a player often replicates similar choices in similar cases. It is from this revealed tendency of reason that one can deduce the rules of reasoning of the player; these rules make a strategy more rational than another according to the player's tendencial notion of rationality.

### 8.1.3 Consequence

This is why we must redefine the notion of rationality as follows:

- a player is rational if they follow a strong tendency, rather than randomization, unless randomness as an instrument to confuse rivals is itself the player's tendency as it reveals itself as a useful strategy in given contexts;
- a choice is irrational if it deviates strongly from the player's tendency.

If players have different rules of reasoning, each player may respond differently to the same stimuli. That is why we do not all make the same choices, and complex adaptive systems either. We adapt in a different way and our personal rules of reasoning guide our behaviour, as it follows a trend. Since these rules of reasoning can change over time (our thinking and maturity evolve), this trend is not immutable: it is constantly updated, in the manner of a Bayesian model. It is therefore by studying the transformation of the trend that change can be explained.

### 8.1.4 A simple thought experiment: flirting with a girl at the bar

Let us indulge in a little thought experiment, shall we? In the movie *A Beautiful Mind*, the character John Nash goes to a bar with some friends to spend some time with friends. Then, some of his friends identify the girl that they find most attractive, and they jokingly tell Nash that he should try to seduce her. An idea then comes to Nash's mind: if he and his friends all try to seduce the same girl and none of her friends, that girl may reject all the boys, and then her friends will also reject them as they do not wish to be second thoughts. The result is that none of the boys will go out with any of these girls.

However, the character Nash follows with another option. If the boys all go for one of her friends instead, then none of them will have the optimal payoff (dating the most attractive girl), but they will all have satisfying payoffs (dating one of her friends) as they will not interfere with each other.

While the movie clumsily uses this thought experiment to explain the notion of the Nash equilibrium (it is actually backward induction), this shows a fundamental difference between the thinking behind the equilibrium analysis of utilitarian game theory and the search for the contextually normalized solution. If we were looking for the contextually normalized solution, we would not look for the least dominated strategies such that individual players do not earn sub-optimal payoffs; we would look for what each player is most likely to do. We may end up with a solution such that all players flirt with the same girl, and that girl rejecting them all, but not necessarily. That expected outcome is the contextually normalized solution, as it is the expected coordination of usual strategies adapted to the context. Yet, knowledge of the contextually normalized solution may lead to better outcomes if one player, in this case Nash, is able to leverage this knowledge in order to warn the other players of a sub-optimal expected outcome and to increase his influence over their strategies and suggest a more optimal coordination that leads to a Pareto-optimal solution (such as flirting with her friends instead and not interfering with one another).

## 8.2 Of unlikely and seemingly irrational deviations

*Although normalization creates expectations, players may deviate from their usual behaviour under sudden impulsions that are difficult to explain with any solution concept, even with the one that we propose here. However, more players interact in more lower-level games, so the behaviour of the state already corresponds to a previous equilibrium between lower-level players, which means that deviation may have been prevented at a* *lower level of the decision-making process, and so the tendencies of complex adaptive systems should appear more stable.*

### 8.2.1 Explanation

For example, you would usually expect a good student who has no problem with a subject-matter and who is rational to sit through their exam, pay attention to the questions and do provide as good an answer as they can, considering that this is the normal behaviour of this type of player as well as that specific individual's habit. Then, you would be surprised if that student got up from their chair only a few minutes after the beginning of the exam, hands out their copy with drawings and no answer, and leaves, only to show up at the next class and listen carefully as if nothing happened before. This is exactly what yours truly did once on the occasion of a mathematics exam in college that was worth one third of their final mark, just because he thought the questions were boring. So, while some scenarios may seem unlikely, they are still possible.

Fortunately for the study of international politics, such unpredictable deviations are much less likely as the behaviour of States—and complex adaptive systems in general—result from the solutions of lower-level games that involve many individual players, each of whom A) is less likely than the other to ignore rules and norms and to deviate from the normalized equilibrium, and B) may try to discipline or marginalize deviant players of their own level.

### 8.2.2 Consequence

Therefore, A) some unexpected deviations may happen and that does not mean that the theory is wrong, and B) complex adaptive systems such as the State still remain less likely to deviate suddenly from a normalized equilibrium—the likelihood of deviation decreases with the augmentation of the number of players and the bargaining in lower-level games.

### 8.2.3 Of the artificial reason of complex adaptive systems: they are not thinking entities, but they do possess reason

*Although complex adaptive systems like a State do not think, their preferences are de facto the reflection of the lower-level games played by the players who manipulate it behind the curtains. We may or may not witness what is really going on in the offices and boardrooms, but some preferences can be observed nonetheless. If one observes a deviation in its tendency, then one is right to believe in a change of approach. Utilitarian game theory remains useful here, if only to guess the possible causes of deviation.*

The objective of the theory presented below is therefore not to find equilibria according to the expected utility of available options, but rather to estimate the probability of each possible solution of a relational form game. Since in a game of power, the influence of each player on the others is important, this method essentially replaces the utility of an option by the likely influence of each player. To do this, one must start by observing the tendency of each player and the rate of personal success.

## 8.3 Of qualitative forecasting: finding the most likely intersection between the stronger players' most preferred and the weaker players' least disliked strategies

*Try to understand how each player thinks (even if a group does not "think" in a conscious sense) rather than transposing your own mindset to their reason. Exclude all strategies that players would outright reject. If players are relatively equal, find the most popular strategies used by each; this is the likely solution. If one is more powerful by far, this one's preferred strategy that is not rejected by others may be adopted. A coalition may become a stronger collective meta-player to counterbalance or co-opt other players more easily.*

### 8.3.1 Explanation

As the proposed theory observes trends, it provides an overview of the probable result of the game, without considerations of the notions of utility or fitness and evolutionary stability[17]. Any player can change strategy at any time and it is essential that the researcher does not fall into the trap of unwavering confidence in statistics and mathematics: hu-

[17]The contextually normalized solution is not equivalent to the evolutionarily stable equilibrium as it does not assume stability as a result of fitness of strategies, but rather a convenient coordination of strategies in the context of the dynamics of relative power. In other words, unlike the evolutionarily stable equilibrium which is assumed stable in the long term, a contextually normalized solution may not be stable for long and may change as soon as a perturbation occurs in the system, players change, or the balance of relative power shifts. In this case, an evolutionarily stable equilibrium is a long-lasting special case of contextually normalized solution.

man subjectivity is not perfectly logical and may be difficult to assess objectively. This is why the qualitative study is necessary in order to take note of the factors that can divert the players from their tendencies or the norm.

This theory brings an innovation in the sense that it brings an assessment of relative bargaining power in the analysis. Rather than considering players as equals as we often do in classical models, assess co-operation with other players primarily based on reputation and trust, or groups coordinating their choices based on signals from others through dynamic play of signalling or projection, the relative bargaining power is incorporated as a means of coercion or sign of the influence of each player on the others. Such a relationship can be deduced by the trends of the recent past, because behaviour indicates the power relations (e.g. coercion, influence, hegemony, etc.) of the players without explaining what conditions the relationship (e.g. reputation or dominance).

In order to find the probability distribution of a strategy powerset, however, another ingredient must be brought into the mix: the diversity of strategies. There is usually a wide range of possible strategies. In this case, failing to have the statistical information necessary to estimate the probability that each player chooses a given option, one can use the classic formulas (of von Neumann or of Nash, according to the available information) in order to estimate the utilities which can then be used to make a scale of probabilities that reflects the scale of expected utilities. If a player tends to follow a utilitarian calculation, as predicted by von Neumann, then the probability of each action should match the expected utility calculation. Ideological behaviour should be assessed in the same way, establishing the utility of each action according to its likely hierarchy of preferences. In this case, in the absence of the trend reason information, the classical formulas remain useful for estimating, albeit more arbitrarily, the expected probabilities of behaviour.

In the case of such estimates, the two most dangerous mistakes that you should avoid are: 1) to transpose to players a reason that seems natural to you; 2) to attribute erroneous preferences or assign an inaccurate probability distribution to strategies. The second point is the one to which you must pay the most attention, since it is difficult to investigate the subjectivity of a player and that the players do not always have a conscious, transitive and consistent order of preferences. These errors are more likely to be committed using less rigorous research methods, where the researcher uses their intuition and experience to judge the behaviour of the players. This is why a Pyrrhonist attitude is necessary: by suspending judgment, the interpreters avoid assigning factual status to hypotheses or intuition and limit themselves to accepting the reality of what they can verify empirically. Reasoning then serves to reassemble the pieces of the puzzle at hand in such a way as to imagine a portrait of the whole landscape, despite the holes in the picture, without pretending that you know what you cannot see. To look behind the curtains of the political theatre is simply to imagine the image of what you do not see by gathering together what you can see, while avoiding conspiracy theory and presupposition.

Sometimes, particularly in social behaviour, patterns of strategies that do not appear to be evolutionarily stable seem to constitute a relatively stable equilibrium. In these cases, peer coercion can promote the standardization and maintenance of certain norms, values and strategies. Strategies can be normalized by influence and coercion as they eventually balance if all members of a community accept it and punish or marginalize the deviants. We then speak of conventions, in the sense proposed by Peyton Young.

Young has, over the years, built a very rich theoretical framework that describes and explains the evolution of social behaviour towards a situation of equilibrium. It describes a convention as a behaviour that is customary and expected by peers[159]. Since the majority of players comply with the convention, which becomes a social norm, it is expected that everyone will do so. This state of affairs creates social pressure that self-regulates behaviour, failing which a deviant player may be reprimanded or marginalized by their community. A convention creates a balance of social self-regulation[160].

Let us broaden the scope of this concept a bit, to bring it back to games that have fewer players (or even two) and fewer iterations (or even one). Young noted that the players' choices may be oriented, or even forced, by conventions and social norms, in particular. These are constraints that lead a player to favour certain choices that are more socially acceptable than others. More specifically, these constraints are part of the social context. If we add the structural context, for example the rules and the hierarchy, we further constrain the "acceptable" or probable choices of a player. Let us add, on top of it all, the contextual capabilities: the set of capabilities of a player, in a given context, modifies the set of available options. We could go on with this list, but just remember that it is the context, in the end, that normalizes behaviour. All contextual constraints alter the set of realistic options. The player still has the agency of making a choice among the set of available options, but agency and the set of options may be more or less constrained.

We learn through trial and error. As a result, our behaviour does not repeat in a deterministic fashion, but there is a continually changing probability for each option. Players usually—but not always—repeat usual strategies in similar contexts.

Yet, we have different reasons and different preferences, so different players may make different choices. To predict the outcome of a relational form game, simply look at each player's habits. The solution of the first iteration will be the co-ordination of their usual most likely choices. They will adapt their strategies in future iterations until they either stop interacting, or reach a contextually normalized solution. The contextually normalized solution will be the co-ordination of the least disliked strategies of the weakest players and the most preferred strategies of the strongest players.

There is no deterministic law of social behaviour. However, there are trends because of how games and equilibria work. The more a group is institutionalized and disciplined, the lesser is the agency of each player within. As a result, behaviour will be more consistent and routines will be more likely.

The more diffuse is decision-making within a group, the less likely it is to deviate, because the will of the majority will change more slowly than the will of one individual as a result of the need for more sub-games of bargaining.

The rivalry between two seemingly equal players in terms of relative bargaining power may lead to an equilibrium until one of them becomes strong enough to trigger a deviation of the other (the weaker player) and a re-normalization of the game such that the stronger player sets the agenda, or the weaker player makes a coalition with others in order to counter-balance as a stronger meta-player.

### 8.3.2 A simple thought experiment: the State as an interlocutor

Let us indulge in a little thought experiment, shall we? Suppose that you are a high ranking diplomat representing a democratic State, and I am your counterpart representing an autocratic State that you are dealing with, and I respond directly to the president. Although we have been friends for a long time and we agree on most subjects, a recent event triggered a conflict between our two respective States and we have to negotiate an agreement together.

Every time one proposes a deal to the other, the latter has to go through a consultation process in order to devise the best response (i.e. the strategy that provides the optimal payoff in consideration of other players' strategies). In your case, you need to arrange at least one meeting, maybe more, with your superiors and your team, and some research may need to be done in order to forecast the impact of each option. As a result, there are many internal lower-level games that you need to play through in order to reach an equilibrium within your own group, and the decision is likely to be the result of the input from many players and necessary concessions.

As for me, I need to discuss the matter with my superiors. As their orders are absolute, I need to comply with them, except that I may and should try to influence them. The stronger my persuasion skills are, and the more they trust me, the more likely they are to deviate from their usual mindset. As a result, I am bound by structural and relative bargaining power constraints, just like you are, but deviation is more likely as there are less lower-level games to play through.

Following the reception of your proposition, I contact my own superior and he tells me that I need to adopt a hard line and refuse the deal. I feel that I have no choice but to comply with his instructions. The negotiations keep going like this, and you have to go through many rounds of negotiation every time, which takes time but there is not much change in your proposition, because the deliberations are so complicated that it is difficult to steer them. As for me, I am able to discuss face to face with my superior; it does not take too long as there is less deliberation. At some point, tired of the interminable negotiations, I try to find ways to influence my superior and I am finally able to convince him to accept the deal that you proposed. We reached an agreement that is skewed towards your country, as it was more inflexible than mine.

Anyone who has ever worked for a government, if even for a few months, knows that a seemingly simple decision can take months of deliberations at various levels, both vertically and horizontally, to see the light of day. You never know what is going on exactly as you cannot follow every email and coffee break conversation, but everyone seems to have a hand in it, and the result is not always the most rational choice. And even if you know your interlocutors personally, you are dealing with what they represent: an institution that is governed by rules, norms, and a work culture.

This is why the interaction between complex adaptive systems is better understood as one between players that follow tendencies more than a utility function and why more democratic players have a slower turnaround than more hierarchic players, and that adapt to each other as a function of relative bargaining power[18]. We always have a certain leeway, but the set of available options is constrained by our capabilities, the context, and other players pulling our strings; and the more players are involved, the more difficult it is to steer collective decision-making because you need to deal with a group, a complex adaptive player that is less flexible than you are.

[18]Just like the State, any group where decision-making is involved to make one decision in the name of the entire group, as an aggregate unit, may be conceptualized as a complex adaptive system in the sense of this theory. Therefore, although you do not know what happened in the head of State's office, at the cafe where a politician met a lobbyist, or what emails were sent, you can observe the party's behaviour and analyze tendencies and shifts. You can also do the same for representatives, who represent all the lower level games and players behind them.

# Part III

# What is the case

*Some years ago I had a conversation with a layman about flying saucers—because I am scientific I know all about flying saucers! I said "I don't think there are flying saucers'.*

*So my antagonist said, "Is it impossible that there are flying saucers? Can you prove that it's impossible?" "No," I said, "I can't prove it's impossible. It's just very unlikely". At that he said, "You are very unscientific. If you can't prove it impossible then how can you say that it's unlikely?"*

*But that is the way that is scientific. It is scientific only to say what is more likely and what less likely, and not to be proving all the time the possible and impossible. To define what I mean, I might have said to him, "Listen, I mean that from my knowledge of the world that I see around me, I think that it is much more likely that the reports of flying saucers are the results of the known irrational characteristics of terrestrial intelligence than of the unknown rational efforts of extra-terrestrial intelligence." It is just more likely. That is all.*

Richard Feynman[64]

# 9

# Hypothetical implications

Albert Einstein once wrote in a letter to fellow engineer Michele Besso about the difficulty he had finding data to test his insights. He wrote, "Have you already calculated the absolute size of the ions under the assumption that they are spheres and that they are large enough to permit the application of the equations of the hydrodynamics of viscous liquids?"[55]. For most of his life, the renowned scientist faced the problem that the empirical data that he needed was not available to him and very difficult to discover using the current means of measurement.

While there is no question to compare the greatness of his work to the pettiness of the one that you are reading at the moment, we face a similar problem. While it is by no means insurmountable, despite the immense amount of data that is being amassed in the early days of data science, there is no data on the preferred strategies or expressed preferences of States in their dyadic interactions, be it in economic or political relations. Most of the data regards more tangible things like the evolution of the gross domestic product, electoral behaviour, etc. Alas, yours truly had no means nor time to go through the excruciating pain of building a data set of thousands of possible dyadic interactions over hundreds of years just to prove the insights pushed into this dissertation.

Instead, we will use four methods to demonstrate how the theory may be applied and why it is valid. In this chapter, we will discuss logical implications of the solution concept with intuitive explanations and some famous cases where these implications occurred. In chapter 10, we will calculate the expected contextually normalized solution for eight games, and compare the results to eleven other solution concepts and experimental findings in order to find out which solution concept is ideal. In chapter 11, we will present a pen-and-paper method that can be used to apply the mathematical model using a minimal amount of data and anecdotal information. Finally, in chapter 12, we will see how to apply the mathematical model using big data to discover patterns and critical junctures.

For now, let us start with a discussion of four major implications of the new solution concept, some implications that grant it more predictive and explanatory power. To prove our point, it should suffice here to provide an intuitive explanation and some examples of such manifestations in the real world.

## 9.1 Of the level of political stability

*The greater the level of political unrest within a country, the more likely the country is to deviate because of internal and external lower-level games.*

### 9.1.1 Intuitive explanation

This can be proven intuitively as a result of lower-level games.

A complex adaptive system such as the State has a reason that depends on the interaction of lower-level players in lower level games. Individuals interact and deliberate, each with their own personal reason, at different levels of hierarchy until you reach the top of the decision-making pyramid. As a result, the reason of the State will be a rational combination of the reason of all lower-level players, normalized by the context.

As long as every player is either satisfied with the status quo of the contextually normalized solution or unable to perturb it, then the equilibrium will remain a stable state. In other words, if no one can and wishes to change the reason of the State, then its reason will remain relatively stable.

### 9.1.2 Some empirical support

Now, suppose that there is a great deal of civil unrest. lower-level players are much more likely to be dissatisfied with their current context, and consequently they may wish to change it. If the strategies they use in this context appear to have unsatisfying results, they may try other strategies. As a result, the greater number of players try new strategies, especially if they have greater relative bargaining power, the greater will be the deviation in lower-level games. As a small deviation in lower-level games—like the assassination on 28 June 1914 of Archduke Franz Ferdinand of Austria and his spouse Sophie, Duchess of Hohenberg, by Gavrilo Princip and his fellows—may sometimes have a greater impact in higher level games—like the beginning of the First World War. Granted, there often need to be other factors in play, so it is always a contextually normalized solution—in the case of the First World War, there were other tensions and the matter of the military alliances at the international level, but the civil unrest in the Balkans and the eventual assassination plot were triggers in lower-level games that initiated the deviation at the higher level.

## 9.2 Of hierarchy and the openness of decision-making

*The more democratic is the decision-making process of a State, the less likely it is to deviate in a short span of time—because deliberations take place over more lower-level games and with more players so it is more difficult to manipulate the games at higher levels.*

### 9.2.1 Intuitive explanation

This can be proven intuitively as a result of lower-level games.

The greater is the rigidity of rules, the lesser is the capability of each player to make a choice as they should follow these rules. As a result, rules serve as constraints that limit the number and the nature of the options that are available to you in any given context. The opposite is equally true: the more freedom you have as a result of more open rules or a more open and transparent decision-making process, the more options are available to you.

Our first thought may be that, as a result of greater flexibility in lower-level games, higher-level games are more likely to deviate; that is not the case. As players have more freedom, the decision-making process is actually less likely to deviate from its set course of reason. There are two explanations for this phenomenon.

The first explanation is that the more players are involved in the decision-making process, the more deliberations will take place regarding a wider gamut of topics. As more lower-level games are taking place, decision-making at higher levels take more time because they depend on games at lower levels, and decision-makers at higher levels have more interests to defend so they are more bound by their engagements than they would be if lower-level players had less freedom and impact. Therefore, decision-making at the top being bound by their obligations and engagements at lower levels—as a result of the adaptation to the context and the greater relative bargaining power of lower-level players relative to higher-level players—they have less flexibility and are consequently less likely to deviate.

The second explanation is that the smaller is the number of players involved in the decision-making process, the higher is the agency of higher-level players as they are less bound by their engagements and obligations to lower-level players. As a result, the State (or other complex adaptive player) is more likely to deviate because the top players have greater relative bargaining power, so a greater impact on the behaviour of the system.

### 9.2.2 Some empirical support

- A State such as North Korea in the late twentieth and early twenty-first century, in which political power is concentrated in the hand of a few elite players, is much more likely to deviate and present seemingly erratic behaviour than a country like Canada during the same time period.

- The concentration of relative bargaining power in the hands of one person because of that person's attitude can change how a State behaves. For example, the United States of America seemed more rational and less erratic under President Barack Obama than under his successor Donald Trump, because the Obama presidency had greater transparency and accountability while the Trump presidency is more autocratic, brash, and opaque.

## 9.3 Of similarity of regimes and ideologies

*States that have similar economic or political regimes or ideologies are less at risk of conflict against one another and more likely to make a coalition against players who are different, because there is a normalization between them; the more different two States are, the more likely they are to wage war because of otherness (the opposite of normalization). Normalization is a conflict prevention mechanism through adaptation to one another.*

### 9.3.1 Intuitive explanation

This can be proven intuitively as a consequence of the privilege of kinship.

Suppose that you have two players, 1 and 2, who have similar reason. Then, the behaviour of each player will appear normal to the other, and it is expected that they will normalize their strategies such that there is no perturbation in their relations. As long as they reason in a similar fashion, there is no reason for perturbation at this game-level, and thus no reason for a deviation.

However, suppose that these same players have very different reasons. Then, the reason of one may seem unnatural, or even irrational to the other, as the utility functions of both reasons do not match at all. As a result, one or the other may try to make the other player deviate as a result of the misunderstanding, or there might even be a conflict.

This phenomenon explains the theory of democratic peace with a rationale that does not depend on innate special attributes of democracy:

- as democracies are more similar in kind and reason than other types of regimes, and as they have less contentious ideals and more common interests, their behaviour is normalized such that there is no reason nor will to deviate.
- if we take back the earlier postulate regarding the greater stability of democratic systems, as each player is less likely to deviate in an interaction between two democracies and as lower-level players may be used to their normalized interactions with other States, it is much less likely—but not impossible—that two democratic States will suddenly deviate from their usual tendency and face each other in war.

It also explains situations such as the rise of civil war. Suppose that there are two non-State complex adaptive players, such as nationalist groups. If one of the two groups starts threatening the other and the other needs to adapt to the new context by trying new strategies, this may lead to a coordination of warmongering strategies on both sides such that the tensions and the death toll will rise. Then, a re-normalization may appear with a change of context such as the intervention of external forces (of peacekeeping or military intervention).

### 9.3.2 Some experimental observations on kinship

Kinship is the principle by which individuals socialize with others who are similar to them. As a way to structure social relations, kinship is at once an ordering and an "othering". As it is the case for most identity matters, kinship is defined according to exclusivity as much as inclusivity. Common characteristics (e.g., skin colour, language, customs, etc.) can be interpreted as identity markers, but one should not forget that characteristics are also defined in contrast to something different. For example, why should humans care for bipedal identity in inter-human relations? Why should one consider oneself Asian, for example, if only Asians lived? Would nationalism matter if there was only one nation? Inter-communal relations are a matter of identity comparison: two communities consider themselves distinct according to an array of similarities and differences.

Kinship is a way to sort the "good" from "bad", based on an assessment of similarity between players.

We discussed earlier of the fact that a community of players may develop distrust against another community because of some negative elements. One interesting hypothesis, from psychological experiments and game-theoretic simulations regarding the impact of kinship in inter-communal relations, is that humans are more likely to trust their kin and cooperate if they face a common threat[52].

Rival communities may cooperate against a common threat in order to ensure their mutual benefit. In this case, the common threat is the reason why two communities might seek to promote unity and the similarity of their identity; in other words, the common threat is the reason to promote kinship. This phenomenon is evident in some wars: it is not rare to observe two previously rival nations join forces and promote kinship or friendship in wartime, and then part ways and become rivals again. In the case of inter-communal relations, it is not clear whether kinship is meant to fade if a common opposition disappears. However, you can hypothesize that, if every nation on Earth became one, and if the entire human population ended up being of the same ethnicity and speaking the same language, new identity markers would likely emerge to divide communities, as it always did.

Jae C. Oh [110] explored the effect of kinship in the prisoner's dilemma (hereafter, PD). Oh's hypothesis is that "kinship biased conditional co-operation (KBCC) greatly improves the survival of cooperative individuals, eventually driving the population to cooperating equilibrium".[110, p. 149] If players remember their opponent's previous strategies and use a tit-for-tat strategy, they may converge either toward reciprocal co-operation or reciprocal defection. However, if they use KBCC (i.e., a bias that promotes interaction among similar players), then the outcome is slightly different: they are more likely to interact and cooperate with kin than with strangers. If there is more interplay among kin than among strangers, and if kin usually cooperate together, then it logically follows that mutual co-operation is the most likely strategy profile. However, Oh adds another component: conscience. If a traitorous player defects against a cooperating player, guilt may ensue, so that the traitorous player may shift to a cooperative strategy later on[110, p. 161]. While this explanation may not explain deviant cases and conflicts between two rival communities, it may serve to reinforce the notion that kin cooperate together, by providing a moral incentive to avoid defection.

## 9.4 Of the relative bargaining power

*The greater is the relative bargaining power of a player, the more likely that player is to steer the solution towards their preferred outcome. As for weaker players, they will either adapt to the stronger players, or they will forge a coalition if the latter may perturb the equilibrium. Even if you are much weaker—like a terrorist organization or a rogue state relative to a superpower—creating a perturbation may cause a re-normalization of the game in your favour.*

### 9.4.1 Intuitive explanation

The greater is the relative bargaining power of a player, the more likely it is to be able to impose a decision, co-opt or influence the other player. For example, in the relation between you and your boss, your boss's bargaining power relative to yours is greater, so you are more likely to follow your boss than the other way around (unless you were able to gain more bargaining power for some reason, but that is another matter of discussion).

Therefore, in a context where one player has much greater relative bargaining power, it is to be expected that the contextually normalized solution will shift in their advantage: this would be a unipolar equilibrium.

In a context where two equally strong players coexist, there are two major possibilities that we will focus on (and a few minor ones that will not be considered here). If they are equal, both players will counterbalance each other in a symbiotic fashion to form a bipolar equilibrium, either as a result of cooperation or competition. This bipolar equilibrium will likely trigger one of two reactions from weaker players: either to join one of the two dominant players, or to make a coalition of weaker players in order to counterbalance the two dominant players. So there are two pure equilibria (a balance of power with coalitions, or a balance of power with the introduction of at least one more dominant player to make a multipolar equilibrium) and one mixed equilibrium (a few dominant players who lead coalitions and some weaker coalitions).

A bipolar equilibrium will remain stable as long as both players have equivalent relative bargaining power. The equilibrium will be broken and players will deviate if one player surpasses the other.

### 9.4.2 Some empirical support

- A unipolar equilibrium: in the few years following the fall of the Union of Soviet Socialist Republics, the United States of America had far greater bargaining power than any other player, and they were thus able to shape the agenda of international relations. However, their relative bargaining power has dropped significantly in the meantime, so the context is currently undergoing a phase of re-normalization as other players rise, notably regional leaders.

- A bipolar equilibrium: The Cold War was the stage of a bipolar equilibrium for many decades during the twentieth century. That is until the Union of Soviet

Socialist Republics suffered some internal perturbation in lower-level games as a result of social and economic problems, triggering a change of response at higher levels and the reforms that ultimately led to the disintegration of the country and a new re-normalization.

- A multipolar equilibrium: there was a temporary multipolar equilibrium when the Non-Aligned Movement gained traction in its early days, with Third World seen as an alternative to the First World (the United States of America and its allies) and the Second World (the Union of Soviet Socialist Republics and its allies). However, the multipolar equilibrium was re-normalized as a bipolar equilibrium following the fall in economic and political power of the Third World; it no longer had enough bargaining power to counterbalance the two other dominant players.

# 10

# Comparison to other solution concepts

## 10.1 Of the first test of the solution concept: a comparison of our solution concept to eleven others, regarding eight non-cooperative games, in light of experimental results

We find the expected contextually normalized equilibria for seven games and compare these results with the predictions of eleven solution concepts obtained by Laurent Mathevet and Julian Romero[100][19]. These games are:

[19] All graphs that represent the predictions of all solution concepts—except for the conceptually normalized equilibrium—and the results of the experiments with these solution concepts are also from the work of Laurent Mathevet and Julian Romero[100]

- the prisoner's dilemma;
- the battle of the sexes;
- the stag hunt;
- the chicken game;
- the common interest game;
- the ultimatum game;
- and the unique mixed equilibrium game.

The solution concepts whose predictions will be compared to that of our model are:

- the mixed-strategy Nash equilibrium[106];
- the Folk theorem;
- the equilibrium theory with automaton strategies and cost of complexity[2];
- the weak renegotiation-proofness[59, 25];
- the internal renegotiation-proofness[122];
- the axiomatic approach of repeated interactions[99];
- the weighted fictitious play;
- reinforcement learning;

- action sampling;
- the self-tuning experience-weighted attraction learning model[79];
- and the strategic experience-weighted attraction learning model[84].

As most of these games are well known and as it is not useful to learn the full metaphors otherwise for our needs, we will not discuss the content of the metaphors behind each game here. Feel free to look for the stories elsewhere if you need them. For the purpose of verifying the adequacy of solution concepts, the payoff tables will suffice.

Also, as all of these games consist of an interaction between two players, there is no need for a diagram here. It will be presumed throughout that players are equal in the first round of a game, then follow the tendency of the first round of the game; it will change only in case of perturbation, such as a coalition or coup of a player against the other or an alteration of the context. Also, because we have no information on the player's tendencies for the experimental testing, let us suppose that they are rational in the tradition of utilitarian game theory, for the sake of testing and comparing the new solution concept. As we do not know the frequencies, let the utility serve as the only variable to determine the proportion of individuals who would use each strategy as a function of its utility.

## 10.2 Of the expected contextually normalized equilibria of eight games: in games where strategies have an initially equal probability distribution, the contextually normalized equilibria will follow the Folk theorem

Experiments and many recent theories now agree that the initial composition of a group has an influence on players' behaviour. Therefore, in games where the initial majority of players cooperate, the contextually normalized solution will likely be repeated cooperation among players, and where the initial majority of players do not cooperate, players will converge towards non-cooperation.

For example, in more peaceful societies and communities where individuals are taught that co-operation is more beneficial for every player, positive-sum games seem to be more common and it is more naturally rational for players to co-operate than to defect. Let us now see, more precisely, what is the case for classic toy games.

## 10.3 Of the contextually normalized equilibria of classic games: a comparison of various solution concepts and the contextually normalized solution

### 10.3.1 Of the prisoner's dilemma

**Examples of some applications to international relations: trade agreements; non-binding treaties.**

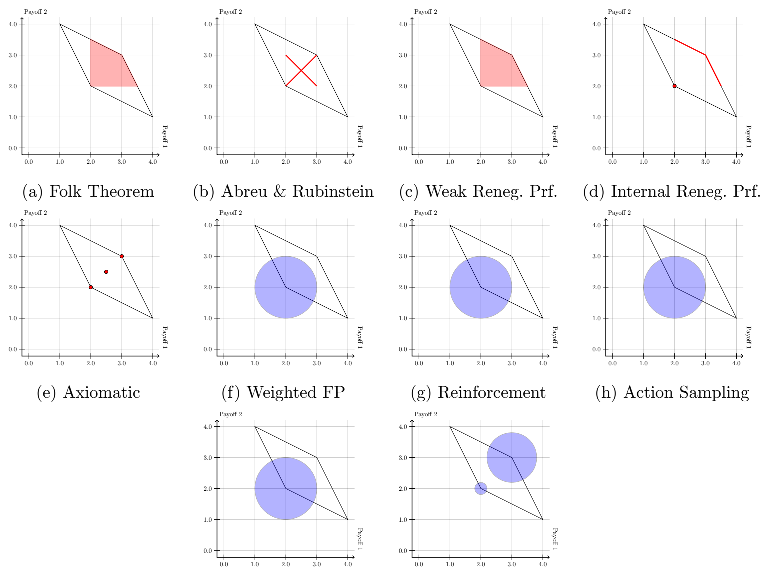
Suppose that you are a criminal who was caught by the police, together with your partner in crime, and that the police officers interrogate you both in different rooms. You have a choice to denounce your partner in order to reduce your sentence, or stay silent and wishing that your partner will not denounce you. Let $s_i^1$ be defection, and let $s_i^2$ be cooperation.

In this case, the payoffs are negative. Then:

Table 4: Payoff matrix for the prisoner's dilemma

| | $s_2^1$ | $s_2^2$ |
|---|---|---|
| $s_1^1$ | 3,3 | 1,4 |
| $s_1^2$ | 4,1 | 2,2 |

Here are some expected solutions for this game.



(a) Folk Theorem (b) Abreu & Rubinstein (c) Weak Reneg. Prf. (d) Internal Reneg. Prf. (e) Axiomatic (f) Weighted FP (g) Reinforcement (h) Action Sampling (i) Self-Tuning EWA (j) Strategic EWA

Figure 1: Predicted solutions for the prisoner's dilemma

Here is the expected contextually normalized solution.

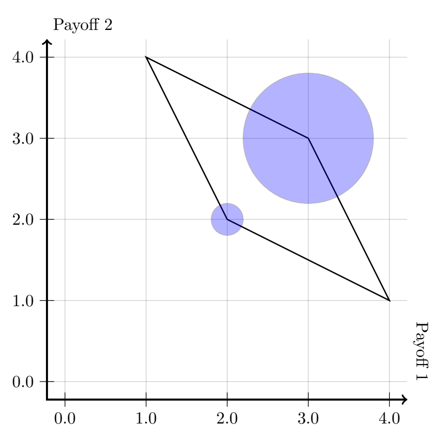



Figure 2: Contextually normalized solution for the prisoner's dilemma

And here is the experimental result.

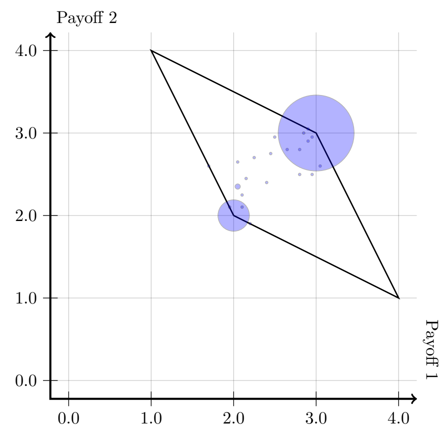



Figure 3: Experimental results for the prisoner's dilemma

Demonstration of the method to find the expected contextually normalized solution

Let there be two players (1 and 2) who can each choose between two strategies ($s_i^1$and $s_i^2$), and let the payoffs for each strategy profile be those stated previously.

If players are equal at first, then $\rho_1^{perso}$=$\rho_2^{perso}$=50%. It follows that $\rho_1^{rel} = \rho_2^{rel} = 50\%$.

**Probabilistic utility of each strategy**

The utility functions are equivalent here, so for $s_i^1$:

$$u(s_i^1) = \frac{3+1}{3+1+4+2} \cdot 100\% = 40\%$$
$$u(s_i^2) = \frac{4+2}{3+1+4+2} \cdot 100\% = 60\%$$

**Probability of dominance of a given player's strategy**

$$P^{dom}(s_i^{i^k}) = \rho_i^{rel} u(s_i^{i^k})$$

$$P^{dom}(s_1^1) = (40\% \cdot 50\%) = 20\%$$

$$P^{dom}(s_1^2) = (60\% \cdot 50\%) = 30\%$$

$$P^{dom}(s_2^1) = (40\% \cdot 50\%) = 20\%$$

$$P^{dom}(s_2^2) = (60\% \cdot 50\%) = 30\%$$

**Sum of the probability of dominance of each strategy in every possible strategy profile**:

$$P^{dom}(\mathfrak{s}^*) = P^{dom}(s_i^{i^k}) + P_j^{dom}(s_j^{j^k})$$

$$P^{dom}(s_1^1, s_2^1) = 20\% + 20\% = 40\%$$

$$P^{dom}(s_1^2, s_2^1) = 30\% + 20\% = 50\%$$

$$P^{dom}(s_1^1, s_2^2) = 20\% + 30\% = 50\%$$

$$P^{dom}(s_1^2, s_2^2) = 30\% + 30\% = 60\%$$

**Probability of result of each strategy profile**

$$P^{res}(\mathfrak{s}^*) = \frac{P^{dom}(\mathfrak{s}^*)}{\sum\limits_{s \in \mathcal{S}} P^{dom}(s)} \cdot 100\%$$

$$P^{res}(s_1^1, s_2^1) = \frac{40\%}{200\%} \cdot 100\% = 20\%$$
$$P^{res}(s_1^1, s_2^2) = \frac{50.00\%}{200\%} \cdot 100\% = 25.0\%$$
$$P^{res}(s_1^2, s_2^1) = \frac{50.00\%}{200\%} \cdot 100\% = 25.0\%$$
$$P^{res}(s_1^2, s_2^2) = \frac{60\%}{200\%} \cdot 100\% = 30\%$$

All other things being equal and constant, the most likely contextually normalized solutions for this game is $s_1^1 \times s_2^1$ (both players defect), and $s_1^b \times s_2^a$ is the least likely. However, if players who had lower payoffs in the first round switch their strategy, we may reach two contextually normalized equilibria: $s_1^1 \times s_2^1$ (both players cooperate), and $s_1^b \times s_2^a$ (both players defect). Whether we reach the non-cooperative equilibrium will likely depend on the initial composition of the group, as players would otherwise cooperate.

In the case of the prisoner's dilemma, the new solution concept and the experimental data match perfectly.

### 10.3.2 Of the battle of the sexes

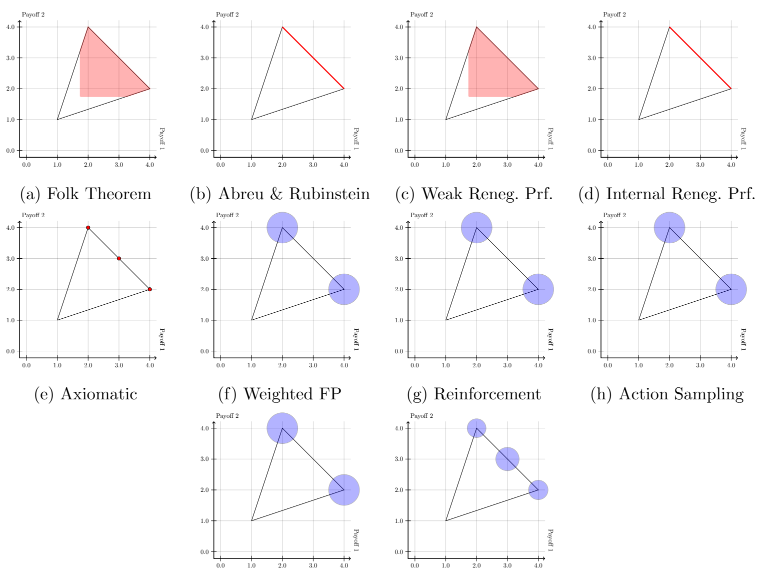
**Example of an application to international relations: territorial disputes, where concessions need to be made in order to resolve the dispute.**

Suppose that you are a a member of a couple, and that you and your partner both want to watch a movie. Let $s_i^1$ be watching a movie that player $i$ dislikes, and let $s_i^2$ be watching a movie that player $i$ likes. Then:

Table 5: Payoff matrix for the battle of the sexes

| | $s_2^1$ | $s_2^2$ |
|---|---|---|
| $s_1^1$ | 1,1 | 2,4 |
| $s_1^2$ | 4,2 | 1,1 |

Here are some expected solutions for this game.



(a) Folk Theorem (b) Abreu & Rubinstein (c) Weak Reneg. Prf. (d) Internal Reneg. Prf.

(e) Axiomatic (f) Weighted FP (g) Reinforcement (h) Action Sampling

(i) Self-Tuning EWA (j) Strategic EWA

Figure 4: Predicted solutions for the battle of the sexes

Here is the expected contextually normalized solution.

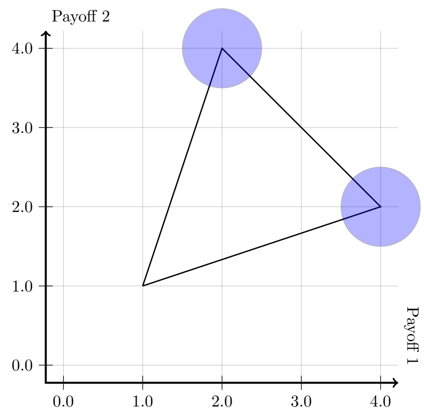



Figure 5: Contextually normalized solution for the battle of the sexes

And here is the experimental result.

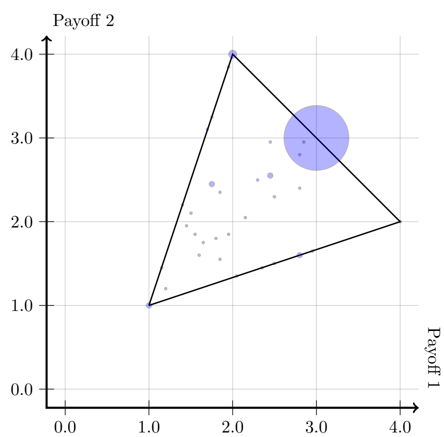



Figure 6: Experimental results for the battle of the sexes

Demonstration of the method to find the expected contextually normalized solution

Let there be two players (1 and 2) who can each choose between two strategies ($s_i^1$and $s_i^2$), and let the payoffs for each strategy profile be those stated previously.

If players are equal at first, then $\rho_1^{perso} = \rho_2^{perso} = 50\%$. It follows that $\rho_1^{rel} = \rho_2^{rel} = 50\%$.

*Probabilistic utility of each strategy* The utility functions are equivalent here, so for $s_i^1$:

$$u(s_i^1) = \frac{1+2}{1+2+4+1} \cdot 100\% = 37.5\%$$
$$u(s_i^2) = \frac{4+1}{1+2+4+1} \cdot 100\% = 62.5\%$$

*Probability of dominance of a given player's strategy*

$$P^{dom}(s_i^{ik}) = \rho_i^{rel} u(s_i^{ik})$$

$$P^{dom}(s_1^1) = (37.5\% \cdot 50\%) = 18.75\%$$

$$P^{dom}(s_1^2) = (62.5\% \cdot 50\%) = 31.25\%$$

$$P^{dom}(s_2^1) = (37.5\% \cdot 50\%) = 18.75\%$$

$$P^{dom}(s_2^2) = (62.5\% \cdot 50\%) = 31.25\%$$

*Sum of the probability of dominance of each strategy in every possible strategy profile*

$$P^{dom}(\mathcal{s}^*) = P^{dom}(s_i^{ik}) + P_j^{dom}(s_j^{jk})$$

$$P^{dom}(s_1^1, s_2^1) = 18.75\% + 18.75\% = 37.5\%$$

$$P^{dom}(s_1^2, s_2^1) = 31.25\% + 18.75\% = 50\%$$

$$P^{dom}(s_1^1, s_2^2) = 18.75\% + 31.25\% = 50\%$$

$$P^{dom}(s_1^2, s_2^2) = 31.25\% + 31.25\% = 62.50\%$$

*Probability of result of each strategy profile*

$$P^{res}(\jmath^*) = \frac{P^{dom}(\jmath^*)}{\sum\limits_{s \in \mathcal{S}} P^{dom}(s)} \cdot 100\%$$

$$P^{res}(s_1^1, s_2^1) = \frac{37.50\%}{200\%} \cdot 100\% = 18.75\%$$

$$P^{res}(s_1^1, s_2^2) = \frac{50.00\%}{200\%} \cdot 100\% = 25.0\%$$

$$P^{res}(s_1^2, s_2^1) = \frac{50.00\%}{200\%} \cdot 100\% = 25.0\%$$

$$P^{res}(s_1^2, s_2^2) = \frac{62.5\%}{200\%} \cdot 100\% = 31.25\%$$

All other things being equal and constant, should this game be a non-consensual game where each player may choose a different option, the most likely outcome is that each of them will go see their own preferred movie alone (P=31.25%). Otherwise, if they wish to coordinate their behaviour and see a movie together, there are two equally likely contextually normalized equilibria: $s_1^a \times s_2^b$ or $s_1^b \times s_2^a$. So if both players are equal, they will likely alternate from one solution to the other every time; otherwise, if one player is dominant (and this is hopefully not the case!) the couple will more often see that player's preferred movies.

The new solution concept fully agrees with the experimental data.

### 10.3.3 Of the stag hunt

**Examples of some applications to international relations: universal treaties such as environmental accords, where non-signatories and free riders may benefit from the other players' efforts.**

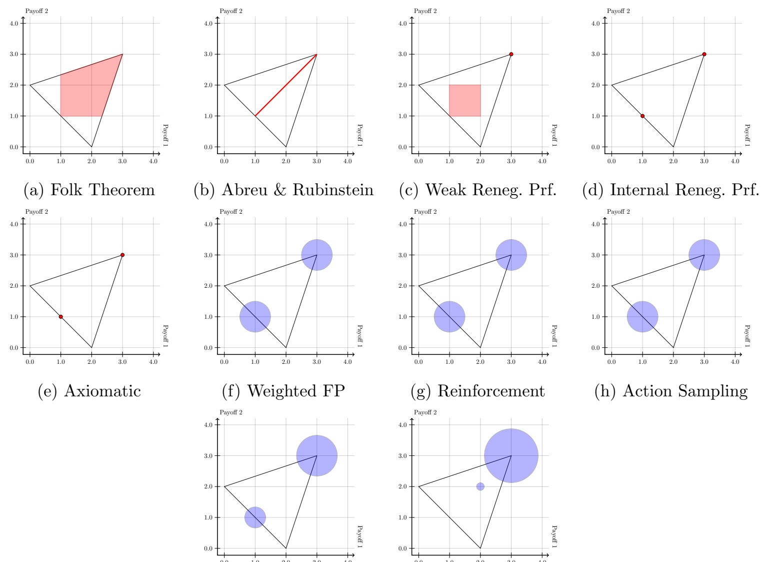
Suppose that you and another person who is neither a friend nor a foe are hunting. You may cooperate to hunt and share a stag, or hunt rabbits separately. Let $s_i^1$ be cooperation to hunt the stag, and let $s_i^2$ be hunting rabbits separately. Then:

Table 6: Payoff matrix for the stag hunt

| | $s_2^1$ | $s_2^2$ |
|---|---|---|
| $s_1^1$ | 3,3 | 0,2 |
| $s_1^2$ | 2,0 | 1,1 |

Here are some expected solutions for this game.



(a) Folk Theorem (b) Abreu & Rubinstein (c) Weak Reneg. Prf. (d) Internal Reneg. Prf.

(e) Axiomatic (f) Weighted FP (g) Reinforcement (h) Action Sampling

(i) Self-Tuning EWA (j) Strategic EWA

Figure 7: Predicted solutions for the stag hunt

Here is the expected contextually normalized solution.

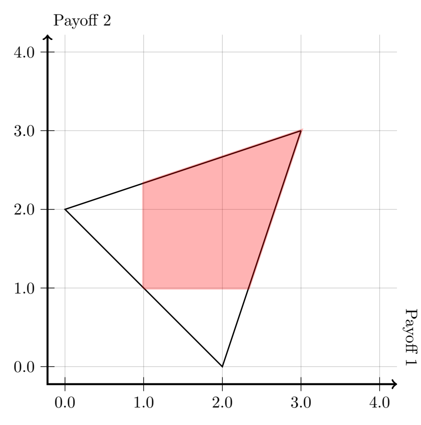



Figure 8: Contextually normalized solution for the stag hunt

And here is the experimental result.

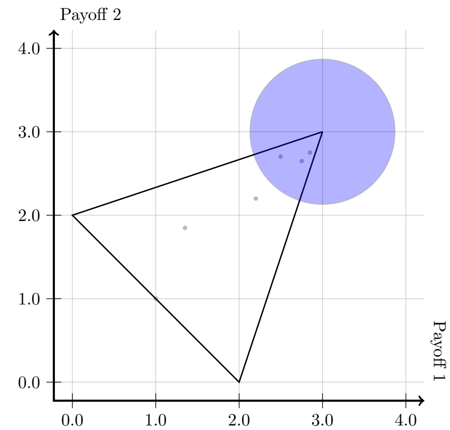



Figure 9: Experimental results for the stag hunt

- Demonstration of the method to find the expected contextually normalized solution

Let there be two players (1 and 2) who can each choose between two strategies ($s_i^1$and $s_i^2$), and let the payoffs for each strategy profile be those stated previously.

If players are equal at first, then $\rho_1^{perso}$=$\rho_2^{perso}$=50%. It follows that $\rho_1^{rel} = \rho_2^{rel} = 50\%$.

*Probabilistic utility of each strategy* The utility functions are equivalent here, so for $s_i^1$:

$$u(s_i^1) = \frac{3+0}{3+0+2+1} \cdot 100\% = 50\%$$
$$u(s_i^2) = \frac{2+1}{3+0+2+1} \cdot 100\% = 50\%$$

*Probability of dominance of a given player's strategy*

$$P^{dom}(s_i^{ik}) = \rho_i^{rel} u(s_i^{ik})$$

$$P^{dom}(s_1^1) = (50\% \cdot 50\%) = 25\%$$

$$P^{dom}(s_1^2) = (50\% \cdot 50\%) = 25\%$$

$$P^{dom}(s_2^1) = (50\% \cdot 50\%) = 25\%$$

$$P^{dom}(s_2^2) = (50\% \cdot 50\%) = 25\%$$

*Sum of the probability of dominance of each strategy in every possible strategy profile*

$$P^{dom}(\jmath^*) = P^{dom}(s_i^{i^k}) + P_j^{dom}(s_j^{j^k})$$

$$P^{dom}(s_1^1, s_2^1) = 25\% + 25\% = 50\%$$

$$P^{dom}(s_1^2, s_2^1) = 25\% + 25\% = 50\%$$

$$P^{dom}(s_1^1, s_2^2) = 25\% + 25\% = 50\%$$

$$P^{dom}(s_1^2, s_2^2) = 25\% + 25\% = 50\%$$

*Probability of result of each strategy profile*

$$P^{res}(\jmath^*) = \frac{P^{dom}(\jmath^*)}{\sum\limits_{s \in \mathcal{S}} P^{dom}(s)} \cdot 100\%$$

$$P^{res}(s_1^1, s_2^1) = \frac{50\%}{200\%} \cdot 100\% = 25\%$$

$$P^{res}(s_1^1, s_2^2) = \frac{50\%}{200\%} \cdot 100\% = 25.0\%$$

$$P^{res}(s_1^2, s_2^1) = \frac{50\%}{200\%} \cdot 100\% = 25.0\%$$

$$P^{res}(s_1^2, s_2^2) = \frac{50\%}{200\%} \cdot 100\% = 25\%$$

All other things being equal and constant, every coordination of strategies is as likely as the next. Then, according to this initial composition of the group, the entire group may either steer towards cooperation or defection. However, given the greater collective advantage to co-operate, it is expected that a normalization may steer towards co-operation.

The new concept solution does not fully agree with the experimental data.

#### 10.3.4 Of the chicken

**Examples of some applications to international relations: the arms race between the United States of America and the Union of Soviet Socialist Republics during the Cold War; the Cuban missile crisis;**

Suppose that you and a rival are speeding head on towards each other in racing cars. You both hope that the other will deviate in order to claim that you are more courageous than the other; otherwise, you will both likely die in the car crash. Let $s_i^1$ be driving ahead, and let $s_i^2$ be deviating.

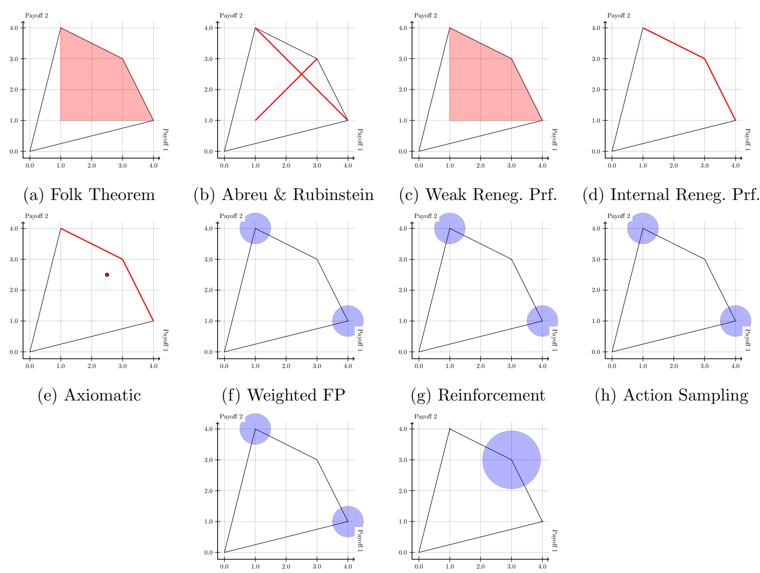
In this case, the payoffs are negative. Then:

Table 7: Payoff matrix for the chicken game

| | $s_2^1$ | $s_2^2$ |
|---|---|---|
| $s_1^1$ | 3,3 | 1,4 |
| $s_1^2$ | 4,1 | 0,0 |

Here are some expected solutions for this game.




(a) Folk Theorem (b) Abreu & Rubinstein (c) Weak Reneg. Prf. (d) Internal Reneg. Prf.

(e) Axiomatic (f) Weighted FP (g) Reinforcement (h) Action Sampling

(i) Self-Tuning EWA (j) Strategic EWA

Figure 10: Predicted solutions for the chicken game

Here is the expected contextually normalized solution.

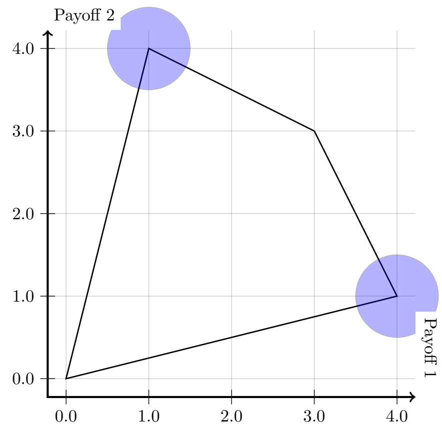



Figure 11: Contextually normalized solution for the chicken game

And here is the experimental result.

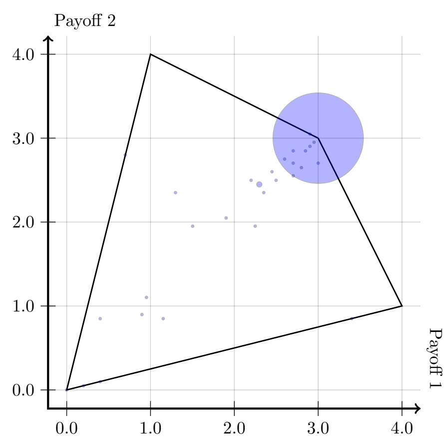



Figure 12: Experimental results for the chicken game

Demonstration of the method to find the expected contextually normalized solution

Let there be two players (1 and 2) who can each choose between two strategies ($s_i^1$and $s_i^2$), and let the payoffs for each strategy profile be those stated previously.

If players are equal at first, then $\rho_1^{perso}$=$\rho_2^{perso}$=50%. It follows that $\rho_1^{rel} = \rho_2^{rel} = 50\%$.

*Probabilistic utility of each strategy* The utility functions are equivalent here, so:

$$u(s_i^1) = \frac{3+1}{3+1+4+0} \cdot 100\% = 50\%$$
$$u(s_i^2) = \frac{4+0}{3+1+4+0} \cdot 100\% = 50\%$$

*Probability of dominance of a given player's strategy*

$$P^{dom}(s_i^{ik}) = \rho_i^{rel} u(s_i^{ik})$$

$$P^{dom}(s_1^1) = (50\% \cdot 50\%) = 25\%$$

$$P^{dom}(s_1^2) = (50\% \cdot 50\%) = 25\%$$

$$P^{dom}(s_2^1) = (50\% \cdot 50\%) = 25\%$$

$$P^{dom}(s_2^2) = (50\% \cdot 50\%) = 25\%$$

*Sum of the probability of dominance of each strategy in every possible strategy profile*

$$P^{dom}(\mathfrak{s}^*) = P^{dom}(s_i^{ik}) + P_j^{dom}(s_j^{jk})$$

$$P^{dom}(s_1^1, s_2^1) = 25\% + 25\% = 50\%$$

$$P^{dom}(s_1^2, s_2^1) = 25\% + 25\% = 50\%$$

$$P^{dom}(s_1^1, s_2^2) = 25\% + 25\% = 50\%$$

$$P^{dom}(s_1^2, s_2^2) = 25\% + 25\% = 50\%$$

*Probability of result of each strategy profile*

$$P^{res}(\mathcal{s}^*) = \frac{P^{dom}(\mathcal{s}^*)}{\sum\limits_{s \in \mathcal{S}} P^{dom}(s)} \cdot 100\%$$

$$P^{res}(s_1^1, s_2^1) = \frac{50\%}{200\%} \cdot 100\% = 25\%$$

$$P^{res}(s_1^1, s_2^2) = \frac{50\%}{200\%} \cdot 100\% = 25\%$$

$$P^{res}(s_1^2, s_2^1) = \frac{50\%}{200\%} \cdot 100\% = 25\%$$

$$P^{res}(s_1^2, s_2^2) = \frac{50\%}{200\%} \cdot 100\% = 25\%$$

In this case, given that the utilities are negative, the solution with the greatest percentage will most likely be avoided and the solution with the smallest percentage will be the most likely to happen.

All other things being equal and constant, every coordination of strategies is as likely as the next. Then, according to this initial composition of the group, the entire group may either steer towards cooperation or defection. However, given the lesser collective damage in co-operating, it is expected that a normalization may steer towards co-operation.

The new concept solution does not fully agree with the experimental data.

### 10.3.5 Of the common interest

**Examples of some applications to international relations: the relationship between terrorists and the media, where the terrorists gain from media attention and the media gain from advertising terrorist events.**

Suppose that you and another driver are both driving cars and that you have a choice between driving in the right direction or the wrong direction. Let $s_i^1$ be driving in the right direction, and let $s_i^2$ be driving in the wrong direction. Then:

Table 8: Payoff matrix for the common interest game

| | $s_2^1$ | $s_2^2$ |
|---|---|---|
| $s_1^1$ | 3,3 | 1,2 |
| $s_1^2$ | 2,1 | 0,0 |

Here are some expected solutions for this game.

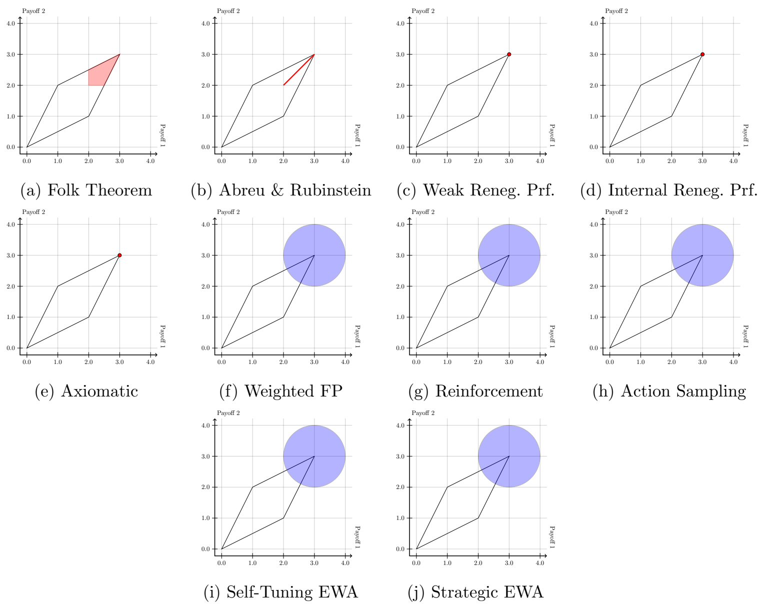



Figure 13: Predicted solutions for the common interest game

Here is the expected contextually normalized solution.

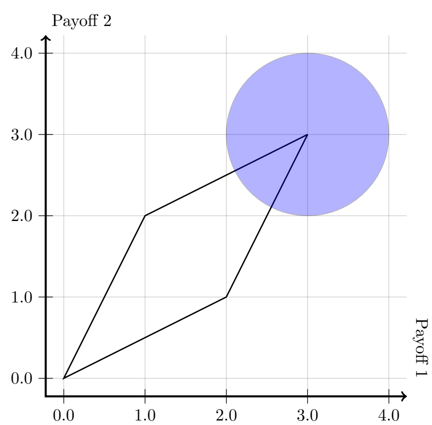



Figure 14: Contextually normalized solution for the common interest game

And here is the experimental result.

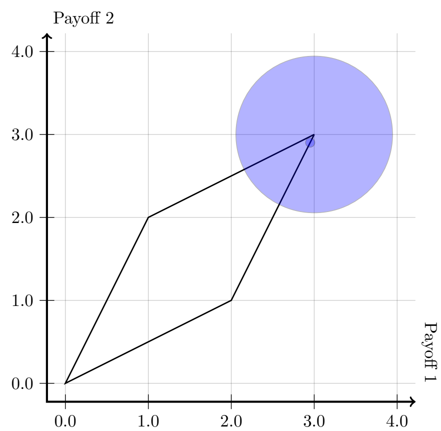



Figure 15: Experimental results for the common interest game

Demonstration of the method to find the expected contextually normalized solution

Let there be two players (1 and 2) who can each choose between two strategies ($s_i^1$and $s_i^2$), and let the payoffs for each strategy profile be those stated previously.

If players are equal at first, then $\rho_1^{perso}$=$\rho_2^{perso}$=50%. It follows that $\rho_1^{rel} = \rho_2^{rel} = 50\%$.

*Probabilistic utility of each strategy* The utility functions are equivalent here, so:

$$u(s_i^1) = \frac{3+1}{3+1+2+0} \cdot 100\% = 67\%$$
$$u(s_i^2) = \frac{2+0}{3+1+2+0} \cdot 100\% = 33\%$$

*Probability of dominance of a given player's strategy*

$$P^{dom}(s_i^{i^k}) = \rho_i^{rel} u(s_i^{i^k})$$

$$P^{dom}(s_1^1) = (67\% \cdot 50\%) = 33.5\%$$

$$P^{dom}(s_1^2) = (33\% \cdot 50\%) = 16.5\%$$

$$P^{dom}(s_2^1) = (67\% \cdot 50\%) = 33.5\%$$

$$P^{dom}(s_2^2) = (33\% \cdot 50\%) = 16.5\%$$

*Sum of the probability of dominance of each strategy in every possible strategy profile*

$$P^{dom}(\jmath^*) = P^{dom}(s_i^{i^k}) + P_j^{dom}(s_j^{j^k})$$

$$P^{dom}(s_1^1, s_2^1) = 33.5\% + 33.5\% = 67\%$$

$$P^{dom}(s_1^2, s_2^1) = 16.5\% + 33.5\% = 50\%$$

$$P^{dom}(s_1^1, s_2^2) = 33.5\% + 16.5\% = 50\%$$

$$P^{dom}(s_1^2, s_2^2) = 16.5\% + 16.5\% = 33\%$$

*Probability of result of each strategy profile*

$$P^{res}(\jmath^*) = \frac{P^{dom}(\jmath^*)}{\sum\limits_{s \in \mathcal{S}} P^{dom}(s)} \cdot 100\%$$

$$P^{res}(s_1^1, s_2^1) = \frac{67\%}{200\%} \cdot 100\% = 33.5\%$$

$$P^{res}(s_1^1, s_2^2) = \frac{50.00\%}{200\%} \cdot 100\% = 25.0\%$$
$$P^{res}(s_1^2, s_2^1) = \frac{50.00\%}{200\%} \cdot 100\% = 25.0\%$$
$$P^{res}(s_1^2, s_2^2) = \frac{33\%}{200\%} \cdot 100\% = 16.5\%$$

In this case, given that the utilities are negative, the solution with the greatest percentage will most likely be avoided and the solution with the smallest percentage will be the most likely to happen.

All other things being equal and constant, the most likely contextually normalized solution for this game is $s_1^1 \times s_2^1$ (both players drive in the right direction). Otherwise, one or the other may pass through the opposite direction occasionally (P=25% on each side). Finally, it is quite unlikely that both of them will voluntarily drive in the wrong direction at the same time.

The new solution concept fully agrees with the experimental data.

#### 10.3.6 Of the ultimatum

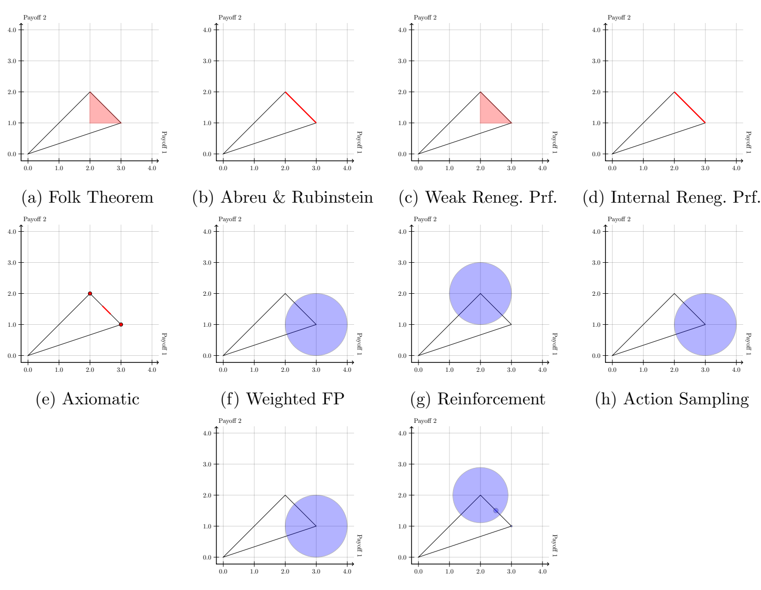
**Examples of some applications to international relations: threat of war; demand for ransom to a State by terrorists.**

Suppose that two players have a pie to share. Player 1 makes an offer to player 2. If player 2 accepts the offer, then both players have their share of the pie. However, if player 2 rejects the offer, they both get nothing. Let $s_1^1$ and $s_1^2$ be a fair offer and an unfair offer from player 1 respectively, and let $s_2^1$ and $s_2^2$ be agreement or refusal of player 2 respectively. Then:

Table 9: Payoff matrix for the ultimatum game

| | $s_2^1$ | $s_2^2$ |
|---|---|---|
| $s_1^1$ | 2,2 | 2,2 |
| $s_1^2$ | 3,1 | 0,0 |

Here are some expected solutions for this game.




(a) Folk Theorem (b) Abreu & Rubinstein (c) Weak Reneg. Prf. (d) Internal Reneg. Prf. (e) Axiomatic (f) Weighted FP (g) Reinforcement (h) Action Sampling (i) Self-Tuning EWA (j) Strategic EWA

Figure 16: Predicted solutions for the ultimatum game

Here is the expected contextually normalized solution.

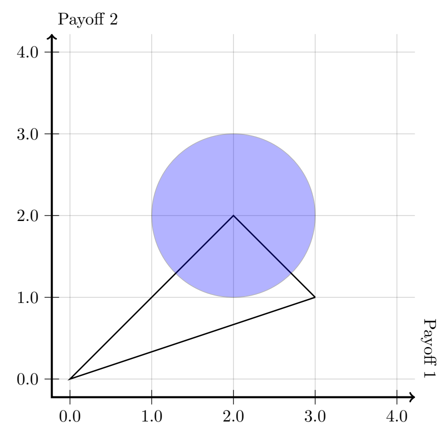



Figure 17: Contextually normalized solution for the ultimatum game

And here is the experimental result.

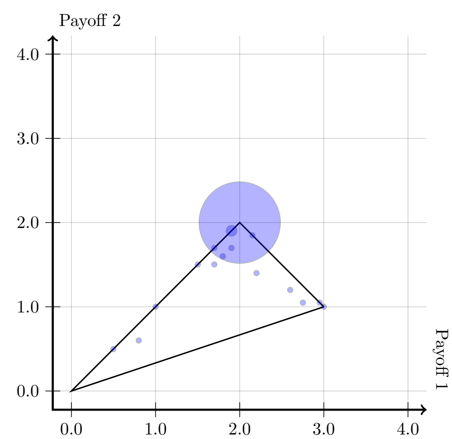



Figure 18: Experimental results for the ultimatum game

Demonstration of the method to find the expected contextually normalized solution

Let there be two players (1 and 2) who can each choose between two strategies ($s_i^1$and $s_i^2$), and let the payoffs for each strategy profile be those stated previously.

If players are equal at first, then $\rho_1^{perso}$=$\rho_2^{perso}$=50%. It follows that $\rho_1^{rel} = \rho_2^{rel} = 50\%$.

*Probabilistic utility of each strategy* For $s_1^1$:

$$u(s_1^1) = \frac{2+2}{2+2+3+0} \cdot 100\% = 57.1\%$$
$$u(s_1^2) = \frac{3+0}{2+2+3+0} \cdot 100\% = 42.9\%$$
$$u(s_2^1) = \frac{2+1}{2+1+2+0} \cdot 100\% = 60\%$$
$$u(s_2^2) = \frac{2+0}{2+1+2+0} \cdot 100\% = 40\%$$

*Probability of dominance of a given player's strategy*

$$P^{dom}(s_i^{ik}) = \rho_i^{rel} u(s_i^{ik})$$

$$P^{dom}(s_1^1) = (57.1\% \cdot 50\%) = 28.55\%$$

$$P^{dom}(s_1^2) = (42.9\% \cdot 50\%) = 21.45\%$$

$$P^{dom}(s_2^1) = (60\% \cdot 50\%) = 30\%$$

$$P^{dom}(s_2^2) = (40\% \cdot 50\%) = 20\%$$

*Sum of the probability of dominance of each strategy in every possible strategy profile*

$$P^{dom}(\jmath^*) = P^{dom}(s_i^{ik}) + P_j^{dom}(s_j^{jk})$$

$$P^{dom}(s_1^1, s_2^1) = 28.55\% + 30\% = 58.55\%$$

$$P^{dom}(s_1^2, s_2^1) = 21.45\% + 30\% = 51.45\%$$

$$P^{dom}(s_1^1, s_2^2) = 28.55\% + 20\% = 48.55\%$$

$$P^{dom}(s_1^2, s_2^2) = 21.45\% + 20\% = 41.45\%$$

*Probability of result of each strategy profile*

$$P^{res}(\jmath^*) = \frac{P^{dom}(\jmath^*)}{\sum\limits_{s \in \mathcal{S}} P^{dom}(s)} \cdot 100\%$$

$$P^{res}(s_1^1, s_2^1) = \frac{58.55\%}{200\%} \cdot 100\% = 29.28\%$$

$$P^{res}(s_1^1, s_2^2) = \frac{51.45\%}{200\%} \cdot 100\% = 25.73\%$$

$$P^{res}(s_1^2, s_2^1) = \frac{48.55\%}{200\%} \cdot 100\% = 24.28\%$$

$$P^{res}(s_1^2, s_2^2) = \frac{41.45\%}{200\%} \cdot 100\% = 20.73\%$$

All other things being equal and constant, the most likely contextually normalized solution for this game is $s_1^1 \times s_2^1$ (both players cooperate), but the other solutions are very close behind. It is therefore suggested that if player 1 offers bad deals in the beginning, player 2 may refuse most of the time; however, agreement is the most likely equilibrium as such normalization would benefit both players.

The new solution concept fully agrees with the experimental data.

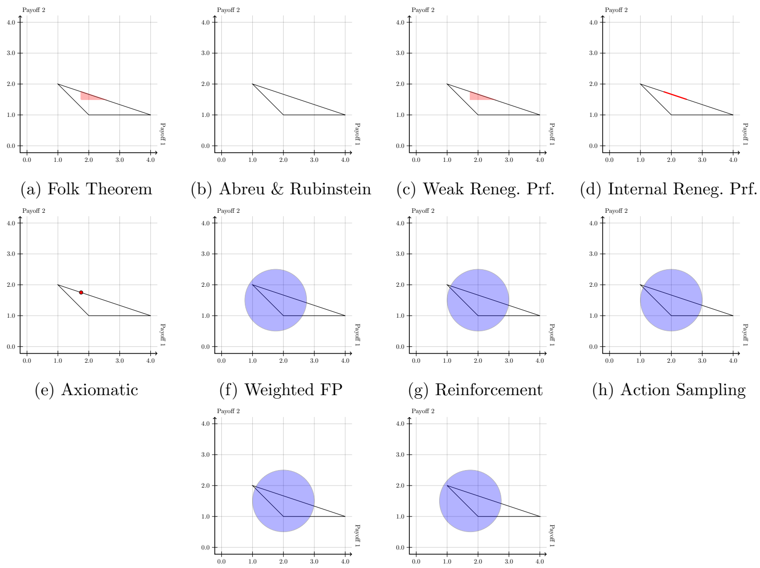
### 10.3.7 Of the unique mixed equilibrium game

Table 10: Payoff matrix for the unique mixed equilibrium game

| | $s_2^1$ | $s_2^2$ |
|---|---|---|
| $s_1^1$ | 4,1 | 1,2 |
| $s_1^2$ | 1,2 | 2,1 |

Here are some expected solutions for this game.



(a) Folk Theorem (b) Abreu & Rubinstein (c) Weak Reneg. Prf. (d) Internal Reneg. Prf.

(e) Axiomatic (f) Weighted FP (g) Reinforcement (h) Action Sampling

(i) Self-Tuning EWA (j) Strategic EWA

Figure 19: Predicted solutions for the unique mixed equilibrium game

Here is the expected contextually normalized solution.

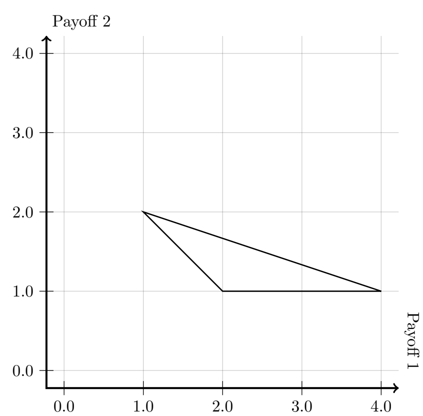



Figure 20: Contextually normalized solution for the unique mixed equilibrium game

And here is the experimental result.

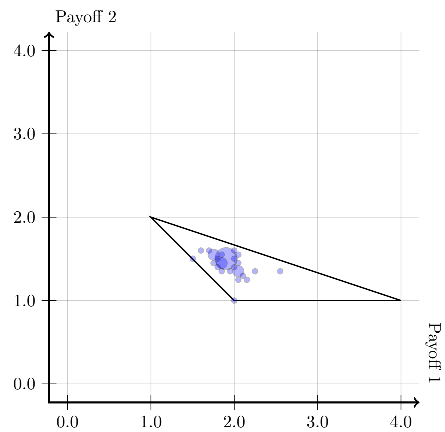



Figure 21: Experimental results for the unique mixed equilibrium game

Demonstration of the method to find the expected contextually normalized solution

Let there be two players (1 and 2) who can each choose between two strategies ($s_i^1$and $s_i^2$), and let the payoffs for each strategy profile be those stated previously.

If players are equal at first, then $\rho_1^{perso}$=$\rho_2^{perso}$=50%. It follows that $\rho_1^{rel} = \rho_2^{rel} = 50\%$.

*Probabilistic utility of each strategy*

$$u(s_1^1) = \frac{4+1}{4+1+1+2} \cdot 100\% = 62.5\%$$

$$u(s_1^2) = \frac{1+2}{4+1+1+2} \cdot 100\% = 37.5\%$$

$$u(s_2^1) = \frac{1+2}{1+2+2+1} \cdot 100\% = 50\%$$

$$u(s_2^2) = \frac{2+1}{1+2+2+1} \cdot 100\% = 50\%$$

*Probability of dominance of a given player's strategy*

$$P^{dom}(s_i^{ik}) = \rho_i^{rel} u(s_i^{ik})$$

$$P^{dom}(s_1^1) = (62.5\% \cdot 50\%) = 31.25\%$$

$$P^{dom}(s_1^2) = (37.5\% \cdot 50\%) = 18.75\%$$

$$P^{dom}(s_2^1) = (50\% \cdot 50\%) = 25\%$$

$$P^{dom}(s_2^2) = (50\% \cdot 50\%) = 25\%$$

*Sum of the probability of dominance of each strategy in every possible strategy profile*

$$P^{dom}(\mathcal{s}^*) = P^{dom}(s_i^{ik}) + P_j^{dom}(s_j^{jk})$$

$$P^{dom}(s_1^1, s_2^1) = 31.25\% + 25\% = 56.25\%$$

$$P^{dom}(s_1^2, s_2^1) = 18.75\% + 25\% = 43.75\%$$

$$P^{dom}(s_1^1, s_2^2) = 31.25\% + 25\% = 56.25\%$$

$$P^{dom}(s_1^2, s_2^2) = 18.75\% + 25\% = 43.75\%$$

*Probability of result of each strategy profile*

$$P^{res}(\mathcal{s}^*) = \frac{P^{dom}(\mathcal{s}^*)}{\sum\limits_{s \in \mathcal{S}} P^{dom}(s)} \cdot 100\%$$

$$P^{res}(s_1^1, s_2^1) = \frac{56.25\%}{200\%} \cdot 100\% = 28.13\%$$

$$P^{res}(s_1^1, s_2^2) = \frac{56.25\%}{200\%} \cdot 100\% = 28.13\%$$
$$P^{res}(s_1^2, s_2^1) = \frac{43.75\%}{200\%} \cdot 100\% = 21.88\%$$
$$P^{res}(s_1^2, s_2^2) = \frac{43.75\%}{200\%} \cdot 100\% = 21.88\%$$

All other things being equal and constant, player 1 will most likely use $s_1^1$, and player 2 may use either $s_2^1$ or $s_2^2$ with equal probability. This is only a little more likely.

For all of these experiments, the new solution concept fully agrees with the experimental data.

# 11

# Test case study using diagrams, pen and paper

Due to the lack of useful data to analyze, the previous section presented hypothetical results of games using the new theory and compared these results to the hypothetical results of other methods and models. We will now follow in the same vein, in consideration of the lack of useful data at the moment of writing this dissertation, but this time proposing a back-of-the-envelope (also known as a pen-and-paper) method.

## 11.1 Of Fermi problems and instrumental diagrams

In my first Physics course in college, our teacher gave us a peculiar challenge: we were given protractors and measuring tapes, and our teacher asked us to count how many leaves there were in a specific tree. This is what we call a Fermi problem: a problem that can be solved in many ways and that requires an approximation with a limited amount of data available. There is no definite way to answer such problems, nor is there a definite answer unless you have all necessary information.

The field of politics is plagued by Fermi problems, in particular in regard to bargaining problems. Because much of politics depends on subjectivity, the intuition of decision-makers, and hidden relations, it is often impossible to know what is going on exactly, or to measure the relevant variables adequately.

Because of these difficulties, many political scientists judge formal and quantitative methods as vain and prefer narrative analyses. The problem with purely narrative analyses is that two analysts may formulate perfectly credible and coherent hypotheses and give equally good arguments to support them, and yet one of them—or both—is wrong in fact.

This is why natural sciences rely on experiments to test their hypotheses—and if the natural consequences of the hypothesis do not correspond with the observed results of the experiment, then the hypothesis is wrong. But most political games are unique, rather than iterated. Most of these games have a different set of players and circumstances.

And it is nearly impossible to make and replicate experiments that simulate political games properly because of the implicated subjectivity and unknown variables. As a consequence, we need to rely on natural experiments, that is the observation of phenomena that happen in real life, but we have no way to sort good interpretations from bad ones.

Many thinkers who deserve our respect built theories based on non-falsifiable assumptions, based on their own experience and worldview. In order to avoid the dogmatism that necessarily follows from the application of such theories, we tried to find a simple way to analyze the power relations between political players, in Fermi problems where we do not know the identity of all the players that are involved, nor their interests or preferences. In such problems, we should avoid assumptions regarding this data, as assuming may lead to the construction of beautiful illusions.

Observing the tendencies of players is useful because it gives us a good idea of their thought pattern, and that allows us to explain or forecast future choices without supposing sets of preferences, if the player follows a tendency—and that should be the case in systems with many constraints such as governments. Consequently, studying tendency avoids the construction of coherent but false explanatory schemes. However, it does not explain change, nor the influence of some players over the choices of others. For this reason, if you want to explain games such as politics, then you should analyze the power relations between players and look for factors that may trigger deviations.

Yet, as we said earlier, information may be scarce, so we need a good method to estimate the solution in a credible manner with a minimal amount of supposition, or none at all if possible. Because of this, a graphical 'back-of-the-envelope' method may be a good option for quick and easy estimations.

Let full lines (———) be known relations and dashed lines (- - - -) be possible relations. Let arrows indicate the direction of dominance (with arrow heads indicating the dominated player), lines with arrows on each end indicate cooperative relations (<——>), lines with arrows facing each other (—><—) indicate conflictual relations, and double lines (======) indicate complicated relations characterized simultaneously by rivalry and a desire to co-operate. Finally, let dotted lines (......) make the link between different levels, such as between a State and the inside of the black box. Draw a diagram where every known player is represented, with decision-makers higher on the diagram and lobbies lower, and note beside the name of every player an estimate of their relative bargaining power among the set of bargaining players, and their tendency to choose each option (in the back-of-the-envelope method, this is equivalent to the ordering of revealed preferences). Using this diagram, you may guess who dominates the game and what should happen if coalitions are made or not.

## 11.2 Of regionalism in East Asia: a toy case study

We will study—at the micro level with gross estimates—the likely motivations behind two recently abandoned regional projects negotiated by the Japanese state with its East Asian economic partners: EAFTA (East Asian Free Trade Area) and CEPEA (Comprehensive Economic Partnership for East Asia). We will explore only a limited set of information, but we will drill down the Japanese State to see if opening the black box may help us understand the reason of that complex adaptive system.

### 11.2.1 Of two parallel projects

EAFTA: East Asian Free Trade Area

EAFTA would have been a free trade agreement in the ASEAN+3 zone. Members of the ASEAN include Indonesia, Malaysia, Philippines, Singapore, Thailand, Brunei, Vietnam, Laos, Myanmar, and Cambodia. The three other members were the People's Republic of China, the Republic of Korea and Japan. It was proposed in 2001 by the East Asia Vision Group, a group of experts established by ASEAN+3 to study regional co-operation opportunities in East Asia. EAFTA's expressed political objective was to reinforce relations among East Asian nations, as well as fixing the problem of diverging rules of origins between preexisting agreements (also known as the "noodle bowl" effect). The establishment of EAFTA would have been made possible by the progressive consolidation of ASEAN+1 agreements.

### CEPEA: Comprehensive Economic Partnership for East Asia

CEPEA would have been a free trade agreement in the ASEAN+6 zone. It was negotiated by all members ASEAN+3, as well as Australia, India and New Zealand. The idea was proposed for the first time at the 38th ASEAN Economic Ministers meeting, in April 2006, by Toshihiro Nikai, then-Minister of Economy, Trade and Industry of Japan. It was formally proposed at the second EAS (East Asia Summit), in January 2007.

CEPEA had two missions: 1) deepening economic integration in East Asia, and 2) reducing the development gap within the region. Essentially, CEPEA's role would have been to offer measures of economic co-operation, and to liberalize and facilitate trade and investment. CEPEA being a regional economic partnership, trade liberalization should have applied to a wide range of commercial sectors. It was also supposed to harmonize market mechanisms and rules across the region. EAFTA and CEPEA share the same objectives essentially; the main difference lies in membership.

### EAFTA vs CEPEA

According to the economic projections of the Asian Development Bank (ADB), CEPEA would bring more economic benefits (in GDP growth) than EAFTA. China and Japan would have more gains in the context of CEPEA than in EAFTA, but by only a small margin. Thus, Japan would only have marginal advantages to promote CEPEA over EAFTA in economic terms, but higher advantages in political terms if it wants to contain China.

### 11.2.2 Inside the black box

The distribution of political power

Japan has expressed many times, in ministerial speeches as well as in white papers, that it aims to ensure economic and political stability within the region and to accelerate the development of East Asia with the help of the Japanese investment.

The Japanese prime minister is more an agent of the government than an independent actor. The cabinet, also known as Kantei, has under its service a limited number of specialists, who can hardly follow all essential matters. As a consequence, the prime minister usually follows the ministries' recommendations. Ozawa Ichirō, who has been prime minister of Japan, claimed that it is difficult to know who really takes decisions, but the prime minister is more likely a puppet than a puppeteer:

> "In point of fact, it is not entirely clear just where decisions are made. It is hard to surmise how the various policies of the relevant offices are integrated, who is making what decisions, or where they are made. Policy, in other words, is decided without anyone's taking responsibility for it."[112, p. 23]

Ministries possess the power of policy-making. The three ministries that are the most influential on Japanese economic foreign policy are METI (the Ministry of Economy, Trade and Industry), MOF (the Ministry of Finance) and MOFA (the Ministry of Foreign Affairs). Regarding regional agreements, METI is the prime policy-maker. However, another ministry enters the fray as a potential deal breaker for Japan's free trade agreements: MAFF (the Ministry of Agriculture, Forestry and Fisheries). While METI, MOF, and MOFA have a tendency to promote trade liberalization and foreign direct investment, MAFF usually asks for protectionist measures to protect domestic agriculture and fishing industries from foreign competition.

### Bureaucracy

Bureaucracy has significant power over trade policy of Japan, as the policy-making power lies primarily in its departments. We call "iron triangles" the relationship between a bureaucratic agency, a keiretsu (a business group) and one or more politicians. In general, a policy must obtain the agreement of the three parties to be put forward. This leads to a clientelist practice that is very common in Japan: the amakudari, that is the "descent from heaven”. Amakudari occurs when a company promises an advantageous position or retirement package to a bureaucrat after their retirement from public service, in exchange for services and the promotion of private interests while they work for the government. Amakudari has long been accepted and encouraged as a means of attracting talented individuals to positions of lower paid public service, with the hope of a better future. As a civil servant, a bureaucrat must serve the interests of the state as well as those of the civilians, so there is no contradiction with them serving private interests. Therefore, in this game, bureaucrats have an incentive to serve the interests of private companies to ensure themselves a comfortable retirement; in return, the companies have an interest in these arrangements in order to get inside information and political favours.

### Lobbying

There are three major business lobbies in Japan: Nippon Keidanren (the Japan Business Federation), Keizai Dōyūkai (the Japan Association of Corporate Executives), and Nihon Shōkō Kaigisho (the Japan Chamber of Commerce and Industry). It is useful for these lobbies to influence political leaders in order to defend their commercial interests.

Hidetaka Yoshimatsu has shown that Keidanren has been involved in promoting several free trade projects, for example bilateral free trade agreements with Singapore, Mexico, and the Republic of Korea. Keizai Doyukai and Keidanren invest heavily in research to inform politicians of their interests. In addition, representatives of these associations and the government meet regularly to discuss the economic orientation of Japan. It appears that the METI, in particular, often mentions these lobbies in the reports and that the government tends to defend their economic interests.

Note that Keizai Doyukai was interested very early in the CEPEA project. In fact, it seems to be interested in it even before the project is formally proposed by the Japanese government. In March 2006, just weeks before the project proposal by Nikai, Keizai Doyukai published a report proposing to strengthen the leadership of Japan in the region, to ensure the stability of the regional economy, to include Australia, India, and New Zealand in the project, to focus development around ASEAN and to reduce the development gap within the region through an East Asian free trade agreement. This proposal may correspond to the CEPEA project; nothing indicates that this is not the case because most of the described interests may correspond to both projects. However, some elements, for example the inclusion of Australia, India and New Zealand, curiously relate to the differences between EAFTA and CEPEA.

In sum, private interests may have a significant influence on Japanese policy.

Agriculture

The government has a tendency to defend not only the interests of corporate lobbies, but also the most vulnerable sectors of its economy. Among them, agriculture and fisheries are the most sensitive sectors. The Japanese agricultural sector is not sufficiently competitive with imports, since the cost of living is higher in Japan than elsewhere in East Asia and Japanese farmers therefore need to sell their products at higher prices to maintain satisfactory profits. Given that the support of the rural has long been essential in order to win the elections in Japan, the government has had a tendency for decades to protect the agricultural sector and, therefore, buy rural votes. A union of farmer co-ops called Japan Agricultural Cooperatives, also known as Nokyo, holds great power over the government of Japan, in particular though the lobby of its national headquarters, commonly known as Zenchu (for Zenkoku Nōgyō-kyōdō-kumiai Chuōkai, or the Central Union of Agricultural Cooperatives).

### 11.2.3 Sino-Japanese rivalry

In order to preserve its comparative advantages, Japan must adapt to rising economic powers, for example China and South Korea. Joel Rathus holds that Sino-Japanese rivalry is one of the primordial factors that explain why the Japanese government promotes regionalism[121, p. 3]. It would be a way to counterbalance the power of China by reinforcing the interdependence of Japan with other countries in the region, and stimulating Japanese economy by promoting regional economic integration.

Today, the rivalry between China and Japan is chiefly a matter of leadership. To this end, both states negotiate multiple regional agreements in order to exert leadership and attract economic and political partners.

In a study that compares regionalist initiatives of Japan and China, Hamanaka Shintaro argues that it is the leader status, not its responsibility, that matters here. You can act as a leader without your leadership being accepted and the opposite is also possible.

It is because of Japan's leadership that the East Asia Community (EAS) consists of ASEAN+6 rather than ASEAN+3 members. Whereas the Chinese government privileged the transition of the ASEAN+3 Summit to the EAS in order to establish an eventual economic community, the East Asia Community (EAC), the Japanese government privileged a more inclusive community, consisting of ASEAN+6 members. On the one hand, many analysts believe that China wished to block the membership of Australia, India and New Zealand in order to improve their relative bargaining power. On the other hand, the inclusion of those players may constitute an advantage for Japan, if it wishes to counterbalance China. Following the inclusion of these members, China stepped back and chose to promote ASEAN+3 instead of the EAS.

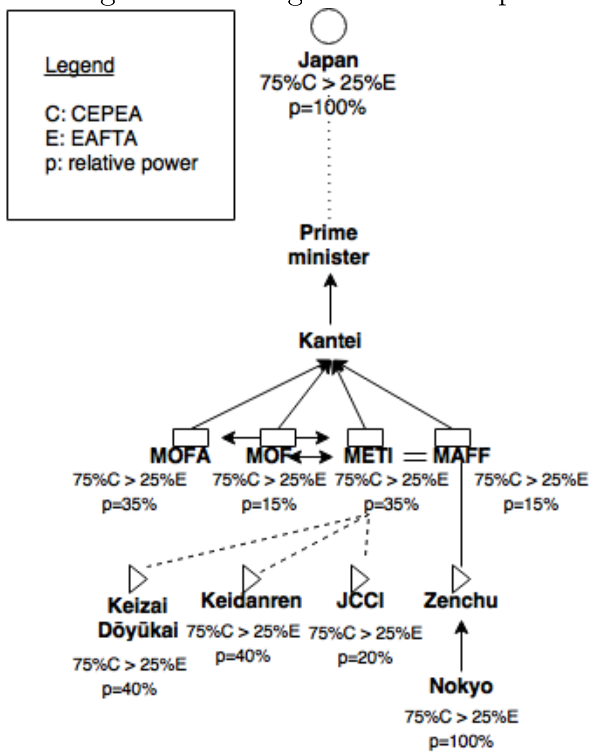
### 11.2.4 The complex asymmetric game

For this study, all numbers will be estimates based on a very simple rationale: if a player has no revealed preference, then every option is preferred 50% of the time; if a player prefers one option over the other, then the preferred option is worth 75% and the other 25%; and if a player rejects an option, then this option is chosen 0% of the time and the other 100%. The relative bargaining power ratio here is arbitrary and based upon the analyst's judgment. Had we precise statistics, we could proceed in a similar fashion. An alternative for more precise numbers would be to use discourse analysis to calculate a ratio of the revealed preference of an option over another in the same years, and using the number of ratified agreements between each dyad of players over the total number of agreements among the ASEAN+3 for EAFTA and ASEAN+6 for CEPEA as a relative bargaining power ratio. Yet, for the purpose of this example case study, estimates will suffice.

Let us start with Japan's internal power relations.

Figure 22: The game within Japan

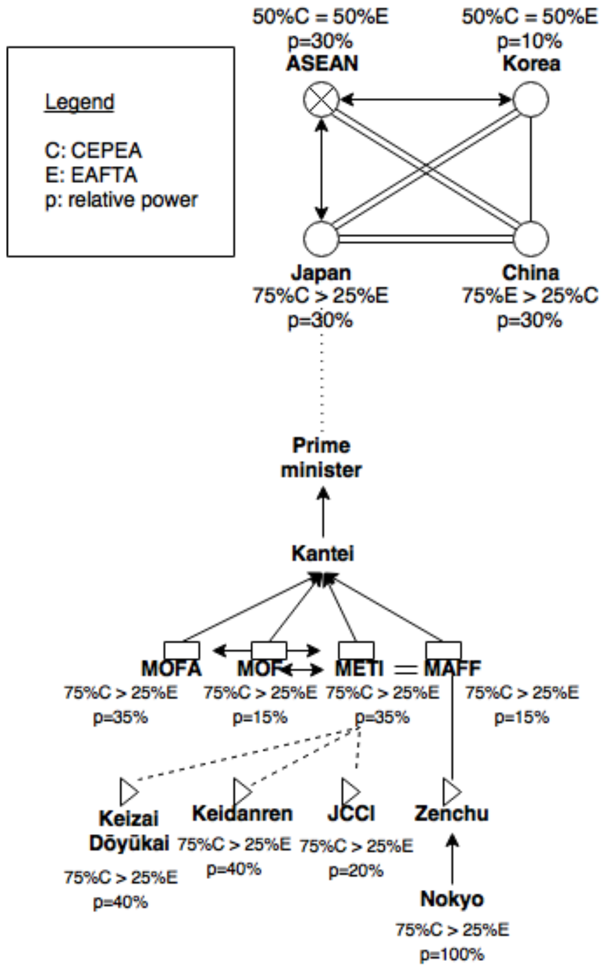



This game is a very simple one. In the case studied here, the bureaucracy is manipulated by private companies and it manipulates them back. Lobbies manipulate the government and the latter's interest is served by a more efficient economy, and public servants. Also, take into consideration that each actor can take different levels of analysis into account. Each player may defend individualistic interests, as the bureaucrat who defends private interests to ensure a comfortable retirement. Yet, they may also defend collective interests: for example, the fact that the Japanese government is trying to promote the economic development of other nations in East Asia ensures its interests, certainly, but also those of other nations. Another example would be the defence of the interests of commercial lobbies by the government in order to improve the country's economic performance. These power games are such that the reason of State may vary as a function of private interests, as well as public interests.

Here, the most influential players behind METI's decisions are by far Keizai Dōyūkai and Nippon Keidanren. As a consequence, even if other lobbies such as the Japan Chamber of Commerce and Industry preferred other options than the ones promoted by these two, they would likely fail to attract enough sympathy from METI officials to deviate their policy. As for MAFF, the main lobby behind its decisions is Nokyo. Today, MAFF will go wherever Nokyo leads it. However, MAFF's relative bargaining power among the ministries that decide Japan's foreign policy regarding free trade agreements is not important enough to deviate Japan's will to sign an agreement; at best, as it has been the trend in recent memory, it is able to influence MOFA to impose protectionist clauses in agreements. Actually, in order to have any notable influence over the international bargaining process, MAFF needs to have MOFA on its side (15%+35%=50%).

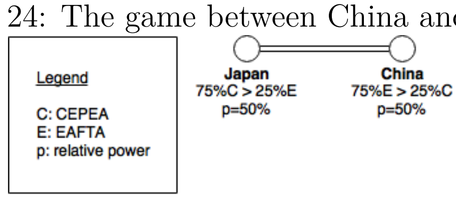
Within ASEAN+3, Japan is in a peculiar position: it has a tendency to assume leadership, through speeches, white papers, and even as it proposes new projects. However, it is one of three poles of attraction that are more or less equivalent for various reasons. China is an economic and political juggernaut on the rise, with a huge and relatively inexpensive workforce that is attractive to foreign investors such as the Japanese, as well as an important market to sell ASEAN's goods, but it is seen as a threat by most of its neighbours. ASEAN is an attractive developing market for all players in the region. As for Japan, it is seen as a valuable market and source of investment by China and ASEAN, despite China's desire to be the prime power and leader in the region. The impact of Korea in this game is negligible. As a result, if Japan, China or the ASEAN as a coalition wish to impose a project or to have a greater relative bargaining power over the opposition in a negotiation round, then this player needs the support of at least one of the other big three (30%+30%=60%). Korea needs much more support. This might explain why Korea has not assumed much leadership at all in the ASEAN+3 negotiation rounds, if at all.

Figure 23: The game within ASEAN+3




We also see that there is no clearly revealed preference, according to the estimated tendencies of each member to promote one project or the other, within the ASEAN+3 community.

Figure 24: The game between China and Japan

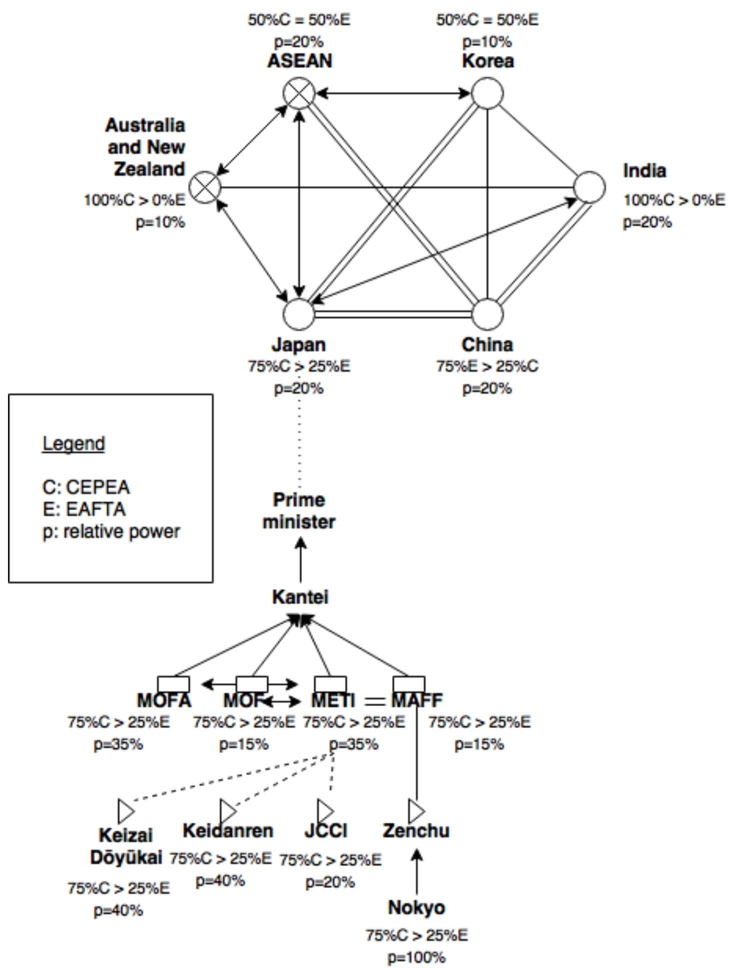


$$\text{CEPEA} = (75 \cdot 50 + 25 \cdot 50)\% = 50\%$$

$$\text{EAFTA} = (75 \cdot 50 + 25 \cdot 50)\% = 50\%$$

$$[\text{CEPEA} = \text{EAFTA}] => \text{Impasse}$$

Figure 25: The game within ASEAN+6



The main differences between EAFTA and CEPEA lie in the structure and power relations. CEPEA involves more players and that it reduces everyone's relative bargaining power as a result. As shown in figure 23, this gives an edge to the CEPEA's support as Australia, India, and New Zealand have no interest to be left out of the game. As a result, within the ASEAN+6 community, the CEPEA is the preferred option, according to the tendencies expressed by each country in their official speeches and documents.

$$\text{CEPEA} = (100(20+10) + 75 \cdot 20 + 50(20+10) + 25 \cdot 20)\% = 65\%$$

$$\text{EAFTA} = (75 \cdot 20 + 50(20+10) + 25 \cdot 20 + 0(20+10))\% = 35\%$$

$$[\text{CEPEA} > \text{EAFTA}] => \text{Possible agreement, if China agrees}$$

As for the balance of power, it is much easier for China and Japan to counterbalance each other's power in ASEAN+6 than ASEAN+3. Therefore, should Japan or China be able to attract more support from other members, it should be easier for them to demonstrate their leadership and to become the dominant power in the region. The political context is especially useful for Japan: as shown on figure 23, China has more ambiguous relations (should we say rivals?) within ASEAN+6 than Japan. India, in particular, constitutes an important counterweight to the Chinese juggernaut, as the diplomatic relations between the two countries are not optimal, and both countries are direct economic competitors on many levels. This could make it easier for Japan and more difficult for China to accomplish their projects within this community.

However, this rivalry between China and Japan might be the reason why neither initiative came to fruition: neither China nor Japan accepted the other's leadership, and since no consensus can be reached without the agreement of both, the negotiations were doomed. As shown in figure 24, as the need for consensus within the ASEAN+3 and ASEAN+6 is equivalent to the need for consensus between China and Japan, ceteris paribus, a direct opposition leads nowhere.

$$\text{CEPEA} = 75\% \cdot 50\% + 25\% \cdot 50\% = 50\%$$

$$\text{EAFTA} = 75\% \cdot 50\% + 25\% \cdot 50\% = 50\%$$

$$[\text{CEPEA=EAFTA}] => \text{Impasse}$$

As a result, there was an impasse in real-life negotiations.

Today, as a consequence of that impasse, both projects have now been replaced by talks to create a Regional Comprehensive Economic Partnership (RCEP), a project of economic integration that should harmonize pre-existent ASEAN free trade agreements without a preset list of members and with the possibility to add more external members later. Such negotiations take place purely within the framework of ASEAN+6, as in figure 23, so it is more likely to succeed, especially that no consensus is needed because it is more or less the evolution of currently ratified agreements.

### 11.2.5 Japan's reason to prefer CEPEA over EAFTA

It can be noted that project EAFTA and CEPEA had the following similarities: 1) they included at least the members of ASEAN+3; 2) they were designed to promote development throughout East Asia; 3) they had to solve the problem of "noodle bowl," i.e. different sets of rules of origin across the various free trade agreements in the region.

As a function of these similarities, we can describe the following revealed tendency: Japan follows a hybrid reason, that rallies clientelistic interests and national economic interests, and aims to liberalize trade in East Asia in order to: 1) open the East Asian markets to Japanese private enterprises; 2) support the development of East Asian nations to ensure political stability in the region; 3) reduce barriers and complications to international trade.

In general, it appears that Japan has a tendency to promote its economic interests, most of all: it aims to promote free trade, to expand the market for Japanese products and services, and to help the expansion of Japanese businesses abroad. However, it has another strong tendency to promote regional co-operation with the expressed intention to ensure political stability in the region, it reduces the risks to its security. The "benevolence" of Japan, which claims to promote development across the region, might be a facade to better defend their individual interests, but this remains to be proven. As for the links between private and public players, it seems that all players are trying to defend their private interests by manipulating others to reach agreements beneficial to them personally, as part of the amakudari. State members and companies have an interest to work together.

The clientelist game behind Japanese decisions appears to correspond to an insurance game where players have interest to co-operate in order to achieve more gains. Here, a player defends the interests of another player on condition that the service is reciprocal. By sharing enough information, everyone can satisfy their interests.

We noted that CEPEA offers only marginal advantages to Japan and China over EAFTA, so the expected utility of CEPEA is only slightly higher than EAFTA. In addition, there is no more risk involved in creating EAFTA or CEPEA. Both options are rational and there does not seem to be any reason to prefer one over the other, in terms of absolute economic utility. Thus, the expected utility model, in its simplest economic expression, does not explain the preference of Japan for CEPEA.

Yet, while there may not be a strong economic advantage for Japan to promote CEPEA over EAFTA, there is a strategic political advantage. Increasing the number of players included in the partnership reduces the power and influence of every player individually, which means that it becomes easier to contain the rise of China, which is the main rival of Japan in this region. Considering that Japan has a tendency to present itself as the leader that ASEAN members should follow, and another tendency to seek to counterbalance the rise of China, it is plausible to believe that Japan promoted CEPEA as a conscious means to reduce or contain the relative bargaining power of China. Thus, Japan would be taking the risk of harming its diplomatic relations with China to slow down the rise of this rival. It would be willing to take risks in order to minimize potential losses.

The bargaining game between Japan and other nations is like the pie-sharing consensual game, where everyone wants to have a fair share of the cake but also their favourite parts. In addition, the size of each share depends on the number of players who wish to have a share. In this case, the distribution of shares is not proportional: each of the nations of Southeast Asia has a smaller share of the cake than China, Japan and the Republic of Korea taken individually, but their coalition in ASEAN gives them a greater bargaining power. In addition, the inclusion of other players in the CEPEA project resulted in smaller shares for everyone, because of the will to reduce the share of China relative to the shares of others.

Japan has proposed CEPEA, despite its previous promotion of EAFTA, because of an interest to develop markets and reduce the relative bargaining powers. In that sense, CEPEA would be more useful both in terms of absolute power and relative bargaining power interests. CEPEA was therefore a more strategic option than EAFTA because it improved the chances of Japan to stabilize its power relative to China. The only foreseeable reason why Japan would deviate from its tendency to favour an economic partnership with only ASEAN+3 members rather than ASEAN+6 members is the prospect of a special agreement with China, that would give them both special advantages over the other potential partners. As of now, no such agreement is in the cards.

This case study was an example of a back-of-the-envelope application of the method presented in this dissertation. However, it would be best applied on 'big data' with computer algorithms. The next chapter serves to present examples of this kind of application.

# 12

# Test case study using big data

In this chapter, we used a data set on the United Nations' General Assembly's (hereafter, UNGA) resolutions compiled and maintained by professors Erik Voeten, Anton Strezhnev, and Michael Bailey[150]; more precisely, we used the "Raw UNGA dataset", which presents the nature of the vote of every State from the first UNGA resolution vote to the last of 2015. We will use this data—a rare example of a set that can be used to observe the evolution of trends in international decision-making—to study the alignment of the UNGA with the United States and the USSR or Russia during and after the Cold War.

## 12.1 Method

While it is customary in political science to present detailed literature reviews and to focus on historical detail, we will instead focus on pure data analysis for three reasons: the model presented in this dissertation is data-centric and is therefore better fit for analysis as we see in data science, rather than political science; we want to show that the method can be used to find insights that are independent of deep knowledge of the case at-hand; as a post-positivist theory, the theory does not propose *a priori* hypotheses and assumptions that lead the analyst's interpretation of historical knowledge, but rather offer the means to generate and support data-centric hypotheses about the objective data itself.

Consequently, the following case studies will focus on the method, rather than historical knowledge, against the current trend in political science.

We used the equations of the model presented in chapter 7 on the raw UNGA voting data, which had five possible options for each resolution vote: yes, no, absence, abstention, no membership. The raw data is accessible in the appendices.

We ran the model on the computer to find how many times each State voted each option (yes, no, abstention, absence). From there, we calculated the rate of success and the relative power of the two States, relative to one another. As a reminder, the equation evaluates relative power as a measure of the level of success of one's preferred option with regard to the winning solution. This premise is considered valid as the player is then on the winning side. You may find more detail on the philosophical rationale of this premise in chapter 7. Finally, we calculated the probability of dominance of each strategy profile, to find whether there is a pattern or not in voting behaviour.

## 12.2 The competition between the USA and the USSR or Russia at the UNGA

### 12.2.1 Context

Many scholars consider the end of the Cold War officially took place in 1991, with the dissolution of the Union of Soviet Socialist Republics (USSR). However, is that really the case? Did the Cold War end, or did it shift towards a new, more subtle expression?

### 12.2.2 Question

Has the influence of the United States of America (USA) significantly increased relative to Russia at the United Nations' General Assembly (UNGA) following the dissolution of the USSR?

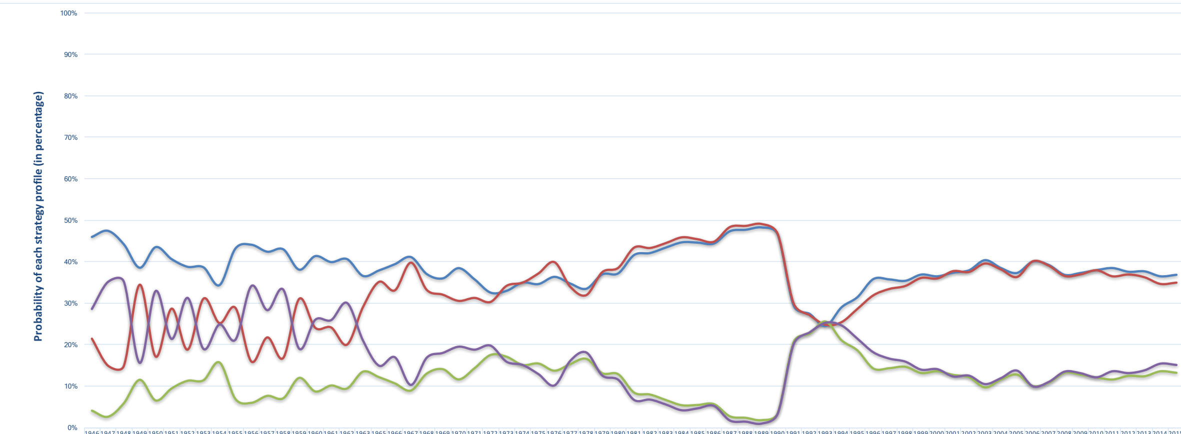
### 12.2.3 Hypothesis

We begin with a null hypothesis: there is no relationship between the dissolution of the USSR and a change in relative power of Russia and the USA over decision-making at the UNGA since the official end of the Cold War.

### 12.2.4 Sample

For this analysis, we retained all votes from the USA and the USSR on all issues, regardless of the object of a resolution.

Strategy 1 is the backing of a resolution, and strategy 2 is its rejection.




| | 1946 | 1947 | 1948 | 1949 | 1950 | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P(USSR:s1,USA:s1) | 45.9 | 47.3 | 44.1 | 38.5 | 43.4 | 40.5 | 38.7 | 38.6 | 34.3 | 43.1 | 44.0 | 42.3 | 42.9 | 38.0 | 41.3 | 39.8 | 40.5 | 36.5 |
| P(USSR:s1,USA:s2) | 21.4 | 14.9 | 14.8 | 34.4 | 17.0 | 28.6 | 18.7 | 31.1 | 25.1 | 28.8 | 15.9 | 21.7 | 16.7 | 31.0 | 24.0 | 24.1 | 20.0 | 29.0 |
| P(USSR:s2,USA:s2) | 4.08 | 2.62 | 5.85 | 11.4 | 6.52 | 9.42 | 11.2 | 11.3 | 15.6 | 6.87 | 5.96 | 7.63 | 7.06 | 11.9 | 8.69 | 10.1 | 9.41 | 13.4 |
| P(USSR:s2,USA:s1) | 28.5 | 35.0 | 35.1 | 15.5 | 32.9 | 21.3 | 31.2 | 18.9 | 24.8 | 21.1 | 34.1 | 28.2 | 33.2 | 18.9 | 25.9 | 25.8 | 30.0 | 20.9 |

| | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P(USSR:s1,USA:s1) | 37.8 | 39.3 | 41.0 | 36.9 | 35.9 | 38.4 | 35.7 | 32.5 | 32.9 | 34.9 | 34.6 | 36.3 | 34.7 | 33.4 | 36.9 | 37.1 | 41.5 | 42.0 |
| P(USSR:s1,USA:s2) | 35.1 | 33.1 | 39.7 | 33.1 | 32.0 | 30.5 | 31.2 | 30.3 | 34.1 | 34.9 | 37.1 | 39.9 | 33.9 | 31.9 | 37.4 | 38.5 | 43.4 | 43.3 |
| P(USSR:s2,USA:s2) | 12.1 | 10.6 | 8.92 | 13.0 | 14.0 | 11.5 | 14.3 | 17.4 | 17.0 | 15.0 | 15.4 | 13.6 | 15.2 | 16.5 | 13.0 | 12.8 | 8.41 | 7.95 |
| P(USSR:s2,USA:s1) | 14.8 | 16.8 | 10.2 | 16.8 | 17.9 | 19.4 | 18.7 | 19.6 | 15.8 | 15.0 | 12.8 | 10.0 | 16.0 | 18.0 | 12.5 | 11.4 | 6.58 | 6.67 |

| | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P(USSR:s1,USA:s1) | 43.3 | 44.6 | 44.5 | 44.3 | 47.2 | 47.6 | 48.1 | 46.5 | 29.4 | 27.4 | 24.5 | 29.0 | 31.4 | 35.8 | 35.7 | 35.3 | 36.8 | 36.4 |
| P(USSR:s1,USA:s2) | 44.5 | 45.9 | 45.4 | 44.8 | 48.3 | 48.6 | 49.1 | 46.7 | 29.9 | 27.1 | 24.7 | 25.4 | 28.6 | 31.9 | 33.4 | 34.1 | 36.1 | 35.9 |
| P(USSR:s2,USA:s2) | 6.62 | 5.37 | 5.45 | 5.65 | 2.72 | 2.36 | 1.81 | 3.50 | 20.5 | 22.5 | 25.4 | 20.9 | 18.5 | 14.2 | 14.2 | 14.6 | 13.1 | 13.5 |
| P(USSR:s2,USA:s1) | 5.47 | 4.09 | 4.57 | 5.16 | 1.62 | 1.33 | 0.89 | 3.27 | 20.0 | 22.9 | 25.2 | 24.5 | 21.3 | 18.0 | 16.5 | 15.8 | 13.9 | 14.0 |

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P(USSR:s1,USA:s1) | 37.3 | 37.9 | 40.3 | 38.4 | 37.2 | 40.0 | 39.1 | 36.8 | 37.2 | 37.9 | 38.4 | 37.5 | 37.6 | 36.4 | 36.8 |
| P(USSR:s1,USA:s2) | 37.7 | 37.5 | 39.5 | 38.1 | 36.3 | 40.1 | 39.0 | 36.5 | 36.9 | 37.9 | 36.4 | 36.9 | 36.2 | 34.6 | 34.9 |
| P(USSR:s2,USA:s2) | 12.6 | 12.0 | 9.66 | 11.5 | 12.7 | 10.0 | 10.8 | 13.2 | 12.7 | 12.0 | 11.5 | 12.4 | 12.3 | 13.5 | 13.1 |
| P(USSR:s2,USA:s1) | 12.2 | 12.4 | 10.4 | 11.8 | 13.6 | 9.88 | 10.9 | 13.4 | 13.0 | 12.0 | 13.5 | 13.0 | 13.7 | 15.3 | 15.0 |

Figure 26: Probability of each strategy profile of the USSR and the USA at the UNGA, every year from 1946 to 2015

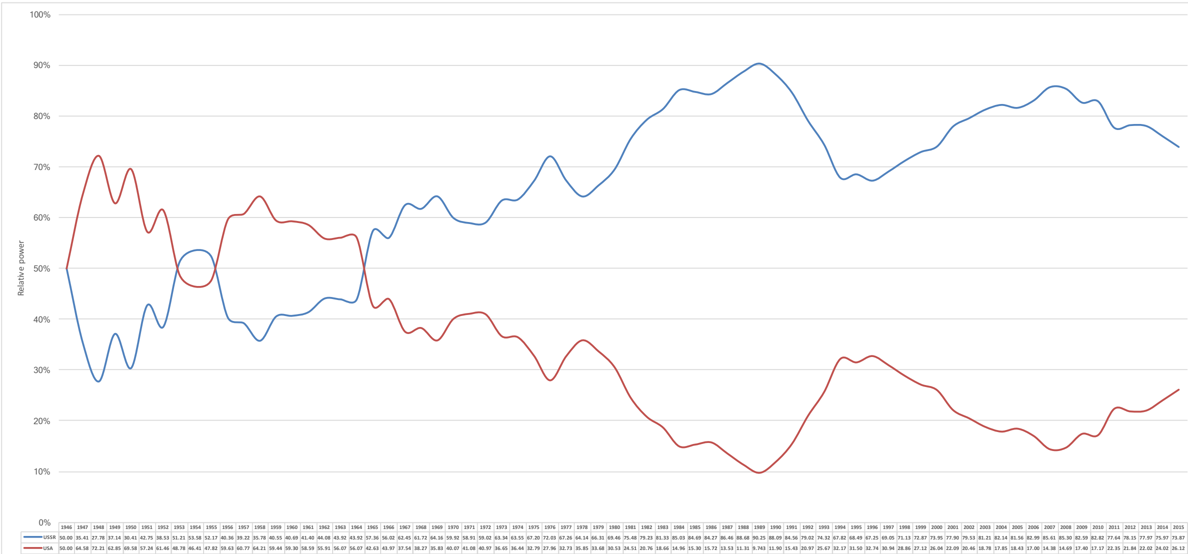



Figure 27: Relative power of the USA and the USSR, every year from 1946 to 2015

#### 12.2.5 Discussion

As we can see on figure 25, there was a significant shift in the usual votes of both the USSR and the USA in 1990-91, and then another in 1993-94. From 1946 to 1962, the contextually normalized solution between the two States at the UNGA was general agreement (both the USSR and the USA backing the resolution most of the time), although this normalization would not reach 50% (see the blue line).

With the escalation of tension between the two States following the Cuban missile crisis in October 1962, we see a stark change in the voting pattern of the USA, who started rejecting resolutions more often than not, whereas the USSR kept backing most resolutions until the end of the Cold War. From 1963 to 1994, the probability of both the USSR and the USA agreeing with the majority to a UNGA resolution was approximately equal to the probability of the USSR backing the resolution while the USA rejected it. There was therefore a dual contextually normalized solution, rather than a single Nash equilibrium. We can see an accentuation of these two equilibria, as behaviour became more normalized, where other solutions (the USA backing a resolution while the USSR rejected it, or both States rejecting the same resolution) became increasingly unlikely.

The period of dissolution of the USSR is marked by a period of uncertainty and instability on the graph: starting in 1990-91 until 1994-95, we can see that the usual voting behaviour of both States shifted dramatically: every solution was suddenly de-normalized, and they all hovered around 25% over that period. The situation was then re-normalized to the normalization seen before the dissolution of the USSR from 1995 onward: two contextually normalized equilibria coexisted since, namely both backing the resolutions or backing of Russia and rejection of the USA, with a probability of 35-40% each.

As for the relative power of each State, figure 26 shows that the majority of the world generally agreed with the USA from 1946 to 1965 (the time of the escalation of conflict between the USA and the USSR) and then the majority agreed with the USSR or Russia more often from 1965 onward. We also find six critical junctures after which each country either gained or lost relative power. They occurred in: 1948, 1954-55, 1958, 1989, 1996, 2007-09. Each of these turning points reveals an important perturbation that shifted the world's opinion regarding these two countries, independent of the issues at-hand:

- 1948: the Berlin Blockade.
- 1954-55: the dissolution of Indochina (into North and South Vietnam, notably), the first Taiwan Strait Crisis, and the foundation of the Non-Aligned Movement and the Warsaw Pact;
- 1958: the second Taiwan Strait Crisis and the start of the second Berlin crisis (the USSR asks the West to leave Western Berlin);
- 1989: revolutions in Eastern Europe and the dissolution of a part of the USSR.
- 1996: interference of the USA in Russian elections, in favour of Boris Yeltsin against Vladimir Putin.
- 2007-09: the Russia-Georgia crisis, and the onset of future interference and interventions of Russia in other countries.

We will not delve into the intricacies of each of these events, as our aim here is to elucidate the movements in voting and relative power patterns of the USA and USSR-Russia at the UNGA. What matters is that we demonstrated that the proposed mathematical model is useful to gain insights on patterns of behaviour and to find critical junctures; guided by these insights, specialists of concerned players or phenomena can then follow up with expert interpretations of these patterns and deviations. We have also demonstrated above that players appear to follow voting patterns, regardless of the object of each resolution and that their relative power is affected by critical events.

### 12.2.6 Conclusions

Has the influence of the USA significantly increased relative to Russia at the United Nations' General Assembly (UNGA) following the dissolution of the USSR? No; the data actually shows the opposite, contrary to the popular opinion. Following the end of the Cold War, there was a time of instability where previous tendencies were de-normalized, to the point that all four likely solutions had a probability of approximately 25% for a short period of time. Post-Cold War interactions re-normalized such that Russia gained almost as much influence at the UNGA as during the Cold War relative to the USA, who gradually lost influence—possibly due to reputation problems.

Objectively, we can say that:

- The USSR/Russia has always had a greater tendency to align with the majority vote than the USA.
- The USA has had a greater tendency to reject the majority vote since the escalation of the Cuban missile crisis.
- The voting tendencies of the USA and the USSR/Russia at the UNGA have dramatically shifted at the time of the dissolution of the USSR. At this point in time,

both States were re-adjusting to the new reality, and all solutions were equivalent (around 25% of probability). Thus, following the official end of the Cold War, the previous equilibria were broken and set to re-normalize to their previous order by the end of the decade.

- The voting tendencies of the USA and Russia today reflect the same game as before the dissolution of the USSR. While displays of hard power have changed since the official end of the Cold War, the Cold War game seems to be about the same at the UNGA in terms of voting patterns.

Two solutions shared the top ranks as contextually normalized equilibria for most of that game: the most normal solution is mutual agreement and backing of the resolutions, closely followed by backing of resolutions by the USSR or Russia and rejection by the USA. As we can see, behaviour does not always reach a single equilibrium—sometimes, there may be a shared normalization between two or a small number of solutions, that share the top ranks. In such cases, behaviour may seem random or perfectly adapted to each case (for example each State voting reasonably according to a coherent rationale for each resolution), but that is not the case, either with complex adaptive systems or individuals; players follow habits as well as the conventions and the structures of rules and power that surround them, so their behaviour usually follows a tendency that changes slowly over time. Then, nothing is permanent and it would be futile to search for natural laws in political science, yet nothing is perfectly reasonable and it is equally vain to look for answers in historical detail. We follow the forces that pull us, yet we have some freedom to wiggle.

Now, if we consider the agreement of a hegemonic State with the majority vote as a symbol of its influence over the majority, whereas an opposing hegemonic State would reject the majority vote every time the majority agreed with its opponent, then it appears that the USSR exerted influence over a greater number of States than the USA from 1962 to 1990. The influence of the USSR decreased drastically as a signal of its imminent downfall at that point in time, and Russia slowly brought back most of its former influence in the halls of the UNGA up until 2015 (the latest data point).

Russia's displays of hard power have increased significantly over the 2010-20s decade, and considering that it annexed Crimea in 2014 and started consolidating alliances with Turkey, Syria, and other States opposed to the USA since, we may reconsider if the Cold War really ended, or whether we only witnessed a de-normalization of relations following an important perturbation, with an eventual re-normalization to the Cold War game. Perhaps that game was not over after all, but only manifested differently while some players kept busy manipulating strings and planning their next play behind the curtains.

# 13

# Conclusion

*"We absolutely must leave room for doubt or there is no progress and there is no learning. There is no learning without having to pose a question. And a question requires doubt. People search for certainty. But there is no certainty. People are terrified—how can you live and not know? It is not odd at all. You only think you know, as a matter of fact. And most of your actions are based on incomplete knowledge and you really don't know what it is all about, or what the purpose of the world is, or know a great deal of other things. It is possible to live and not know."*

Richard Feynman[64, p. 115]

## 13.1 Final remarks

In this dissertation, we tried to find a way to fix some important problems of game theory and international relations theory. What we achieved is a working model of trends, but not one of change; unless we find a way to predict and measure the likely impact of perturbations over behaviour, more precisely how much deviation any given perturbation may cause, then the theory is incomplete.

At best, we have a theory that is well adapted to data mining techniques, such that you may estimate the likelihood of some possible results of an interaction between some complex adaptive systems with different weights and preferences, if and only if all other things are held constant. The *ceteris paribus* assumption is the greatest weakness here—although it is a useful assumption in experimental sciences—because a theory of adaptive behaviour should be able to predict change, not only to describe it. Moreover, you should never forget that what is suggested here is a tool to complement expertise, because when it comes to social behaviour and phenomena, if I may borrow someone else's formula: not everything that can be counted counts, and not everything that counts can be counted[37, p. 13].

The problem is that, in the social realm, nothing is as structured and constant as in the physical realm. Even chaos theory measures regular—albeit non-linear—patterns of the physical world, whereas human behaviour is not necessarily governed by regularity, although we can see patterns. The more rigid is the structure of a complex system, the more stable are the patterns; and the more flexible is the structure, the more anarchic its behaviour may seem.

This leads to another paradox: what if, instead of following their own normal tendency according to their preferences, every player used the theory that was presented here to make their choices? Then, there are two likely outcomes:

- the players will be able to better assess the likely consequences of their interaction, and they may negotiate to optimize gains and avoid undesirable payoffs;
- or the player's behaviour may, paradoxically, show no trend as they will adapt their behaviour according to what the theory predicts. Then, their behaviour will still be predictable if you use the model as they did, but trends will be more difficult to observe.

Does this mean that any theory of rational behaviour is doomed to failure from the onset? Not necessarily. There was once a German philosopher who, on the front line in the midst of World War I, created a logical system, one proposition after another, that later became his doctoral dissertation. His system can be summarized as follows:

1. "The world is everything that is the case. [...]
2. What is the case, the fact, is the existence of atomic facts. [...]
3. The logical picture of the facts is the thought. [...]
4. The thought is the significant proposition. [...]
5. Propositions are truth-functions of elementary propositions. (An elementary proposition is the truth of itself.) [...]
6. The general form of the truth-function is: $[\overline{p}, \overline{\xi}, N(\overline{\xi})]$. This is the general form of proposition. [...]

7. Whereof one cannot speak, thereof one must remain silent."[158]

The last proposition of Ludwig Wittgenstein's *Tractatus Logico-Philosophicus*[158] is enigmatic: if the world can be described by atomic propositions that are truth-functions of themselves, in the sense that they are tautologies that describe a constructed interpretation of the symbols of reality, then we should be able to communicate our interpretations of everything that is the case, the sum of all facts. And then some—such as William James and Richard Rorty—may argue that every honest interpretation of the symbols of reality must be true in themselves as they are rightful interpretations of reality from the point of view of the interpreter. But then, we get into a logical problem: that of relativism. An even more enigmatic set of propositions may be the key to escape this problem:

6.5. "For an answer which cannot be expressed the question too cannot be expressed. *The riddle* does not exist. If a question can be put at all, then it *can* also be answered.

6.51. Scepticism is *not* irrefutable, but palpably senseless, if it would doubt where a question cannot be asked. For doubt can only exist where there is a question; a question only where there is an answer, and this only where something *can* be *said*.

6.52. We feel that even if *all possible* scientific questions be answered, the problems of life have still not been touched at all. Of course there is then no question left, and just this is the answer.

6.521. The solution of the problem of life is seen in the vanishing of this problem. (Is not this the reason why men to whom after long doubting the sense of life became clear, could not then say wherein this sense consisted?)

6.522. There is indeed the inexpressible. This *shows* itself; it is the mystical.

6.53. The right method of philosophy would be this. To say nothing except what can be said, *i.e.* the propositions of natural science, *i.e.* something that has nothing to do with philosophy: and then always, when someone else wished to say something metaphysical, to demonstrate to him that he had given no meaning to certain signs in his propositions. This method would be unsatisfying to the other—he would not have the feeling that we were teaching him philosophy—but it would be the only strictly correct method.

6.54. My propositions are elucidatory in this way: he who understands me finally recognizes them as senseless, when he has climbed out through them, on them, over them. (He must so to speak throw away the ladder, after he has climbed up on it.) He must surmount these propositions; then he sees the world rightly.

7. Whereof one cannot speak, thereof one must be silent."[158]

Philosophy and science are based on the principle of reason: nothing is without reason. Then, every question must have an answer; and we seek to answer these questions using logic. However, as Wittgenstein adds:

5.621. "The world and life are one.

5.63. I am my world. (The microcosm)."[158]

We are part of the world, and we use language to decipher the symbols of the reality that surrounds us. Doing so, the world as I see it is my own world, a holistic picture that only I make of it and that language translates into logic. Then, everyone may have a different interpretation of the world according to their own worldview.

If language is the vehicle of reason, and if atomic propositions are tautologies because they justify themselves, then only propositions about real things can themselves be real. Yet, if we use systems of logic to determine the truth of propositions, then we use propositions that may be nothing more than artificially true constructs that justify themselves in their own world, in the realm of language.

In that case, to avoid artificial constructs that have no reason to be true in reality, we must revert to the same conclusion that was reached by Sextus Empiricus[57], David Hume[81], and Ludwig Wittgenstein[158]: skeptical empiricism. We must speak only of what we know, what is real, and suspend judgement about what might be that we cannot know. We can know about what is likely, but we cannot know anything about what really is the case (what is real outside the realm of probability and interpretation) and even less about what is not known for sure (such as unexpected irregularities and deviations). You can only enumerate a list of known potential factors of deviation and, according to your experience, argue that they may or may not cause a deviation, but you cannot integrate this into the probability calculation if you have no means to calculate the likely impact objectively.

That means that we should keep the theory of trends as is—even without the complementary theory of change—unless we have the means to elucidate the factors of change and their impact. Unfortunately, as of writing this dissertation, the data and technology to detect and evaluate the impact of factors of change in political discourse and social behaviour were insufficient, and theorizing philosophically about the factors that might trigger deviations in complex adaptive systems' behaviour is beyond the capability of human intuition. Therefore, "whereof one cannot speak, thereof one must remain silent", as Wittgenstein said, and we may only describe trends and say what would reasonably be the case *ceteris paribus*.

As a final surprise, here is a secret about this dissertation: parts 1 and 2 were constructed as a series of informal theorems followed by their proofs (unlike the modern proof method and more akin to Isaac Newton's *Philosophiæ Naturalis Principia Mathematica*[108] and Euclid's *Elements*[58]), but each theorem also logically followed the previous one as if each proposition is the stepping stone for the next (in a similar fashion to Ludwig Wittgenstein's *Tractatus Logico-Philosophicus*[158]. Part 3 was added late in the process for some early readers who had difficulty understanding the theory and its philosophical and practical implications. Thus, as initially designed, our conclusion will consist of the set of all propositions of parts 1 and 2 to prove the coherency of the set of propositions as a coherent whole, and if you are unsure as of how a proposition was demonstrated or unconvinced by its statement, you may refer to the corresponding section of the work.

## 13.2 Summary

Can we study the State as a rational unit?

What we know

Of complexity: the State is a complex adaptive system, that is a dynamic system that does not follow pre-determined rules of behaviour; it follows that its behaviour is difficult to predict according to concepts of linear solutions. It is not because a State does not necessarily have a conscious, consistent or coherent reasoning that it is irrational.

Like an ant colony organizes and carries out tasks that are beyond the faculties or will of each ant in the group, the behaviour of a group can express a reason that results from the interaction of its units, either by accident or by design. As the actor-network theory suggests, any network can be seen as an actant if it produces actions; this is the case of the State. Every part of the network that constitutes the State adapts to the stimuli of the network and the State itself adapts to other systems on various levels (notably the national system and the international system). This is why the State choices vary, but not are completely unpredictable. Such a group is labelled a "complex adaptive system" in the language of complexity science. A system is said to be complex if its dynamics cannot be explained nor predicted adequately in terms of deterministic rules describing their behaviour; it is said to be adaptive if it adapts to its context rather than following a linear path. The reason why game theory has so much difficulty predicting State behaviour and transformations in international relations is actually because the State is a complex adaptive system.

Of the interaction of complex players: when two complex adaptive systems interact, their representatives usually recognize their counterparts as agents of the systems. When the latter evaluate the available strategies, they think about the relationships between these systems. The State remains a unit within the international system on two levels: on the one hand, the representatives of one State represent and must defend the interests of the nation and, on the other, the State remains symbolically the entity that interacts with other institutional players.

Of the unity of the State: the State, as a complex adaptive system, is a practical unit in its relations with other States and non-State players.

Of non-State players: some non-State complex adaptive systems, such as international organizations, also play asymmetric games of bargaining with States. At the time of their creation, international institutions are given a certain degree of autonomy to ensure that they can exercise their functions without the political interference of outside players. They are not innocent or apolitical: they serve a political purpose, which is either elaborated from within or by external actors. Although some schools of thought argue that international organizations reflect the interests of their agents and others assume that they are units, the reality is still more complex: each organization has a different level of autonomy that may change over time, and they are both manipulated and manipulative to varying degrees. Authority in the age of globalization is thus diffused through the political games that take place, in particular, in the context of international institutions.

Of anarchy and international organizations: authority on the international stage is diffuse, but the State still has the final legitimate authority. The State grants authority and autonomy to international organizations, but it does not withdraw. This is not necessarily a transfer of skills, but rather a transformation of the logic of authority. International organizations then become manipulative and manipulated to varying degrees, as do States. Authority in international institutions is diffused because it results from games played between players who try to influence other players and the game itself in their favour. Since the game is practised between players who may have divergent preferences, interactions in international institutions play in the narrow corridor between harmony and discord, where interests can rejoin. No one controls international politics, let alone global governance, since it takes place where the political authority of one entity is insufficient at present.

Of security: security is a response to a threat, a choice to identify a phenomenon as a national or international security issue. The reason of State and the national interest are therefore subjectively determined by agents of the State. Security policy is a choice that is made from a range of options in response to the conditions of our social environment. Everything is a matter of choice. Security depends on our choices of interests and identity. Players always make a choice even when the options are limited to conforming or resisting the structural constraints. Military conflicts are political choices that result from rational calculations, which may be subjective as well as objective, and reason is not necessarily objective: the structures and the social environment are subjectively interpreted and then objectified in order to incorporate them into the reason for the choices.

Of the economy: the delegation of power is a conscious reorganization of games; therefore, when the State adopts more liberal policies, it manipulates the rules of the games rather than concede defeat to non-State players.

QED, the State is a useful category. But what of the rationality of its decisions?

Of rationality: the perfectly rational player is a chimera, but players usually try to intuitively maximize gains according to their utility function.

Of the diversity of strategies: players have different utility functions and they neither have the same aversions, nor the same reactions.

Of equilibrium models in international relations theory: there is no consensus. As a result of the divergence in the instrumentalization of game theory by theories with contradictory rationality and normativity assumptions, many competing hypotheses have been defended regarding the most natural equilibrium of the international system and the factors of convergence and deviation. These hypotheses are logically incompatible because of their assumptions as well as their implications.

All these ideas therefore relate to the notion of utility, assuming that the players are rational and that they understand what is in their interest. Some of these ideas, for example, the greater stability of the uni-polar equilibrium because of the strategy of *bandwagoning* or the bi-polar equilibrium because of the strategy of equilibrium of powers, are in opposition. We therefore face a problem of hermeneutical divergence due to a contradiction of the theoretical presuppositions.

QED, the State may be a rational unit, but there are no standard criteria of rationality other than Von Neumann and Morgenstern's rationality axioms and the principle of utility maximization, because each player may rationalize strategies according to a different utility function and a different reaction to risk. Should the State be studied scientifically as a rational unit but some hermeneutics problems have to be addressed first.

Is the State a rational player? Since there is no objective criteria for rationality, the question needs to be rephrased: can we understand the State using a formal model of rationality?

Of rationalizability: strategies may or may not be rationalizable, depending on the utility function of the player. The strategy of a player depends on their reason (the logic that guides the choice). In other words, various strategies are linked to various reasons. Rationalizability makes it possible to circumscribe the set of strategies that are viable options for a player who aims to win in an uncooperative game with incomplete information about opponents. We are already opening the door to a more flexible definition of rationality.

Of forecasting: the study of normality and equilibrium does not allow to predict *a priori* or to explain correctly *a posteriori* the abnormal cases or the breakdown of an equilibrium. Game theory has no claim to universality. It nevertheless conveys the belief that rational behaviour tends towards equilibrium when a game is repeated.

Of theoretical assumptions: assumptions are the building blocks of worldviews. All successful theories rely on a great deal of assumptions. Without assumptions, your hypothesis has no foundation, it has nowhere to start from. In an ideal world, those assumptions would not have to exist, because our predecessors would have discovered all the fundamental truths that we need, and that knowledge would be true without a doubt. However, this Wonderland of science does not exist: it is almost impossible to prove anything, as you never know when someone may refute your beliefs with more convincing arguments than yours.

Of the diversity of equilibria: how to find the right one? The problem is that there is not always a unique equilibrium in a game; actually, there are often many, and players who participate to experiment may take a long time to converge to one or another. This is true of evolutionary biology, and it has been proven by John Nash that every non-cooperative game has at least one equilibrium, sometimes more.

Of the diversity of worldview and reasons: we all think differently, so what seems naturally rational to me is not always naturally rational to you. $\mathbb{N} \neq \mathbb{R}$: what is natural is not exactly what is real. In international relations theory, we tend to think of what is natural as what is most logical, which actually distorts reality we are studying because reality is often counter-intuitive. Natural abstraction is useful but it has the following shortcoming: what is natural varies from one individual to another. Common sense is not universal: you only have to compare the common sense of the Japanese to that of the Senegalese and you will find major differences. Since common sense is different, our natural interpretation of reality differs. Each worldview in International Relations has a natural reason and reason that underlies conflicts of interpretation. We have different reasons and must be aware of these in order to judge the correctness of an interpretation. What may seem natural to us is not necessarily real.

Of the natural bias in international relations: the problem in International Relations is that most theories are biased towards a notion of what is normal, natural, or constant. Considering that theorists tend towards the theories that seem most natural to them, according to their own worldview, inter-theoretic dialog is difficult because of the incompatibility of theoretical premises. The partisans of each school of thought argue that their worldview corresponds to reality, $\mathbb{N} = \mathbb{R}$, but if worldviews diverge, such that $\mathbb{N}_1 \neq \mathbb{N}_2$, then both conceptions of what is natural cannot be equally true simultaneously unless they complement each other. If they complement each other, then they may be used symbiotically. If they contradict each other, then one is less true than the other. Then, the answer to the presumed problem of paradigm incommensurability in international relations theory is that theories with incompatible assumptions become logically compatible if they are circumscribed to clearly defined special cases.

Of the correspondence of theories to types of reason: each general theory on normal political reason is actually a special theory on one type of reason. Theories are applicable when and only when their premises are true. Then, let the rationality assumptions of a theory circumscribe the thought pattern of a player, and let every theory set its own thought pattern of reason this way. We get as a result a typology of player types, where players differ according to their thought pattern. We have thus done a full circle, from Confucius to experiments in game theory to international relations theory: different types of players behave differently, and theories can serve to study classes of players. We can use realism to study the behaviour of realist players, liberalism for liberal players, etc. This extends far beyond the classic idea of hawks vs doves and owls, which was already used in political science to describe different types of players.

What we suggest is that an always up-to-date compilation of the frequency at which players of a given type choose a given strategy in a set may be useful to data mine into States' behaviour. It would allow us to overcome the problem of abusive generalization (by claiming trends without taking each player's reason into account), and that of incomplete information (because we do not see what is going on inside the black box[20]). If

[20] Alexander Wendt famously argued, notably in his paper "Anarchy is What States Make of It"[21] and his book "Social Theory of International Politics"[157], that the State is an anthropomorphic entity, as it behaves as an individual in its relations with other States and that it reasons its behaviour according to its interests. Many other positivist hypotheses in international relations theory share this perspective of the State as a reified subject, where the State's reason is defined by a set of interests. In such cases, the State is usually viewed as a black box, one that exhibits behaviour independent of its internal dynamics. What I propose does not rely on material realism, and it does not reify the State as an anthropomorphic entity, unlike most black-box conceptualizations. I avoid this in my dissertation, and this is where you may see paradoxes. Yet, these paradoxes are not really paradoxes; they are actually ambiguities, and they are there on purpose to make sure the analyst who understands what I propose does not derive towards reification, nor anti-reification. I used to believe that studying the State as a unitary player is one of the worst mistakes that political scientists can make, because the State is not a thinking being and that there are actually individuals who make decisions. So I thought it was better to study what is really going on behind the curtains, not only the manifestations of States themselves. However, after a few years of thinking that way and trying to resolve the problem that I address in the dissertation, I realized that it is usually impossible to obtain a clear picture of what is going on behind the curtains. We only see a fragment of the reality, and others may see different fragments, which may lead to equally

the analyst adequately assesses the tendency of every player, then we may use statistics to study probabilities, which gives us a more solid empirical foundation to make predictions and explanations which would derive directly from the model, rather than the analyst's intuition, and take each player's subjectivity into account even with incomplete information.

How we play

How can we explain the behaviour of a complex adaptive player such as the State?

If a complex adaptive system is rational, then its reason is explicable as an adaptation to contextual stimuli, rather than on the basis of normal premises of rationality[22]. An

plausible and equally grounded hypotheses that are contradictory and that may all be wrong in the end, in comparison to what we would know if we had perfect information. So we have groups who exhibit behaviour, but who do not think on their own and thus do not determine their personal interest in a consistent manner. We have group-think, but not only that; we have group-think that depends on dynamics where some people have more power than others, either through influence or agency. And because material considerations make no difference when you have Gandhi vs the British Empire, you need to take into account the shifts in exhibited power and behaviour at the levels where they are observable. Because we cannot know with certainty what is going on behind the curtains, we need to remain careful about reifying the State, and playing conspiracy theory with unfalsifiable hypotheses or speculation about what is going on. So we may only study the manifest reality without doubt, and we should remain skeptical about what is actually going on. As my experience at the government has proven, and as Japanese prime minister Ozawa Ichirō wrote in one of his books[112]: even from the inside you have no idea what is really going on, because you do not have complete information. So puppets manipulate each other, but no one knows who pulls which strings. Then, we cannot account for how the reasons of units with a complex adaptive system affect the artificial reason of the complex system itself as we lack information on each unit and the dynamics between them. So while we know that the State is not a black box and while we need to keep this in mind to avoid the mistake of hypothesizing national interests, we need to treat the State as if it was a black box whose inner workings are mysterious unless revealed otherwise. Consequently, we cannot explain precisely how the reasons of internal players lead to the exhibited reason of the State, so we purposely suspend judgement and leave this question open without saying that anything is or is not the case.

[22]In game-theoretic literature, reason and rationality usually go hand-in-hand, but we make a distinction between the two in the proposed theory. Rationality is usually defined either as an optimal correspondence between ends and means, or as utility maximization: players would make choices that maximize, or at least optimize their utility. This may or may not include an aversion to risk, especially for advocates of prospect theory. So reason and rationality are usually equivalent notions in game theory. A reasonable choice according to utility maximization, given a player's utility function for a

alteration of the context can change the reason of the players and the co-ordination obtained. Thus, an apparent "equilibrium" is only a contextually normalized co-ordination that can be reversed by a change in context or a subjective shock. This equilibrium is not necessarily stable. If a player's reason was relatively stable because of the normalization and changes according to their adaptation to the stimuli, then one could observe trends,

given game, is a rational choice. And any option may be rationalizable according to a proper utility function. Here, however, we assume no belief, no level of information, no utility function, no ordering of preferences. Instead, we choose to make a distinction between rationality and reason. The reason of a player is thus defined here as the logic that makes the player act in a given way. It may be true for some individuals that their reason depends on their set of interests and preferences. However, for complex adaptive systems, speculating about such interests of preferences is akin to reifying and anthropomorphizing the system and assuming that there is a consistent and human-like reason behind their actions. I do not have sufficient reason to believe that is the case, and thus I believe it would be best to suspend judgment on that aspect. Consequently, the reason of a player is not necessarily a set of interests and preferences, but simply the logic behind decision-making. Then, a complex adaptive system therefore has a latent artificial reason that is the result of the interaction of other players in lower level games, rather than conscious utility calculation. It is not a conscience, but an expression of groupthink and power relations that does not necessarily follow logical principles. Rationality, then, is the quality of behaviour that is reasonable and that follows a player's reason. In utilitarian game theory, because it is assumed that players' reason is based on utility maximization (or at least optimization), it was consequently natural to assume that a rational choice is one that maximizes or optimizes utility according to individualist interests. However, as empirical psychology and behavioural game theory research has shown, every individual player may assign different utility values to each option and, moreover, every player may exhibit a different aversion or inclination to risk and be more or less attracted to gains of various scales. Therefore, any estimation of utility is risky; moreover, it would rely on the assumption that players make independent choices according to rational calculation of utility, or that any question of power and influence would influence utility, and we would therefore have to find ways to quantify this subjectivity. The quantification of subjectivity is the greatest challenge here, and a very difficult one if you want to circumscribe interpretation such that we ensure that every analyst reaches the same conclusion and that this conclusion is as close to reality as possible, then the estimation of the subjective change of utility as a consequence of influence or power relations is very difficult. In order to avoid such subjective estimation, we can instead omit theorizing about conscious thinking, and focus instead on observable behaviour. Then, if a player followed their own inclinations—for example their interests and their preferences—then it would follow that any rational behaviour would not deviate too much from that player's tendencies, because otherwise that would mean that the player deviates from their own preferences and interests. And that would be contrary to any notion of rationality presented earlier in either game theory or psychology. So, in our model, we consider that behaviour that is rational is such that it does not deviate too much from a player's tendencies. It is not essentially reduced to consistency; its reflection is indeed consistency, while its cause is the expression of the player's hidden motives, considering that each player may make different choices according to a different reason.

and possibly changes of trend, in the player's choices. The choice should not vary in an anarchic way from one game to another, except if there is an explainable perturbation, such as a change of government with a different ideology or a revolution.

It follows from the hypothesis that players will adapt their behaviour until they do what is normal, then follow their tendencies as long as there is no perturbation to trigger a deviation.

It also follows that, in an interaction between two unequally powerful players, the solution should include the stronger players' most preferred and the weaker's least disliked strategies. Thus, an equilibrium needs not be a co-ordination of non-invadable strategies, as it is conventionally thought; any normalized solution is stable as long as all players accept it.

Of the definition of games: a game is any interaction between two players such that their strategies affect their payoffs. A non-cooperative game is a game where there is no superior authority to enforce cooperative behaviour. This research focuses on relational form games. A relational form game is a game where some players that are not necessarily unitary conscious entities may exert more power than other players that are not necessarily conscious units either over the course of their interaction, and where each player adapts to the context. It usually leads to a contextually normalized solution.

Of a new solution concept: the contextually normalized solution. A contextually normalized solution is a stable state of a game such that players normalize their strategies as they adapt to each other and the context, and then repeat their normal strategies as long as the context is stable.

Of the difference between the contextually normalized solution and the Nash equilibrium: one is descriptive, the other is prescriptive. The Nash equilibrium is a prescriptive notion, whereas the contextually normalized solution is descriptive. Also, the Nash equilibrium assumes that players rationalize their strategies according to a utility function, whereas the contextually normalized strategy assumes that players will adapt their strategy in reaction to the stronger players', not necessarily as a function of the utility of options.

What is the utility of knowing the contextually normalized solution? If you can explain or predict the expected contextually normalized solution, then you may find a way to make it deviate towards the optimal solution or away from sub-optimal ones, either by using the expected equilibrium as an argument to negotiate mutual deviation or as a clue to influence other players.

Of unlikely and seemingly irrational deviations: although normalization creates expectations, players may deviate from their usual behaviour under sudden impulses that are difficult to explain with any solution concept, even with the one that we propose here. Exceptions that cannot be predicted nor explained may occur, no matter how good a theory is. However, more players interact in more lower-level games, so the behaviour of the state already corresponds to a previous equilibrium between lower-level players, which means that deviation may have been prevented at a lower level of the decision-making process, and so the tendencies of complex adaptive systems should appear more stable. Therefore, A) some unexpected deviations may happen and does not mean that the theory is wrong, and B) complex adaptive systems such as the State still remain less likely to deviate suddenly from the normalization—the likelihood of deviation decreases with the augmentation of the number of players and bargaining lower-level games.

Of the artificial reason of complex adaptive systems: they are not thinking entities, but they do possess reason. Although complex adaptive systems like a State do not think, their preferences are *de facto* the reflection of the lower-level games played by the players who manipulate it behind the curtains. We may or may not witness what is really going on in the offices and boardrooms, but some preferences can be observed nonetheless. If one observes a deviation in its tendency, then one is right to believe in an approaching change. The utilitarian theory remains useful here, if only to find the possible causes of deviation.

Of quantitative forecasting: estimate the relative bargaining power, then measure the skewness of the interaction. The variables that may influence a State's behaviour in international affairs are:

- the level of political stability: the greater is political unrest within a country, the more likely it is to deviate because of internal and external lower-level games;

- the political regime: the more democratic is the decision-making process of a State, the less likely it is to deviate in a short span of time—because deliberations take place over more lower-level games and with more players so it is more difficult to manipulate the games at higher levels;

- similarity of regimes and ideologies: States that have similar economic or political regimes or ideologies are less at risk of conflict against one another and more likely to make a coalition against players who are different, because there is a normalization between them; the more different two States are, the more likely they are to wage war because of otherness (the opposite of normalization). Normalization is a conflict prevention mechanism through adaptation to one another;

- the relative bargaining power: the greater is the relative bargaining power of a player, the more likely that player is to steer the solution towards their preferred outcome. As for weaker players, they will either adapt to the stronger players, or they will forge a coalition if the latter may perturb the equilibrium. Even if you are much weaker—like a terrorist organization or a rogue state relative to a superpower—creating a perturbation may cause a re-normalization of the game in your favour.

We tested the expected contextually normalized equilibria for seven games and compared these results with the predictions of eleven solution concepts. These games are:

- the prisoner's dilemma;
- the battle of the sexes;
- the stag hunt;
- the chicken game;
- the common interest game;
- the ultimatum game;
- and the unique mixed equilibrium game.

The new solution concept correctly assessed each case, except in cases where a normalization seems to take place in experiments where a single-shot evaluation with the new solution concept predicted a 50-50% split. Normalization as a result of the adaptation of players to one another, especially of the weaker to the stronger, therefore explains why one point of equilibrium is more likely where many are possible, as well as why we may deviate from a Nash equilibrium.

As a result, to understand the game of politics, it is best to see it as a puppet show, such that:

1. The world is a circus.
2. At the centre of this circus stands a puppet theatre. There we show political spectacles, where games of power are played every day and night.

3. In this puppet theatre, each puppet is also a puppeteer.

4. No one, not even the puppets themselves, can see clearly who pulls what strings behind the curtains, and they do not even know how long the strings really are.

5. The show may be different every time, but puppets are used to their ways and have limited leeway to move anyway as their strings have finite elasticity and length.

6. Each puppet has its own will and can make its choices, but it cannot go further than the extent of its strings.

7. Although each puppet makes choices, their movement does not necessarily represent their own intentions, but rather the combination of the puppet's pull in its desired direction with the effect of the pull of other puppets on its strings.

8. We could understand the show better if we could imagine what is going on behind the curtains by observing the puppets' movement rather than trying to guess their intentions.

Thereupon the curtain rises.[23]

[23] This theory is extendable to the study of individuals' and other atomic players' behaviour. The proof is trivial and left as an exercise to the (ambitious) reader.

# Part IV

# Appendices

# A

# Trade agreements in East Asia

Table 11: Free trade agreements negotiated or ratified by ASEAN+6 members, 2017

| Country | Framework signed | Negotiations | Signed, not in effect | Signed, in effect | Total |
|---|---|---|---|---|---|
| Australia | 0 | 6 | 1 | 12 | 19 |
| Brunei | 0 | 1 | 1 | 8 | 10 |
| Cambodia | 0 | 1 | 1 | 6 | 8 |
| China (PRC) | 0 | 10 | 1 | 16 | 27 |
| India | 1 | 15 | 0 | 13 | 29 |
| Indonesia | 0 | 6 | 3 | 9 | 18 |
| Japan | 0 | 8 | 0 | 15 | 23 |
| Korea (ROK) | 0 | 9 | 0 | 16 | 25 |
| Lao PDR | 0 | 1 | 1 | 8 | 10 |
| Malaysia | 1 | 4 | 2 | 14 | 21 |
| Myanmar | 1 | 2 | 1 | 6 | 10 |
| New Zealand | 0 | 6 | 1 | 11 | 18 |
| Philippines | 0 | 2 | 2 | 7 | 11 |
| Singapore | 0 | 8 | 1 | 21 | 30 |
| Thailand | 1 | 8 | 1 | 13 | 23 |

**Table 11 continued from previous page**

| Country | Framework signed | Negotiations | Signed, not in effect | Signed, in effect | Total |
|---|---|---|---|---|---|
| Vietnam | 0 | 4 | 1 | 10 | 15 |

Source: Asia Regional Integration Center, Asia Development Bank [11]

Table 12: Top ten ASEAN trade partners, 2015

| Trade partner | Value (US$ MM) | | | % total ASEAN trade | | |
|---|---|---|---|---|---|---|
| | Exports | Imports | Total trade | Exports | Imports | Total trade |
| ASEAN | 305,693 | 238,059 | 543,751 | 25.9 | 21.9 | 24.0 |
| China (PRC) | 134,249 | 211,515 | 345,764 | 11.4 | 19.4 | 15.2 |
| Japan | 113,694 | 124,350 | 238,044 | 9.6 | 11.4 | 10.5 |
| EU 28 | 127,584 | 100,056 | 227,640 | 10.8 | 9.2 | 10.0 |
| USA | 129,171 | 83,172 | 212,343 | 10.9 | 7.6 | 9.4 |
| Korea (ROK) | 45,809 | 76,676 | 122,484 | 3.9 | 7.0 | 5.4 |
| Taiwan | 33,077 | 61,261 | 94,338 | 2.8 | 5.6 | 4.2 |
| Hong Kong | 77,303 | 14,113 | 91,416 | 6.5 | 1.3 | 4.0 |
| India | 39,101 | 19,453 | 58,554 | 3.3 | 1.8 | 2.6 |
| Germany | 26,756 | 28,755 | 55,512 | 2.3 | 2.6 | 2.4 |
| Top 10 | 1,032,436 | 957,411 | 1,989,847 | 87.3 | 88.0 | 87.6 |
| Others | 149,595 | 130,868 | 280,463 | 12.7 | 12.0 | 12.4 |
| Total | 1,182,031 | 1,088,279 | 2,270,310 | 100.0 | 100.0 | 100.0 |

Source: Association of Southeast Asian Nations [109]

Table 13: Intra- and extra-ASEAN exports

| Country | Intra-ASEAN exports | | Extra-ASEAN exports | | Total (M USD) |
|---|---|---|---|---|---|
| | Value (M USD) | % share | Value (M USD) | % share | |
| Brunei | 1,239 | 19.5 | 5,114 | 80.5 | 6,354 |
| Cambodia | 819 | 9.3 | 8,019 | 90.7 | 8,839 |
| Indonesia | 33,577 | 22.3 | 116,789 | 77.7 | 150,366 |
| Lao PDR | 2,646 | 71.2 | 1,068 | 28.8 | 3,714 |
| Malaysia | 56,169 | 28.2 | 142,989 | 71.8 | 199,158 |
| Myanmar | 4,444 | 36.4 | 7,754 | 63.6 | 12,197 |
| Philippines | 8,537 | 14.6 | 50,112 | 85.4 | 58,648 |
| Singapore | 118,271 | 32.3 | 248,073 | 67.7 | 366,344 |
| Thailand | 61,926 | 28.9 | 152,470 | 71.1 | 214,396 |
| Vietnam | 18,064 | 11.1 | 143,950 | 88.9 | 162,014 |
| ASEAN | 305,693 | 25.9 | 876,338 | 74.1 | 1,182,031 |

Source: Association of Southeast Asian Nations [109]

Table 14: Intra- and extra-ASEAN imports

| Country | Intra-ASEAN exports | | Extra-ASEAN exports | | Total (M USD) |
|---|---|---|---|---|---|
| | Value (M USD) | % share | Value (M USD) | % share | |
| Brunei | 1,239 | 19.5 | 5,114 | 80.5 | 6,354 |
| Cambodia | 819 | 9.3 | 8,019 | 90.7 | 8,839 |
| Indonesia | 33,577 | 22.3 | 116,789 | 77.7 | 150,366 |
| Lao PDR | 2,646 | 71.2 | 1,068 | 28.8 | 3,714 |
| Malaysia | 56,169 | 28.2 | 142,989 | 71.8 | 199,158 |
| Myanmar | 4,444 | 36.4 | 7,754 | 63.6 | 12,197 |
| Philippines | 8,537 | 14.6 | 50,112 | 85.4 | 58,648 |
| Singapore | 118,271 | 32.3 | 248,073 | 67.7 | 366,344 |
| Thailand | 61,926 | 28.9 | 152,470 | 71.1 | 214,396 |
| Vietnam | 18,064 | 11.1 | 143,950 | 88.9 | 162,014 |
| ASEAN | 305,693 | 25.9 | 876,338 | 74.1 | 1,182,031 |

Source: Association of Southeast Asian Nations [109]

# B

# Data on voting at the United Nations General Assembly

Legend:

| | |
|---|---|
| $s_i^1$ | Vote: Yes |
| $s_i^2$ | Abstention |
| $s_i^3$ | Vote: No |
| $s_i^8$ | Absence |

Table 15: Aggregate data on the votes of the USSR or Russia at the UNGA from 1946 to 2015

| Year | Country | Real $s_i^1$ | Exp. $s_i^1$ | Real $s_i^2$ | Exp. $s_i^2$ | Real $s_i^3$ | Exp. $s_i^3$ | Real $s_i^8$ | Exp. $s_i^8$ |
|---|---|---|---|---|---|---|---|---|---|
| 1946 | USSR/RU | 44.19% | 25.00% | 4.65% | 25.00% | 51.16% | 25.00% | 0.00% | 25.00% |
| 1947 | USSR/RU | 52.63% | 43.42% | 5.26% | 11.84% | 42.11% | 36.40% | 0.00% | 8.33% |
| 1948 | USSR/RU | 48.08% | 39.88% | 14.42% | 11.63% | 36.54% | 31.28% | 0.96% | 2.93% |
| 1949 | USSR/RU | 78.13% | 52.30% | 3.13% | 4.77% | 18.75% | 18.34% | 0.00% | 0.78% |
| 1950 | USSR/RU | 58.49% | 43.69% | 16.98% | 9.99% | 22.64% | 16.42% | 1.89% | 1.18% |
| 1951 | USSR/RU | 56.00% | 39.54% | 4.00% | 4.57% | 40.00% | 24.49% | 0.00% | 0.30% |
| 1952 | USSR/RU | 44.90% | 32.59% | 20.41% | 11.44% | 34.69% | 23.65% | 0.00% | 0.08% |
| 1953 | USSR/RU | 65.38% | 41.00% | 7.69% | 6.73% | 26.92% | 19.45% | 0.00% | 0.02% |
| 1954 | USSR/RU | 51.61% | 36.13% | 22.58% | 13.00% | 25.81% | 17.80% | 0.00% | 0.00% |
| 1955 | USSR/RU | 70.27% | 44.21% | 5.41% | 5.96% | 24.32% | 16.63% | 0.00% | 0.00% |

**Table 15 continued from previous page**

| Year | Country | Real $s_i^1$ | Exp. $s_i^1$ | Real $s_i^2$ | Exp. $s_i^2$ | Real $s_i^3$ | Exp. $s_i^3$ | Real $s_i^8$ | Exp. $s_i^8$ |
|---|---|---|---|---|---|---|---|---|---|
| 1956 | USSR/RU | 46.27% | 34.20% | 10.45% | 6.72% | 43.28% | 25.81% | 0.00% | 0.00% |
| 1957 | USSR/RU | 58.82% | 37.97% | 5.88% | 4.62% | 35.29% | 24.11% | 0.00% | 0.00% |
| 1958 | USSR/RU | 51.52% | 35.25% | 9.09% | 5.70% | 39.39% | 25.73% | 0.00% | 0.00% |
| 1959 | USSR/RU | 70.37% | 44.00% | 3.70% | 3.28% | 25.93% | 19.40% | 0.00% | 0.00% |
| 1960 | USSR/RU | 58.65% | 40.33% | 8.65% | 5.15% | 32.69% | 21.20% | 0.00% | 0.00% |
| 1961 | USSR/RU | 56.58% | 38.37% | 11.84% | 7.21% | 31.58% | 21.09% | 0.00% | 0.00% |
| 1962 | USSR/RU | 47.83% | 33.51% | 15.22% | 9.41% | 36.96% | 23.75% | 0.00% | 0.00% |
| 1963 | USSR/RU | 53.13% | 34.94% | 3.13% | 3.92% | 43.75% | 27.81% | 0.00% | 0.00% |
| 1964 | USSR/RU | 0.00% | 8.73% | 0.00% | 0.98% | 100.00% | 56.95% | 0.00% | 0.00% |
| 1965 | USSR/RU | 73.17% | 38.77% | 12.20% | 6.34% | 14.63% | 21.56% | 0.00% | 0.00% |
| 1966 | USSR/RU | 69.81% | 44.60% | 11.32% | 7.25% | 18.87% | 14.82% | 0.00% | 0.00% |
| 1967 | USSR/RU | 82.46% | 52.38% | 7.02% | 5.32% | 10.53% | 8.97% | 0.00% | 0.00% |
| 1968 | USSR/RU | 60.78% | 43.49% | 15.69% | 9.17% | 23.53% | 14.01% | 0.00% | 0.00% |
| 1969 | USSR/RU | 61.36% | 41.55% | 20.45% | 12.52% | 18.18% | 12.59% | 0.00% | 0.00% |
| 1970 | USSR/RU | 56.72% | 38.75% | 13.43% | 9.85% | 29.85% | 18.07% | 0.00% | 0.00% |
| 1971 | USSR/RU | 60.32% | 39.85% | 15.87% | 10.40% | 23.81% | 16.42% | 0.00% | 0.00% |
| 1972 | USSR/RU | 62.39% | 41.15% | 25.69% | 15.44% | 11.01% | 9.61% | 0.92% | 0.46% |

**Table 15 continued from previous page**

| Year | Country | Real $s_i^1$ | Exp. $s_i^1$ | Real $s_i^2$ | Exp. $s_i^2$ | Real $s_i^3$ | Exp. $s_i^3$ | Real $s_i^8$ | Exp. $s_i^8$ |
|---|---|---|---|---|---|---|---|---|---|
| 1973 | USSR/RU | 66.67% | 43.62% | 22.58% | 15.15% | 10.75% | 7.78% | 0.00% | 0.11% |
| 1974 | USSR/RU | 69.74% | 45.77% | 18.42% | 13.00% | 11.84% | 7.87% | 0.00% | 0.03% |
| 1975 | USSR/RU | 70.00% | 46.44% | 17.14% | 11.82% | 12.86% | 8.40% | 0.00% | 0.01% |
| 1976 | USSR/RU | 75.28% | 49.25% | 14.61% | 10.26% | 10.11% | 7.15% | 0.00% | 0.00% |
| 1977 | USSR/RU | 69.39% | 47.01% | 21.43% | 13.28% | 9.18% | 6.38% | 0.00% | 0.00% |
| 1978 | USSR/RU | 61.36% | 42.43% | 22.73% | 14.68% | 15.15% | 9.17% | 0.76% | 0.38% |
| 1979 | USSR/RU | 65.85% | 43.54% | 12.20% | 9.77% | 21.95% | 13.27% | 0.00% | 0.09% |
| 1980 | USSR/RU | 69.90% | 45.84% | 13.59% | 9.24% | 16.50% | 11.57% | 0.00% | 0.02% |
| 1981 | USSR/RU | 76.87% | 49.89% | 7.46% | 6.04% | 15.67% | 10.73% | 0.00% | 0.01% |
| 1982 | USSR/RU | 76.88% | 50.91% | 8.75% | 5.89% | 14.38% | 9.87% | 0.00% | 0.00% |
| 1983 | USSR/RU | 77.85% | 51.65% | 6.71% | 4.83% | 15.44% | 10.19% | 0.00% | 0.00% |
| 1984 | USSR/RU | 83.44% | 54.64% | 5.96% | 4.19% | 10.60% | 7.84% | 0.00% | 0.00% |
| 1985 | USSR/RU | 80.00% | 53.66% | 5.81% | 3.95% | 11.61% | 7.77% | 2.58% | 1.29% |
| 1986 | USSR/RU | 83.87% | 55.35% | 7.10% | 4.54% | 6.45% | 5.17% | 2.58% | 1.61% |
| 1987 | USSR/RU | 94.52% | 61.10% | 1.37% | 1.82% | 2.05% | 2.32% | 2.05% | 1.43% |
| 1988 | USSR/RU | 94.85% | 62.70% | 1.47% | 1.19% | 0.74% | 0.95% | 2.94% | 1.83% |
| 1989 | USSR/RU | 96.55% | 63.95% | 0.86% | 0.73% | 0.86% | 0.67% | 1.72% | 1.32% |

**Table 15 continued from previous page**

| Year | Country | Real $s_i^1$ | Exp. $s_i^1$ | Real $s_i^2$ | Exp. $s_i^2$ | Real $s_i^3$ | Exp. $s_i^3$ | Real $s_i^8$ | Exp. $s_i^8$ |
|---|---|---|---|---|---|---|---|---|---|
| 1990 | USSR/RU | 93.02% | 62.50% | 4.65% | 2.51% | 0.00% | 0.17% | 2.33% | 1.49% |
| 1991 | USSR/RU | 56.00% | 43.62% | 37.33% | 19.29% | 1.33% | 0.71% | 5.33% | 3.04% |
| 1992 | USSR/RU | 50.67% | 36.24% | 41.33% | 25.49% | 6.67% | 3.51% | 1.33% | 1.43% |
| 1993 | USSR/RU | 44.62% | 31.37% | 46.15% | 29.45% | 7.69% | 4.72% | 1.54% | 1.13% |
| 1994 | USSR/RU | 51.47% | 33.58% | 41.18% | 27.95% | 7.35% | 4.86% | 0.00% | 0.28% |
| 1995 | USSR/RU | 56.79% | 36.79% | 34.57% | 24.27% | 8.64% | 5.54% | 0.00% | 0.07% |
| 1996 | USSR/RU | 65.79% | 42.09% | 25.00% | 18.57% | 7.89% | 5.33% | 1.32% | 0.68% |
| 1997 | USSR/RU | 68.12% | 44.58% | 24.64% | 16.96% | 7.25% | 4.96% | 0.00% | 0.17% |
| 1998 | USSR/RU | 67.21% | 44.75% | 24.59% | 16.54% | 6.56% | 4.52% | 1.64% | 0.86% |
| 1999 | USSR/RU | 69.12% | 45.75% | 20.59% | 14.43% | 10.29% | 6.28% | 0.00% | 0.22% |
| 2000 | USSR/RU | 71.64% | 47.26% | 22.39% | 14.80% | 4.48% | 3.81% | 1.49% | 0.80% |
| 2001 | USSR/RU | 73.13% | 48.38% | 20.90% | 14.15% | 4.48% | 3.19% | 1.49% | 0.95% |
| 2002 | USSR/RU | 71.23% | 47.71% | 20.55% | 13.81% | 5.48% | 3.54% | 2.74% | 1.61% |
| 2003 | USSR/RU | 77.63% | 50.74% | 17.11% | 12.01% | 5.26% | 3.52% | 0.00% | 0.40% |
| 2004 | USSR/RU | 75.00% | 50.19% | 20.83% | 13.42% | 2.78% | 2.27% | 1.39% | 0.79% |
| 2005 | USSR/RU | 68.92% | 47.01% | 22.97% | 14.84% | 6.76% | 3.95% | 1.35% | 0.87% |
| 2006 | USSR/RU | 77.01% | 50.26% | 17.24% | 12.33% | 5.75% | 3.86% | 0.00% | 0.22% |

**Table 15 continued from previous page**

| Year | Country | Real $s_i^1$ | Exp. $s_i^1$ | Real $s_i^2$ | Exp. $s_i^2$ | Real $s_i^3$ | Exp. $s_i^3$ | Real $s_i^8$ | Exp. $s_i^8$ |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | USSR/RU | 70.13% | 47.63% | 18.18% | 12.17% | 10.39% | 6.16% | 1.30% | 0.70% |
| 2008 | USSR/RU | 71.23% | 47.52% | 24.66% | 15.37% | 4.11% | 3.59% | 0.00% | 0.18% |
| 2009 | USSR/RU | 69.57% | 46.66% | 21.74% | 14.71% | 8.70% | 5.25% | 0.00% | 0.04% |
| 2010 | USSR/RU | 73.13% | 48.23% | 20.90% | 14.13% | 5.97% | 4.30% | 0.00% | 0.01% |
| 2011 | USSR/RU | 70.77% | 47.44% | 20.00% | 13.53% | 9.23% | 5.69% | 0.00% | 0.00% |
| 2012 | USSR/RU | 69.12% | 46.42% | 20.59% | 13.68% | 10.29% | 6.57% | 0.00% | 0.00% |
| 2013 | USSR/RU | 65.63% | 44.42% | 20.31% | 13.58% | 14.06% | 8.67% | 0.00% | 0.00% |
| 2014 | USSR/RU | 62.96% | 42.59% | 22.22% | 14.51% | 12.35% | 8.34% | 2.47% | 1.23% |
| 2015 | USSR/RU | 58.90% | 40.10% | 19.18% | 13.22% | 21.92% | 13.04% | 0.00% | 0.31% |

Legend:

| | |
|---|---|
| $s_i^1$ | Vote: Yes |
| $s_i^2$ | Abstention |
| $s_i^3$ | Vote: No |
| $s_i^8$ | Absence |

Table 16: Aggregate data on the votes of the USA at the UNGA from 1946 to 2015

| Year | Country | Real $s_i^1$ | Exp. $s_i^1$ | Real $s_i^2$ | Exp. $s_i^2$ | Real $s_i^3$ | Exp. $s_i^3$ | Real $s_i^8$ | Exp. $s_i^8$ |
|---|---|---|---|---|---|---|---|---|---|
| 1946 | USA | 60.47% | 25.00% | 4.65% | 25.00% | 34.88% | 25.00% | 0.00% | 25.00% |
| 1947 | USA | 71.05% | 55.70% | 2.63% | 10.09% | 26.32% | 25.88% | 0.00% | 8.33% |
| 1948 | USA | 45.19% | 41.74% | 2.88% | 4.53% | 51.92% | 37.06% | 0.00% | 2.38% |
| 1949 | USA | 28.13% | 26.13% | 20.31% | 12.04% | 51.56% | 37.38% | 0.00% | 0.63% |
| 1950 | USA | 49.06% | 32.06% | 3.77% | 5.06% | 47.17% | 33.99% | 0.00% | 0.16% |
| 1951 | USA | 40.00% | 28.46% | 16.00% | 9.41% | 44.00% | 30.98% | 0.00% | 0.04% |
| 1952 | USA | 51.02% | 32.88% | 10.20% | 7.51% | 38.78% | 27.35% | 0.00% | 0.01% |
| 1953 | USA | 50.00% | 33.35% | 26.92% | 15.40% | 23.08% | 18.45% | 0.00% | 0.00% |
| 1954 | USA | 61.29% | 39.06% | 29.03% | 18.40% | 9.68% | 9.47% | 0.00% | 0.00% |

**Table 16 continued from previous page**

| Year | Country | Real $s_i^1$ | Exp. $s_i^1$ | Real $s_i^2$ | Exp. $s_i^2$ | Real $s_i^3$ | Exp. $s_i^3$ | Real $s_i^8$ | Exp. $s_i^8$ |
|---|---|---|---|---|---|---|---|---|---|
| 1955 | USA | 62.16% | 40.89% | 16.22% | 12.72% | 21.62% | 13.19% | 0.00% | 0.00% |
| 1956 | USA | 76.12% | 48.30% | 7.46% | 6.92% | 16.42% | 11.51% | 0.00% | 0.00% |
| 1957 | USA | 64.71% | 44.44% | 14.71% | 9.08% | 20.59% | 13.18% | 0.00% | 0.00% |
| 1958 | USA | 75.76% | 48.99% | 12.12% | 8.33% | 12.12% | 9.36% | 0.00% | 0.00% |
| 1959 | USA | 42.59% | 33.55% | 25.93% | 15.05% | 31.48% | 18.08% | 0.00% | 0.00% |
| 1960 | USA | 51.92% | 34.35% | 13.46% | 10.49% | 34.62% | 21.83% | 0.00% | 0.00% |
| 1961 | USA | 50.00% | 33.59% | 14.47% | 9.86% | 34.21% | 22.56% | 1.32% | 0.66% |
| 1962 | USA | 60.87% | 38.83% | 10.87% | 7.90% | 28.26% | 19.77% | 0.00% | 0.16% |
| 1963 | USA | 50.00% | 34.71% | 31.25% | 17.60% | 18.75% | 14.32% | 0.00% | 0.04% |
| 1964 | USA | 0.00% | 8.68% | 0.00% | 4.40% | 100.00% | 53.58% | 0.00% | 0.01% |
| 1965 | USA | 36.59% | 20.46% | 26.83% | 14.51% | 36.59% | 31.69% | 0.00% | 0.00% |
| 1966 | USA | 41.51% | 25.87% | 20.75% | 14.01% | 37.74% | 26.79% | 0.00% | 0.00% |
| 1967 | USA | 29.82% | 21.38% | 24.56% | 15.78% | 45.61% | 29.50% | 0.00% | 0.00% |
| 1968 | USA | 35.29% | 22.99% | 21.57% | 14.73% | 43.14% | 28.94% | 0.00% | 0.00% |
| 1969 | USA | 36.36% | 23.93% | 20.45% | 13.91% | 40.91% | 27.69% | 2.27% | 1.14% |
| 1970 | USA | 46.27% | 29.12% | 19.40% | 13.18% | 34.33% | 24.09% | 0.00% | 0.28% |
| 1971 | USA | 47.62% | 31.09% | 30.95% | 18.77% | 20.63% | 16.34% | 0.79% | 0.47% |

**Table 16 continued from previous page**

| Year | Country | Real $s_i^1$ | Exp. $s_i^1$ | Real $s_i^2$ | Exp. $s_i^2$ | Real $s_i^3$ | Exp. $s_i^3$ | Real $s_i^8$ | Exp. $s_i^8$ |
|---|---|---|---|---|---|---|---|---|---|
| 1972 | USA | 44.04% | 29.79% | 34.86% | 22.12% | 19.27% | 13.72% | 1.83% | 1.03% |
| 1973 | USA | 31.18% | 23.04% | 36.56% | 23.81% | 32.26% | 19.56% | 0.00% | 0.26% |
| 1974 | USA | 35.53% | 23.52% | 35.53% | 23.72% | 28.95% | 19.36% | 0.00% | 0.06% |
| 1975 | USA | 28.57% | 20.17% | 41.43% | 26.64% | 30.00% | 19.84% | 0.00% | 0.02% |
| 1976 | USA | 22.47% | 16.28% | 43.82% | 28.57% | 31.46% | 20.69% | 2.25% | 1.13% |
| 1977 | USA | 40.82% | 24.48% | 36.73% | 25.51% | 21.43% | 15.89% | 1.02% | 0.79% |
| 1978 | USA | 40.15% | 26.20% | 33.33% | 23.04% | 24.24% | 16.09% | 2.27% | 1.33% |
| 1979 | USA | 30.08% | 21.59% | 32.52% | 22.02% | 36.59% | 22.32% | 0.81% | 0.74% |
| 1980 | USA | 26.21% | 18.50% | 33.01% | 22.01% | 40.78% | 25.97% | 0.00% | 0.19% |
| 1981 | USA | 17.16% | 13.21% | 28.36% | 19.68% | 53.73% | 33.36% | 0.75% | 0.42% |
| 1982 | USA | 15.63% | 11.11% | 25.00% | 17.42% | 59.38% | 38.03% | 0.00% | 0.10% |
| 1983 | USA | 15.44% | 10.50% | 24.83% | 16.77% | 59.73% | 39.37% | 0.00% | 0.03% |
| 1984 | USA | 10.60% | 7.92% | 24.50% | 16.44% | 64.90% | 42.29% | 0.00% | 0.01% |
| 1985 | USA | 14.84% | 9.40% | 23.87% | 16.05% | 59.35% | 40.25% | 1.94% | 0.97% |
| 1986 | USA | 16.13% | 10.41% | 21.29% | 14.66% | 60.65% | 40.39% | 1.94% | 1.21% |
| 1987 | USA | 12.33% | 8.77% | 26.71% | 17.02% | 57.53% | 38.86% | 3.42% | 2.01% |
| 1988 | USA | 9.56% | 6.97% | 25.74% | 17.12% | 62.50% | 40.97% | 2.21% | 1.61% |

**Table 16 continued from previous page**

| Year | Country | Real $s_i^1$ | Exp. $s_i^1$ | Real $s_i^2$ | Exp. $s_i^2$ | Real $s_i^3$ | Exp. $s_i^3$ | Real $s_i^8$ | Exp. $s_i^8$ |
|---|---|---|---|---|---|---|---|---|---|
| 1989 | USA | 8.62% | 6.05% | 25.86% | 17.21% | 63.79% | 42.14% | 1.72% | 1.26% |
| 1990 | USA | 15.12% | 9.07% | 18.60% | 13.61% | 63.95% | 42.51% | 2.33% | 1.48% |
| 1991 | USA | 14.67% | 9.60% | 20.00% | 13.40% | 61.33% | 41.29% | 4.00% | 2.37% |
| 1992 | USA | 21.33% | 13.07% | 18.67% | 12.68% | 58.67% | 39.66% | 1.33% | 1.26% |
| 1993 | USA | 21.54% | 14.04% | 23.08% | 14.71% | 53.85% | 36.84% | 1.54% | 1.08% |
| 1994 | USA | 33.82% | 20.42% | 16.18% | 11.77% | 50.00% | 34.21% | 0.00% | 0.27% |
| 1995 | USA | 27.16% | 18.69% | 13.58% | 9.73% | 59.26% | 38.18% | 0.00% | 0.07% |
| 1996 | USA | 34.21% | 21.78% | 15.79% | 10.33% | 50.00% | 34.55% | 0.00% | 0.02% |
| 1997 | USA | 28.99% | 19.94% | 17.39% | 11.28% | 53.62% | 35.45% | 0.00% | 0.00% |
| 1998 | USA | 24.59% | 17.28% | 18.03% | 11.84% | 57.38% | 37.55% | 0.00% | 0.00% |
| 1999 | USA | 23.53% | 16.08% | 19.12% | 12.52% | 57.35% | 38.06% | 0.00% | 0.00% |
| 2000 | USA | 23.88% | 15.96% | 20.90% | 13.58% | 55.22% | 37.13% | 0.00% | 0.00% |
| 2001 | USA | 16.42% | 12.20% | 19.40% | 13.10% | 64.18% | 41.37% | 0.00% | 0.00% |
| 2002 | USA | 16.44% | 11.27% | 13.70% | 10.12% | 69.86% | 45.27% | 0.00% | 0.00% |
| 2003 | USA | 17.11% | 11.37% | 10.53% | 7.79% | 72.37% | 47.50% | 0.00% | 0.00% |
| 2004 | USA | 15.28% | 10.48% | 12.50% | 8.20% | 72.22% | 47.99% | 0.00% | 0.00% |
| 2005 | USA | 16.22% | 10.73% | 8.11% | 6.10% | 74.32% | 49.16% | 1.35% | 0.68% |

**Table 16 continued from previous page**

| Year | Country | Real $s_i^1$ | Exp. $s_i^1$ | Real $s_i^2$ | Exp. $s_i^2$ | Real $s_i^3$ | Exp. $s_i^3$ | Real $s_i^8$ | Exp. $s_i^8$ |
|---|---|---|---|---|---|---|---|---|---|
| 2006 | USA | 11.49% | 8.43% | 12.64% | 7.85% | 75.86% | 50.22% | 0.00% | 0.17% |
| 2007 | USA | 11.69% | 7.95% | 10.39% | 7.16% | 77.92% | 51.52% | 0.00% | 0.04% |
| 2008 | USA | 12.33% | 8.15% | 9.59% | 6.58% | 78.08% | 51.92% | 0.00% | 0.01% |
| 2009 | USA | 18.84% | 11.46% | 15.94% | 9.62% | 65.22% | 45.59% | 0.00% | 0.00% |
| 2010 | USA | 16.42% | 11.07% | 16.42% | 10.61% | 65.67% | 44.23% | 1.49% | 0.75% |
| 2011 | USA | 26.15% | 15.85% | 12.31% | 8.81% | 61.54% | 41.83% | 0.00% | 0.19% |
| 2012 | USA | 19.12% | 13.52% | 14.71% | 9.55% | 66.18% | 43.55% | 0.00% | 0.05% |
| 2013 | USA | 20.31% | 13.54% | 10.94% | 7.86% | 68.75% | 45.26% | 0.00% | 0.01% |
| 2014 | USA | 23.46% | 15.11% | 12.35% | 8.14% | 62.96% | 42.80% | 1.23% | 0.62% |
| 2015 | USA | 23.29% | 15.42% | 13.70% | 8.88% | 63.01% | 42.21% | 0.00% | 0.16% |

Table 17: Success rate and relative power of the USA and the USSR or Russia (two-player game) at the UNGA from 1946 to 2015

| Year | USSR/Russia: Success rate | USSR/Russia: Relative Power | USA: Success rate | USA: Relative Power |
|---|---|---|---|---|
| 1946 | 50.00% | 50.00% | 50.00% | 50.00% |
| 1947 | 29.82% | 35.42% | 54.39% | 64.58% |
| 1948 | 22.26% | 27.79% | 57.85% | 72.21% |
| 1949 | 31.40% | 37.15% | 53.14% | 62.86% |
| 1950 | 28.79% | 30.41% | 65.87% | 69.59% |
| 1951 | 40.12% | 42.76% | 53.72% | 57.24% |
| 1952 | 37.07% | 38.53% | 59.13% | 61.47% |
| 1953 | 55.00% | 51.22% | 52.39% | 48.78% |
| 1954 | 58.04% | 53.58% | 50.28% | 46.42% |
| 1955 | 62.75% | 52.17% | 57.53% | 47.83% |
| 1956 | 49.25% | 40.36% | 72.77% | 59.64% |
| 1957 | 48.14% | 39.22% | 74.61% | 60.78% |
| 1958 | 45.28% | 35.79% | 81.23% | 64.21% |
| 1959 | 48.56% | 40.56% | 71.17% | 59.44% |

**Table 17 continued from previous page**

| Year | USSR/Russia: Success rate | USSR/Russia: Relative Power | USA: Success rate | USA: Relative Power |
|---|---|---|---|---|
| 1960 | 47.84% | 40.69% | 69.72% | 59.31% |
| 1961 | 46.94% | 41.40% | 66.44% | 58.60% |
| 1962 | 48.47% | 44.09% | 61.48% | 55.91% |
| 1963 | 46.11% | 43.93% | 58.86% | 56.07% |
| 1964 | 23.06% | 43.93% | 29.43% | 56.07% |
| 1965 | 49.33% | 57.36% | 36.67% | 42.64% |
| 1966 | 55.80% | 56.02% | 43.81% | 43.98% |
| 1967 | 65.62% | 62.46% | 39.45% | 37.54% |
| 1968 | 60.26% | 61.72% | 37.37% | 38.28% |
| 1969 | 61.95% | 64.17% | 34.59% | 35.83% |
| 1970 | 59.33% | 59.92% | 39.69% | 40.08% |
| 1971 | 62.60% | 58.92% | 43.65% | 41.08% |
| 1972 | 62.49% | 59.02% | 43.39% | 40.98% |
| 1973 | 63.51% | 63.35% | 36.75% | 36.65% |
| 1974 | 65.31% | 63.55% | 37.45% | 36.45% |
| 1975 | 67.65% | 67.21% | 33.01% | 32.79% |
| 1976 | 71.47% | 72.04% | 27.74% | 27.96% |

**Table 17 continued from previous page**

| Year | USSR/Russia: Success rate | USSR/Russia: Relative Power | USA: Success rate | USA: Relative Power |
|---|---|---|---|---|
| 1977 | 70.43% | 67.26% | 34.28% | 32.74% |
| 1978 | 65.90% | 64.14% | 36.84% | 35.86% |
| 1979 | 65.87% | 66.32% | 33.46% | 33.68% |
| 1980 | 67.89% | 69.47% | 29.84% | 30.53% |
| 1981 | 72.38% | 75.49% | 23.50% | 24.51% |
| 1982 | 74.63% | 79.23% | 19.56% | 20.77% |
| 1983 | 76.24% | 81.33% | 17.50% | 18.67% |
| 1984 | 79.84% | 85.04% | 14.05% | 14.96% |
| 1985 | 79.92% | 84.69% | 14.44% | 15.31% |
| 1986 | 81.90% | 84.27% | 15.29% | 15.73% |
| 1987 | 88.21% | 86.47% | 13.81% | 13.53% |
| 1988 | 91.53% | 88.68% | 11.68% | 11.32% |
| 1989 | 94.04% | 90.26% | 10.15% | 9.74% |
| 1990 | 93.53% | 88.10% | 12.63% | 11.90% |
| 1991 | 74.77% | 84.56% | 13.65% | 15.44% |
| 1992 | 63.38% | 79.02% | 16.83% | 20.98% |
| 1993 | 55.54% | 74.33% | 19.18% | 25.67% |

**Table 17 continued from previous page**

| Year | USSR/Russia: Success rate | USSR/Russia: Relative Power | USA: Success rate | USA: Relative Power |
|---|---|---|---|---|
| 1994 | 52.77% | 67.83% | 25.03% | 32.17% |
| 1995 | 55.40% | 68.50% | 25.48% | 31.50% |
| 1996 | 59.94% | 67.25% | 29.19% | 32.75% |
| 1997 | 63.30% | 69.06% | 28.36% | 30.94% |
| 1998 | 65.26% | 71.14% | 26.48% | 28.86% |
| 1999 | 67.19% | 72.88% | 25.00% | 27.12% |
| 2000 | 69.41% | 73.96% | 24.44% | 26.04% |
| 2001 | 72.02% | 77.90% | 20.43% | 22.10% |
| 2002 | 71.63% | 79.53% | 18.43% | 20.47% |
| 2003 | 73.97% | 81.21% | 17.11% | 18.79% |
| 2004 | 74.49% | 82.14% | 16.19% | 17.86% |
| 2005 | 71.70% | 81.57% | 16.21% | 18.43% |
| 2006 | 73.21% | 83.00% | 15.00% | 17.00% |
| 2007 | 71.67% | 85.61% | 12.05% | 14.39% |
| 2008 | 70.77% | 85.31% | 12.19% | 14.69% |
| 2009 | 70.17% | 82.59% | 14.79% | 17.41% |
| 2010 | 71.65% | 82.83% | 14.86% | 17.17% |

**Table 17 continued from previous page**

| Year | USSR/Russia: Success rate | USSR/Russia: Relative Power | USA: Success rate | USA: Relative Power |
|---|---|---|---|---|
| 2011 | 71.21% | 77.64% | 20.51% | 22.36% |
| 2012 | 70.90% | 78.16% | 19.81% | 21.84% |
| 2013 | 68.26% | 77.98% | 19.28% | 22.02% |
| 2014 | 65.61% | 75.97% | 20.75% | 24.03% |
| 2015 | 62.26% | 73.87% | 22.02% | 26.13% |

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