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## Currency Wars: The Lack of a Global Monetary System.

By

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### **Abstract**

The meaning of a currency war and its consequences is a topic of hot speculation at every trading desk around the world. This master thesis studies the different currency wars in the twentieth century to propose, infer and test a game theoretical framework, to forecast potential scenarios in the current currency war. The philosophy of this study is not to predict who will be the winners of a currency war, but to understand the rules of the “game”.

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# Introduction

What if you begin your day paying twice the amount for fuel as you usually pay? What if on the same day you notice that your pension savings are gone? What if in a different scenario your investment portfolio in equity is skyrocketing, while the prices of natural resources are collapsing? In both cases, you learn about revolutions or wars in the world. How can these scenarios be related?

Even if a currency war seems to be only a matter of -exporters, central banks, asset managers or hedge funds-, it is also relevant for every single citizen in the world. It can affect the American family when the price of fuel is high. It hurts the security of the people in the Middle East, Ukraine or Venezuela when energy prices go down. It affects the confidence of Europeans in their own currency when their economic asymmetries are more important than Russian geopolitical escalations. It is troublesome for the Japanese taxpayer, when a triple digit debt over gross domestic product, along with fossil energy dependency<sup>1</sup>, could trigger doubts about the Japanese Yen reserve status.

Furthermore, a global currency war also undermines the Chinese people's savings because their trade surplus is in a reserve currency backed by countries with high indebtedness and unemployment rates; US, Eurozone and Japan<sup>2</sup>.

The conflict of economic interests in a currency war also affects geopolitics, therefore the peace and security of everybody in the world. This is the case when geopolitical powers prefer war and military escalations as a way to gain a competitive advantage, rather than coordinated structural reforms able to foster technological spillovers.

There are two contradictory theoretical approaches explaining a currency war. The first focuses on competitive currency devaluations with the aim of boosting exports. This view is centered on the competition for global trade dominance in a zero sum game. The second is about central banks' monetary coordination spillovers. That means, every developed country is better off by adding liquidity into the system simultaneously after a global economic crisis. Stimulus in consumption and investments are necessary until the emergence of a new technological revolution able to sustain coordinated global growth.

These two strategic situations resemble two dilemmas widely studied in game theory. They are known as the prisoner's dilemma (loss-loss situation) and the Rousseau Stag Hunt dilemma (win-win coordination problem). I assume these views are the beginning and the end of a currency war. In fact, I define the beginning of a currency war with the collapse of an international monetary standard caused by a global economic crisis (loss-loss scenario). I define the ending

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<sup>1</sup>Since the Fukushima tragedy in 2011 Japan is running a trade deficit. The shutdown of nuclear plants have increased the fossil energy imports.

<sup>2</sup>When a national currency also serves as a world reserve currency there is a conflict of economic interests that arises between short-term domestic and long-term international objectives. This is known as the Triffin dilemma. For example, it is rational for policy makers in these countries to prefer monetary easing policies such as: negative real interest rates or quantitative easing over policies focused on the stability of the international monetary system.

by the establishment of a new international monetary standard that reflects a new hierarchy of geopolitical power. Indeed, I forecast that this new hierarchy of geopolitical powers is backed by a technological revolution able to sustain coordinated global growth.

There have been three currency wars in the twentieth century. The first currency war began with the panic of 1907 along with the collapse of the gold standard in 1913. It ended with the Bretton Woods standard in 1945 along with a new hierarchy of geopolitical power. This new hierarchy was backed by a technological revolution in the automobile, petrochemical and electricity industries. The second currency war began with the collapse of the Bretton Woods Standard in 1971 along with the oil crisis in 1973. It ended with the failure of the European Exchange Mechanism and the collapse of the Soviet Union. This new hierarchy of geopolitical power was backed by a technological revolution in microprocessors, telecommunications and pharmaceutical industry. The third currency war began in 1997 with the Asian, Russian and dot-com crisis along with the emergence of the Euro as a challenger to the US dollar hegemony. I claim that this currency war will end with a new international monetary standard along with a new hierarchy of geopolitical power. Indeed, a new technological revolution would back this new hierarchy of power.

The added value of this master thesis is to study the intermediate strategic situations throughout the dynamics of a currency war. The potential moves governments / central banks can make after an economic crisis hits and how these moves influence the outcome of the currency war.

*“The linguist Noam Chomsky once suggested that our ignorance can be divided in problems and mysteries. When we face a problem, we may not know its solution, but we have insight, increasing knowledge, and an inkling of what we are looking for. When we face a mystery, however, we can only stare in wonder and bewilderment, not knowing what an explanation would even look like [1]”*

If a currency war is a well defined problem, no serious statistical analysis could be based only on three samples. However, a currency war is an ill defined problem. The two theories trying to explain them, competitive currencies devaluation and monetary coordination spillovers, are contradictory. In fact, they are more a mystery than a problem. Therefore, the focus of this thesis is not on predicting with statistical precision the length of the phases of a currency war. Neither, to determine the spectral features of their cycles. My focus is on identifying a valid set of assumptions to understand the rules of the game. That means, how game-changing geopolitical and economic events transforms the strategic confrontation between geopolitical powers. Moreover, to gain an insight about how geopolitical and economic strategies can create regime-shifts in the stocks and commodities markets prices during a currency war. The goal is to upgrade this mystery to the level of a problem where a more scientific approach could be developed in the future.

I compared the study of currency wars with the study of the world chess championships. Imagine you have access to a database with the length of matches, the duration of the opening, middle and the end game and you have to predict who will win the game between two top masters. It is possible to run a study about the mean duration and the different statistical moments in every championship. Moreover, you can build some hypothetical payoff function based on the value of the pieces and some positional utility function and then to find the spectral features of the cycles and perhaps some nice econometrical regressions. However, your ability to understand the game will not improve with this analysis. Furthermore, if you bet for who will be the next world champion based on this analysis, you probably lost the point of what chess is about. In chess, first you have to figure out what are the rules of the game and then go deep into the master matches to get an understanding about the opening, the middle and end game. Moreover, if you already understand the rules, you have enough computer power to analyze and store patterns along with a team of clever computer programmers fully committed to chase Kasparov, it is

possible to program a world chess champion<sup>3</sup>.

Similarly to the study of the matches of chess-masters like Capablanca, Alekhine or Fisher, this master thesis uses history and game theory as a framework to understand the different phases of a currency war.

In fact, I have identified three phases. The first (opening) occurs when governments and central banks are focused on alleviating unemployment after a deep global economic crisis. They use monetary policy and protectionism strategies. In the second phase (middle game) policy makers are focused on geopolitical coalitions and (proxy) war strategies in order to get access to strategic natural resources. The third phase (end game) is characterized by structural reforms, revolutions and the dissolution of geopolitical coalitions in order to ensure global competitiveness.

The change between the phases reflects a transition between the strategic situations inside a currency war. Sometimes, this new strategic configuration could be critical and highly ambiguous. Therefore, they are very difficult to price by financial markets. In fact, It causes high volatility in the returns of equity and commodities prices.

This thesis is structured as follows. Chapter 1 presents a brief introduction to game theory and to the payoff permutation framework to build the rules of the currency war model. Chapter 2 defines the rules of the game and develops the game-theoretical framework. The goal is to show the mapping between geopolitical and economic strategies into game's payoffs permutations. Chapter 3 uses CW I in order to infer the framework and the payoff function . In Chapter 4 I test the framework developed in Chapter 3 by applying it to Currency War II. Chapter 5 uses the framework to forecast potential scenarios in the current Currency War III. Finally, Chapter 6 shows the conclusions and the limitations of the framework. It also shows two future research directions.

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<sup>3</sup>On may 11, 1997 the chess grandmaster Garry Kasparov resigns after 19 moves in a game against Deep Blue, a chess-playing computer developed by scientists at IBM. This was the sixth and final game of their match, which Kasparov lost two games to one, with three draws.

# Abbreviations and Glossary

## Abbreviations and acronyms:

- **ASEAN:** Association of Southeast Asian Nations.
- **BoJ:** Bank of Japan
- **CW I:** Currency War I.
- **CW II:** Currency War II.
- **CW III:** Currency War II.
- **Dow Jones:** Dow Jones Industrial Index.
- **ECB:** European Central Bank.
- **ERM:** European Exchange Rate Mechanism.
- **FED:** United States Federal Reserve Bank.
- **Germ. & France:** Germany and France. Bloc in currency war II.
- **IMF:** International Monetary Fund.
- **MNC:** Multinational Company
- **NATO:** North Atlantic Treaty Organization.
- **OPEC:** Organization of the Petroleum Exporting Countries.
- **P/E:** Price Earnings Ratio.
- **PD:** Prisoner's dilemma.
- **PBoC:** People Bank of China.
- **UK:** The United Kingdom.
- **UK&France:** Coalition in Currency War I.
- **UN:** The United Nations.
- **US:** The United States.
- **USD:** The United States Dollar.

- **USSR:** Union Soviet Socialist Republics.
- **US&UK:** The United States and the United Kingdom. Coalition in Currency War II.
- **RSH:** Rousseau Stag-Hunt dilemma.
- **R&D:** Research & Development
- **S&P 500:** Standard & Poor's 500 Index.
- **SOE:** State Owned Enterprise.
- **WWI:** World War I.
- **WWII:** World War II.

## Definitions:

- **Autocracy:** refers to a system of government in which a supreme power is concentrated in the hands of one person, whose decisions are subject to neither external legal restraints nor regularized mechanisms of popular control.
- **Bretton Woods Standard:** it refers monetary management established the rules for commercial and financial relations among the world's major industrial states in the mid-20th century. The Bretton Woods system was the first example of a fully negotiated monetary order intended to govern monetary relations among independent nation-states.
- **Business Cycle:** it refers to fluctuations in aggregate production, trade and activity over several months or years in a market economy
- **Cold War:** It was a state of political and military tension after World War II between powers in the Western Bloc (the United States, its NATO allies and others) and powers in the Eastern Bloc (the Soviet Union and its allies in the Warsaw Pact).
- **Currency War:** The lack of an international monetary system. The most used definition is competitive currency devaluations. This definition is misleading because in a currency it possible to have other strategic configurations such as monetary coordination spillovers. Moreover, devaluations or monetary policy is just one sort of strategies a geopolitical power could use in a currency war.
- **Deflation:** It is a decrease in the general price level of goods and services. Deflation occurs when the inflation rate falls below 0% (a negative inflation rate).
- **Gold Standard:** it is a monetary system in which the standard economic unit of account is based on a fixed quantity of gold.
- **Governance mechanisms:** it is the explicit or implicit contractual framework including states, markets, firms, and mixed modes within which a transaction is located.
- **Inflation:** it is a sustained increase in the general price level of goods and services in an economy over a period of time.
- **Stagflation:** it describes a situation where the inflation rate is high, the economic growth rate slows down, and unemployment remains steadily high.

- **Hyperinflation:** it occurs when a country experiences very high and usually accelerating rates of inflation, rapidly eroding the real value of the local currency, and causing the population to minimize their holdings of the local money.
- **Monetary easing:** It is a course of action undertaken to reduce interest rates and boost money supply as a means to stimulate economic activity.
- **Monetary tightening:** It is a course of action undertaken by a central bank to constrict spending in an economy that is seen to be growing too quickly, or to curb inflation when it is rising too fast.
- **Nash bargaining solution:** It is solution concept in cooperative game theory when 1)there is a conflict of interest about agreements 2)Individuals have the possibility of concluding a mutually beneficial agreement 3) No agreement may be imposed on any individual without his approval.
- **Potential Output:** refers to the highest level of real Gross Domestic Product output that can be sustained over the long term.
- **Petrodollar:** it refers to United States dollars earned through the sale by a country of its petroleum (oil) to another country.
- **Quantitative easing:** it is an unconventional monetary policy used by central banks to stimulate the economy when standard monetary policy has become ineffective. A central bank implements quantitative easing by buying specified amounts of financial assets from commercial banks and other private institutions, thus raising the prices of those financial assets and lowering their yield, while simultaneously increasing the monetary base.
- **Structural reforms:** It means changes to the economic-governmental structure. Examples: The Roosevelt new deal , Reagan-Tatcher reforms.
- **Technological revolutions:** It is an era of an accelerated technological progress characterized not only by new innovations but also their application and diffusion.
- **Transaction costs:** it is the cost incurred in making an economic exchange e.g: contractual costs, trading costs

# Chapter 1

## Theoretical review

This chapter introduces the theoretical elements of game theory employed in this thesis. Section 1.1 describes the basic concepts of game theory. Section 1.2 presents the two main macroeconomic approaches to understand currency wars, and shows the equivalence of these macro views with the prisoner's dilemma and the Rousseau stag-hunt dilemma.

### 1.1 Game theory

Game theory models strategic confrontations where each player tries to get the maximum payoff, knowing that the other player will also try to do the same. Typically, a game is defined by four elements:

1. **Players.** They are the decision makers. They can be people, governments, companies. In the case of the currency wars the most important decision makers are governments and central banks. In general players are defined as a finite and countable set of the form  $\{1, 2, \dots, i\}$ .
2. **Actions.** They are the possible set of decisions a player could make. In general actions are defined by a finite countable set of strategies of the form  $\{a_1, a_2, \dots, a_i \dots a_n\}$ . In the context of a currency war they can be whether to devalue or not their currency.
3. **Payoffs.** It is what motivates the players. Do they care about economic growth? Do they care about inflation? Do they care about other players? The general way to quantify what motivates players is by means of a utility function. Utilities' values are derived from playing a particular set of strategies. For example the utility for player one playing strategy  $a_i$  given that player two is playing  $a_j$  is  $u_1(a_i, a_j)$ .
4. **Beliefs.** They are the ranking of preferences for every player. For example, player 1 prefers the strategies with the lowest subindex  $b_1 = \{a_1 \succ a_2 \succ a_i \dots \succ a_n\}$  while player two the strategies with the highest subindex  $b_2 = \{a_n \succ a_{n-1} \succ a_i \dots \succ a_1\}$

The power of game theory lays on the existence of different solution concepts and methodologies. For competitive game theory, namely settings in which cooperation is not modeled, it is known that there is always at least one solution for strategic situations, which comprises possibly randomize strategies. This solution is known as the Nash equilibrium.

*“A Nash equilibrium is a solution concept of non-cooperative games involving two or more players, in which each player is assumed to know the equilibrium strategies of the other players,*

and no player has anything to gain by changing only their own strategy unilaterally”[2].<sup>1</sup>

### 1.1.1 Game-changing strategies

In addition to the previous concepts, I will use the notion of *Game-changing strategies*. Game-changing strategies are actions able to change the players’ beliefs in the game. They can be signals, communication mechanisms, options outside the initial setting of the game or institutional transformations. These strategies can be represented by a permutation in the ranking of preferences. For example, by using communication mechanisms a player could convince other to change the order of his preferences. In the context of a currency war these game changing strategies can be monetary policy, trade barriers, wars, structural reforms, coalitions or revolutions.

The use game-changing strategies is illustrated by an episode of the famous English show Golden Balls<sup>2</sup>, in which two players face prisoner’s dilemma situation. This makes reference to a situation where two members of a criminal gang are arrested and imprisoned. Each prisoner is in solitary confinement with no means of speaking to or exchanging messages with the other. The police admit they don’t have enough evidence to convict the pair on the principal charge. They plan to sentence both to a year in prison on a lesser charge. Simultaneously, the police offer each prisoner a Faustian bargain. Each prisoner is given the opportunity either to betray the other, by testifying that the other committed the crime, or to cooperate with the other by remaining silent. Here’s how it goes: If A and B both betray the other, each of them serves 2 years in prison. If A betrays B but B remains silent, A will be set free and B will serve 3 years in prison (and vice versa). If A and B both remain silent, both of them will only serve 1 year in prison (on the lesser charge)<sup>3</sup>. In the TV show both players have together 13.600 pounds. They have two options; either they split the price in equal parts (*Sp*) or they steal the total prize(*St*). However, if both steal the prize they will finish the game with nothing.

Table 1.1a shows the golden’s ball episode initial setting. The *left player’s* preferences are  $\{StSp \succ SpSp \succ StSt \succeq SpSt\}$ . The *right player’s* are  $\{SpSt \succ SpSp \succ StSt \succeq StSp\}$ .

There are two solutions for this dilemma: the Pareto optimal<sup>4</sup> -every player split the price and they go home with half of the prize-. Or, the Nash Equilibrium -they follow a self interested logic. They do not trust each other going home with nothing-

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<sup>1</sup>Formally stated, let  $A_i$  be the set of all possible strategies for player  $i$ , and the set of all strategies played all players excluding player  $i$ . The strategy  $a_i \in A_i$  is a best response to the strategies  $a_{-i} \in A_{-i}$  played by the other players in the game if the utility  $u_i(a_i, a_{-i}) \geq u_i(a'_i, a_{-i})$  for all  $a'_i \in A_i$ . Let be  $B_i(a_{-i}) \in A_i$  the set of player’s  $i$ ’s best response action against  $a_{-i}$ .  $a^* = (a_1^* \dots a_n^*)$  A is a Nash Equilibrium if  $a_i^* \in B_i(a_{-i}^*)$  for every  $i \in N$ .

<sup>2</sup><http://www.youtube.com/watch?v=S0qjK3TWZE8>

<sup>3</sup>[http://en.wikipedia.org/wiki/Prisoner's\\_dilemma](http://en.wikipedia.org/wiki/Prisoner's_dilemma)

<sup>4</sup>Pareto optimality, is a state of allocation of resources in which it is impossible to make any one individual better off without making at least one individual worse off.



Left /Right	Split ( $Sp$ )	Steal ( $St$ )
Split ( $Sp$ )	6800 , 6800	0, 13.600
Steal ( $St$ )	13.600, 0	0, 0

(a) Golden balls's episode original setting

Left /Right	Split ( $Sp$ )	Steal ( $St$ )
Split ( $Sp$ )	6800 , 6800	6800, 6800
Steal ( $St$ )	13600, 0	0, 0

(b) New game proposed by the *right player*

Table 1.1: Golden balls games



Figure 1.1: Golden balls episode where a prisoner's dilemma is solved by game-changing strategies.

However, the *right player* was able to change the game. He created a permutation of the players preferences by giving a clear signal that he will steal independent of what the *left player* does. Moreover, he also promised to split the money after the TV show ends. This apparent “weird” behavior was indeed a way to permute the payoffs of the games. In particular, the combination between signals and the option outside the initial game setting changed the preferences for the *left player* as follows  $\{StSp \succ SpSp \succeq SpSt \succ StSt\}$ . Additionally, he changed his own preferences as follows  $\{SpSt \succeq SpSp \succ StSt \succ StSp\}$ . Table 1.1b shows the new game proposed by the *right player*. At the end, the game finishes with a happy and emotional (Split, Split) outcome.

### 1.1.2 The class of 2X2 games

A 2X2 game is the minimal representation of a strategic confrontation. The strategic situation involves only two players– Row’s and Column’s– each with only two alternatives– cooperate (C) or defeat (D)–. There are only four possible outcomes and each outcome is described by a single payoff for each player, thus, a game is fully described by 8 numbers.

The most common representation of an ordinal game is in the strategy space by means of a bimatrix. The bimatrix is filled by a payoff function that assigns a number from the payoff set  $\{1, 2, 3, 4\}$  to every strategy played by the Row’s and Column’s players.

[3] introduces the payoff space as a more convenient representation of the 2X2 game because it provides information about players best responses in the form of inducements. In fact, the order graphs representation allows to understand the topological richness of the 2X2 game class [4]. Figure 1.2 illustrates the Prisoner’s dilemma in the strategy and payoff spaces. On the left-hand it shows the bimatrix representation in the strategy space. On the right-hand illustrates the payoff space representation. The X-axis corresponds to the Row’s players payoffs. The Y-axis to the Column player’s.

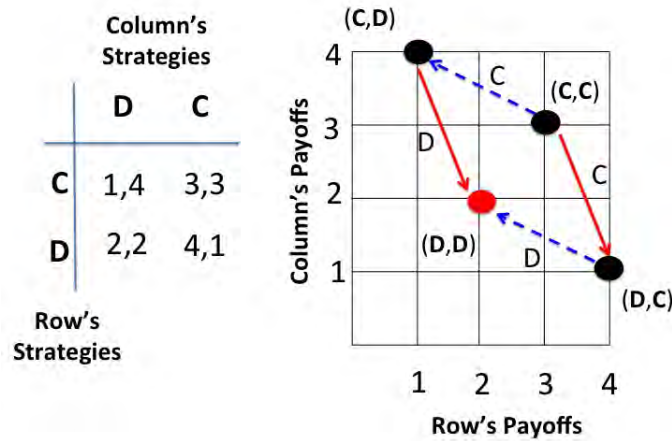


Figure 1.2: Bimatrix and order graph representation for the Prisoner’s Dilemma

The class of simultaneous 2X2 pure strategy games have received considerable attention, including complete classification schemes. For example, [5, 3] developed a complete classification system based on the topological characteristics of these games.

### 1.1.3 The inducement correspondence

An inducement correspondence is a general term for a set of positions that one player can bring about or “induce”. The “Row’s inducement correspondence” means the set of outcomes induced by the Column’s player for the Row’s player to choose from. Figure 1.2 on the right hand illustrates the inducements for every player in the Prisoner’s dilemma in the form of red arrows for the Row’s player and blue dotted arrows for the Column’s player.

For instance, given that Rows’ player is playing cooperate (C), the Column’s player is better off by choosing defeat (D). In this sense by Row’s player using strategy C, induces Column’s player playing D. On the other hand, if Row’s player is playing D, it induces Column’s player to play D. The blue dotted arrows represents the inducements for the Column’s player. Following

the same reasoning, if Column's player plays defeat (D), it induces Row's player to choose D. In the case of Row's player if Column's player choose C, it induces in the Row's player to chose D. If the Column's player choose D, the Row's player is induced to play D. The red arrows represents Row's player inducements.

Summarizing, Column's player will always prefer the uppermost payoff while the Row's player prefers the right most payoff. This is in accordance with the general convention in economics that more is better, thus, upper and right payoff are more desirable[6].

The Inducement correspondence provides an easy way to examine the Nash equilibrium. Given that the payoffs are strictly ordered, there will always be a single best response in a given inducement correspondence. A Nash equilibrium is easy to recognize in the payoff space. Any payoff pair that is the terminus of two arrows is a Nash equilibrium. In Figure 1.2, Figure 1.3 the Nash equilibrium is identified by the red dot.

Figure 1.3 shows the juxtaposition of strategy and payoff spaces. The 4X4 matrix is equivalent to the bimatrix. It is used in this format because this representation makes possible the juxtaposition between the strategy and payoff space. In 4X4 matrix only eight cells are used. In particular the second and fourth column yield the payoffs for the Column's player (blue) by playing D and C respectively . The second and fourth row yields the payoffs for the Rows' player (red) by playing C and D respectively.

On the oder hand, in the payoff space the only valid point in the cartesian plane are the pairs coming from the cartesian product  $\{1, 2, 3, 4\} \times \{1, 2, 3, 4\}$  .The order graph is composed of four nodes and 4 inducement arrows. Any 2X2 ordinal game is fully represented by an order graph.

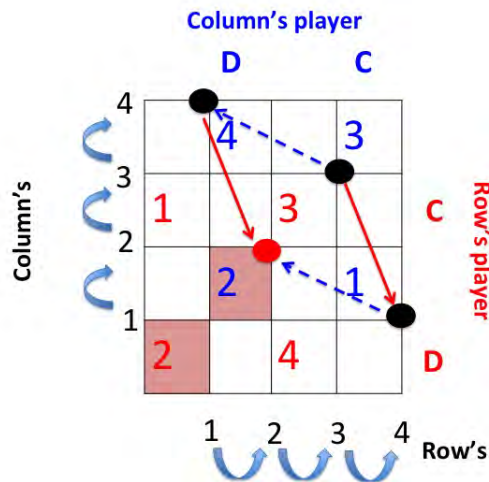


Figure 1.3: Juxtaposition between the strategy space and payoff space.

Furthermore, order graphs are connected by the adjoint payoff permutations (curve arrows) had a very rich and complex topological structure. They can be represented by a torus of 4 layers, every layer with 6 Row's X 6 Column's patterns. This topological structure is organized in a periodic table by [3]<sup>5</sup> and [7] reorganized it for making easier to navigate the topology of 2X2 games.

<sup>5</sup>Prof. Goforth developed a software that is useful to understand the topology of the class of 2X2 games <http://www.cs.laurentian.ca/dgoforth/periodictable.html>

### 1.1.4 Indexing the games: patterns and layers.

[3] have developed an indexing system that reflects the topological structure of the  $2 \times 2$  games. They have identified 6 Row's and Columns patterns and for Each game's number provides information about the game and can be used to find related games quickly. The indexing system serves as a first, rough map of the topological space introduced in the next chapter. Each game has a three-digit index. The Prisoner's Dilemma, for example,  $g_{111}$ . Each digit in the subscript corresponds to one of three features of the payoff matrix described in table 1.2

INDEX	FEATURE	NUMBER
$c$	the column player's payoff pattern	6
$r$	the row player's payoff pattern	6
$l$	the relative orientation	4

Table 1.2: Game Indexing

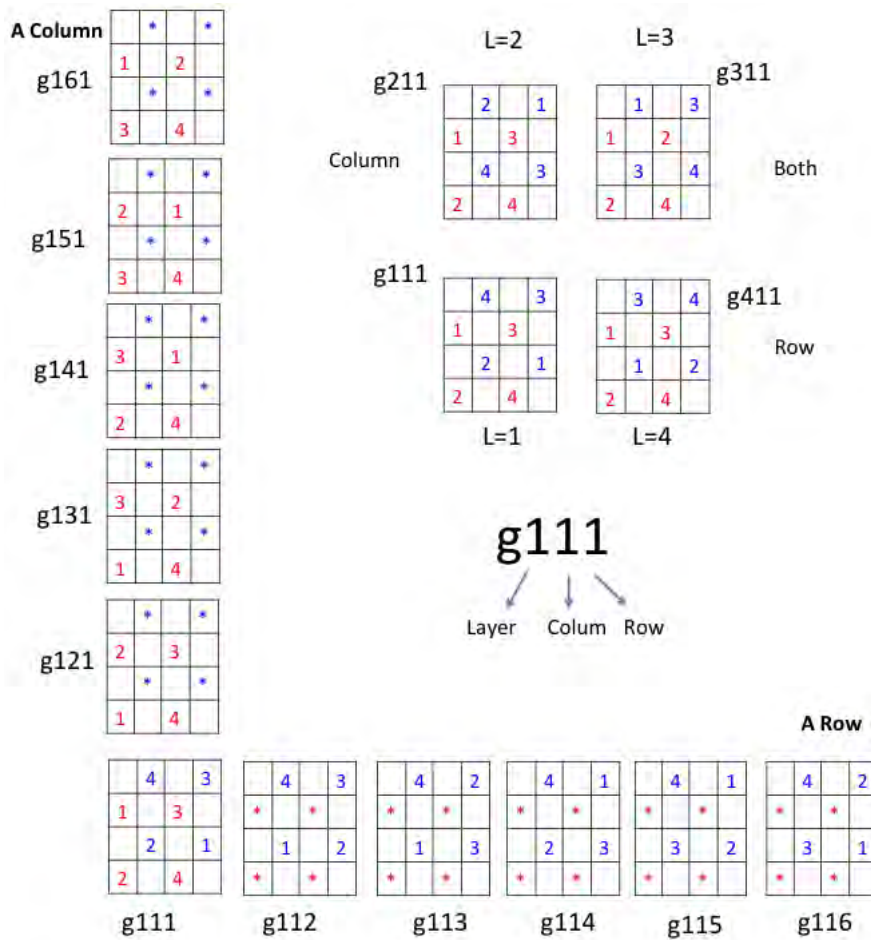
Robison and Goforth call  $c \in \{1, 2, 3, 4, 5, 6\}$  and  $r \in \{1, 2, 3, 4, 5, 6\}$  the column and the row indices. They call  $l \in \{1, 2, 3, 4\}$  layer index.

If we arbitrarily select the location of one player's most preferred outcome in the payoff matrix, it is possible to produce six different payoff patterns for that player by permuting the position of the three less desirable payoffs. The bottom row of payoff matrices in Figure 1.4a illustrates the six patterns for the column player, keeping the 4 payoffs in the upper left cell. Asterisks indicates that the row player's payoffs are the same as the first game in the row. The first game in this example is the Prisoner's dilemma.

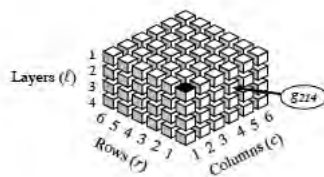
The second matrix in the row was produced by swapping the positions of 1 and 2 in matrix 1. The third is produced by swapping 2 and 3 in matrix 2. The fourth is produced by swapping the 1 and 2 in matrix 3. For the fifth, swap 2 and 3 in matrix 4, and for the sixth swap 1 and 2 in matrix 5.

The same can be done for the row player's payoffs. The results are shown in the matrix in the left-hand column of Figure 1.4a.

With six column patterns, six row patterns, and four layers, we have room for exactly  $144 \times 2 \times 2$  games. The entire collection of games can be visualized, as in Figure 1.4b, as an array that is six games wide, six games high and four layers deep. The three-digit index locates each game in the array.



(a) Payoff patterns 2X2 games. Adapted from Robison & Goforth, Bruns



(b) Arrangement of the 2x2 games y indices,  $g_{lrc}$

Figure 1.4: Payoff patterns and Indexing 2X2 games. Source: Robison & Goforth

### 1.1.5 Topology of the 2X2 games

The topology can be constructed by starting with the Prisoner's dilemma and swapping Row's payoffs of 1 and 2 to create a new game. Similarly, swapping Columns 1 and 2 payoffs creates a third game. Finally, by swapping both it creates a new game. These four games are a tile.

Starting from those four games, swapping column's 2 and 3 payoffs create four more games. Swapping column's 1 and 2 payoffs in these new games then complete two more tiles in either side of the original tile. Swapping row's 2 and 3 payoffs then creates more games above and below, and swapping row's 1 and 2 payoffs in these games completes six more tiles, above and below. These swaps of 1 and 2 and 2 and 3 form a layer composed of nine tiles and thirty-six games, containing all the possible changes from swapping 1 and 2 and 3. Topologically this is a torus, since further 1->2 and 2->3 swaps return to games already in the layer. Figure 1.5 shows the torus construction. Swapping row's payoffs of 3 and 4 creates a different game, after which the same steps can be used to create another layer. Similarly, Column's 3 and 4 payoffs can be swapped, and then swaps for both, to form two more layers. Figure 1.6a , 1.6b , 1.6c , 1.6d shows the layers.

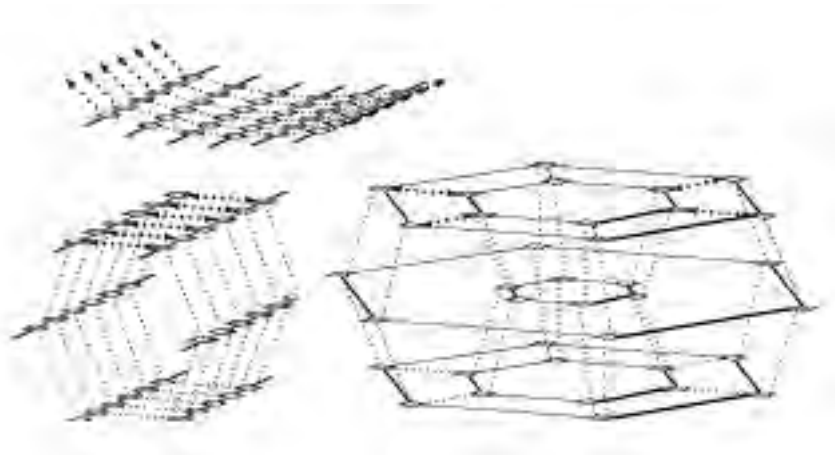
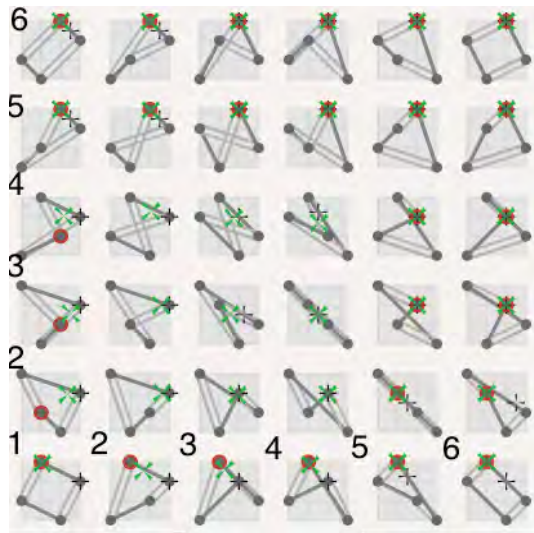


Figure 1.5: Tiles torus, layers. Source: Robison & Goforth

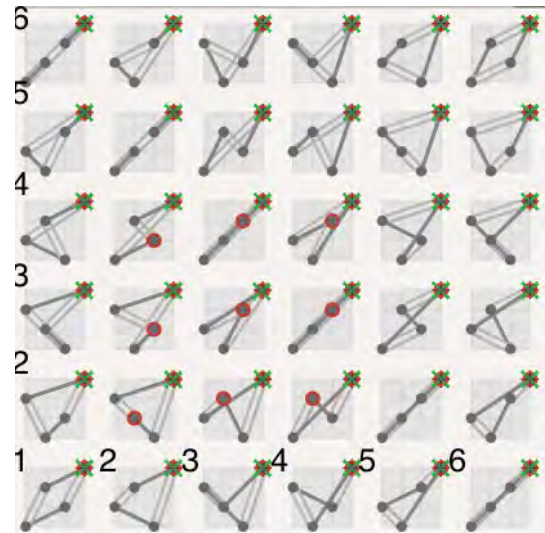
### 1.1.6 Adjoint payoff neighbors:

To define meaningful neighborhoods, Robison and Goforth characterized the smallest significant change in the payoff function. Obviously a change affecting the payoffs of one player is smaller than a change affecting two players. The closest neighboring games are therefore those games that differ only by a small change in the ordering of the outcomes for one player. That is by changing one adjoint Row's or Column's adjoint payoff. Figure 1.7 illustrates the six neighbors of the Prisoner's dilemma (g111). If there is a Row's permutation 1->2 , the game is transformed into g112. If Row's player makes permutation 2->3 the game is transformed into g116. It is important to notice that both permutations transform the original game into games of the same layer (L1). If the Row's player makes permutation 3->4, it transforms the game into g211 in the second layer. On the other hand if Column's player makes permutation 3->4 it transforms the prisoner dilemma into g411 in the fourth layer. If Column's player uses permutation 2->3 and 1->2 it transforms the prisoner's dilemma into g161 and g121 in L1.

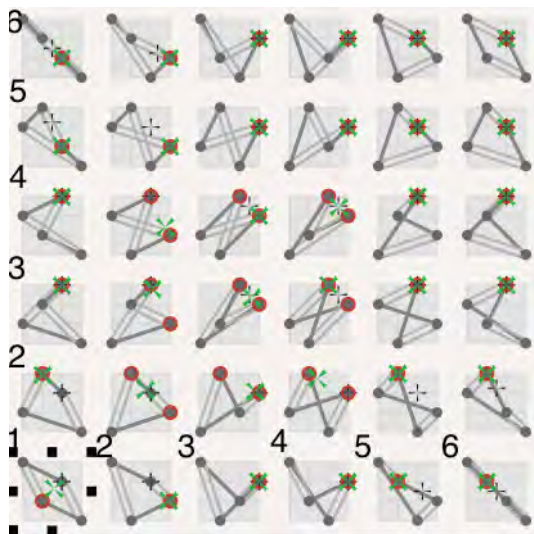




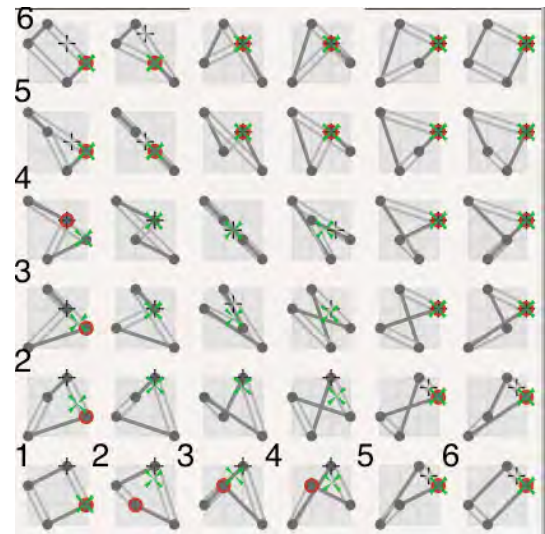
(a) Layer 2. In general column does well



(b) Layer 4 the best outcome is feasible for both players



(c) Layer 1: With PD, Chicken and BoS



(d) Layer 2: Row generally does well

Figure 1.6: Layers 2X2 games. The order graphs shows 3 types of solutions the Nash equilibria in red. Nash bargain the black cross. Miller machine solution the green X. The only solution concept used in this thesis is the Nash Equilibrium. For the other solutions please see <http://www.cs.laurentian.ca/dgoforth/periodictable.pdf> and the software in NetLogo. Source: Robison & Goforth.

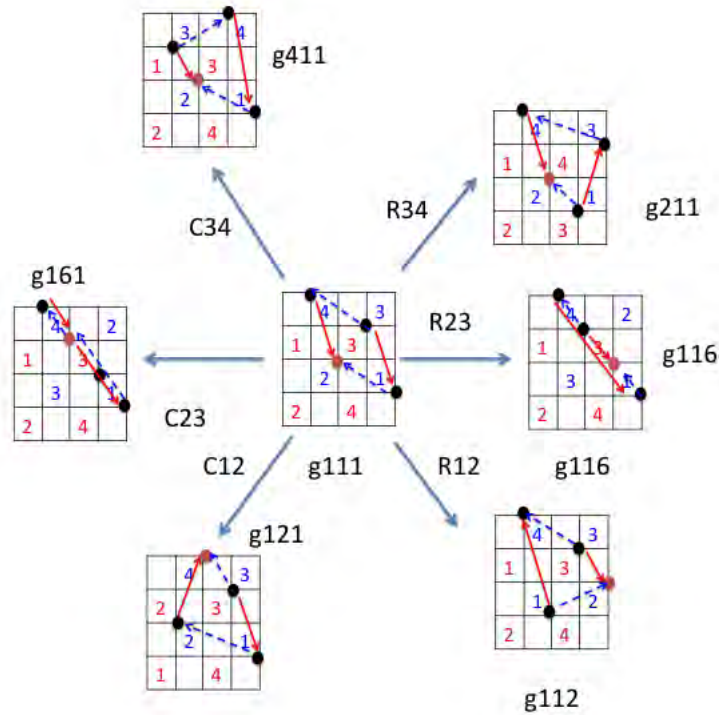


Figure 1.7: Adjacent Neighbors.

By using these adjacent permutations it is possible to create periodic tables that reflect the topology of the class of 2X2 games.

### 1.1.7 Bruns periodic table

Robinson and Goforth began with the most well-known game, Prisoner's Dilemma, indexing it as Game 111, located on Row 1 and Column 1 of Layer 1. However, [7] figured out that displaying game properties works better with Prisoner's Dilemma near the center. This is equivalent to scrolling the indices of the torus for each layer by one step in each direction, and it shows a "periodic table" format which is the main one used in the following discussion.

Figure 1.8 shows the version developed by [7, 8, 9]. He used the names of social dilemmas frequently studied in game theory. I attached the periodic table just for illustrative purposes. In the footnote, I reference a source for the table where the texts in the figure can be read more easily<sup>6</sup>. The layers are indicated as L1, L2, L3, L4. To find a game search for the column and

<sup>6</sup>Based on Robinson and Goforth: A new Periodic Table. Game Numbers: Layer: Row: Column. Symmetric along SW-NE diagonal. Swapping Row and Column positions swaps indices, and Layer for 2&4 © CC-BY-SA



row patterns in the border of the periodic table. The main change of Bruns periodic table is that Row's and Column's patterns order changed from [1 2 3 4 5 6] to [1 6 5 4 3 2 1]. It also redefines the concept of neighborhood of games connected by permutation 1→2.

In the Bruns periodic table 61% of the games are socially favorable; every player is close to a win-win situation. 13% of the social dilemmas are unfair, that means, there is a winner-loser Nash equilibrium. 13% of the social dilemmas are social inefficient. That is, the Nash equilibrium is a loss-loss situation. 10% are cyclic or critical; there is no Nash equilibrium in pure strategies<sup>7</sup> but it is possible to find max-min solutions.

The family of 144 games can be divided into 7 subfamilies according to the intensity of conflict between the two players. Figure 1.8 shows the characteristics of the different families; number of Nash equilibria, Pareto optimal equilibrium and symmetry.

Every game family has a prominent social dilemma that has been widely studied. Figure 1.9 shows the most famous dilemmas by family. They represent the strategic situations between two players; both with two strategies. In general the strategies are: cooperate (C) or defeat (D). The red boxes indicate the Nash equilibria.

The level of conflict and social harm is what defines the classification of the game's subfamilies. Colors indicate the game subfamily.

The prisoner's dilemma is the most famous of the loss-loss family. The temptation for defeat (lack of trust) makes this strategic situation to end in a loss-loss outcome.

The Rousseau stag-hunt is part of the win-win family. This game has two Nash equilibria; the risk-on equilibrium (CC) when coordination is expected, and the risk off equilibrium (DD) when coordination is not expected.

The battle of sexes is the most representative of the biased family. This is a not intense social conflict where the other player's best is the second best for the first player. This game has two Nash equilibria.

For example, the battle of sexes could be used to model the conflict inside the Eurozone after the Euro periphery sovereign debt financial crisis in 2009. Countries in the Euro periphery were better off by accepting a bailout from the Euro core than by having a sovereign default. Moreover, Euro core countries get a second best outcome by restoring the financial stability in the Eurozone despite of the bailout costs.

The chicken game is the most representative of the unfair family *"The phrase game of chicken is used as a metaphor for a situation where two parties engage in a showdown where they have nothing to gain, and only pride stops them from backing down"*[10]. This game has two Nash equilibria in pure strategies.

Bertrand Russell used the Chicken game as an analogy to exemplify the nuclear race between the US and the USSR in the cold war. The only incentive for the US or the USSR for not launching a nuclear attack was the existence of submarines somewhere with nukes ready for a second move. In the case of the cold war the solution for the Chicken game was either the US or the USSR wins. Russell modeled the cold war as a repeated Chicken game. Every repetition implied an accumulated cost for each player. This iterative setting is known as a war of attrition. It lasts until one of the parties is not able to face the accumulated cost of a military race. That was the case of the collapse of the USSR in 1992. The strategic confrontation between the US and the USSR will be analyzed in more detail in chapter 4.

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β 2011.06.21 To find a game: Make ordinal  $4 > 3 > 2 > 1$ . Put column with Row's 4 right, row with Column's 4 up. Find layer by alignment of 4s; then intersection of Row&Column payoffs. see Robinson & Goforth 2005 The Topology of the 2x2 Games: A New Periodic Table [www.cs.laurentian.ca/dgoforth/home](http://www.cs.laurentian.ca/dgoforth/home). [www.BryanBruns.com/2x2chart.html](http://www.BryanBruns.com/2x2chart.html)

<sup>7</sup>There is not Nash equilibrium because is not possible to randomize strategies. In other words, it is a one shot game where a mix strategy such as: cooperate X% and defeat the (100-X)% make no sense.

The missile crisis is a game from the critical family. These games represent puzzles that have not Nash Equilibrium in pure strategies and require immediate action. The only way for resolving them is by mean of game-changing strategies.

In the Cold War, the USSR in a secret operation was able to hide nuclear missiles in Cuba. In October 1962, US discovered the deployment of Soviet Union nuclear missiles in Cuba triggering the missile crisis between the governments of John F Kennedy and Nikita Khrushchev.

The options for the US were to do nothing or to make a preventive nuclear attack. If US do nothing, USSR get a huge geopolitical advantage very costly to defend. If US makes a preventive nuclear attack, the USSR will retaliate with other nuclear attack.

The only option for solving this crisis is by changing the structure of the game. The US did that by responding with a blockade and a declaring to the soviets an ultimatum for the missiles withdrawal. In the words of Khrushchev:

*“You, Mr. President, are not declaring a quarantine, but rather are setting forth an ultimatum and threatening that if we do not give in to your demands you will use force. Consider what you are saying! And you want to persuade me to agree to this! . . . You are no longer appealing to reason, but wish to intimidate us.”*<sup>8</sup>

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<sup>8</sup>[http://www2.gwu.edu/~nsarchiv/nsa/cuba\\_mis\\_cri/docs.htm](http://www2.gwu.edu/~nsarchiv/nsa/cuba_mis_cri/docs.htm)

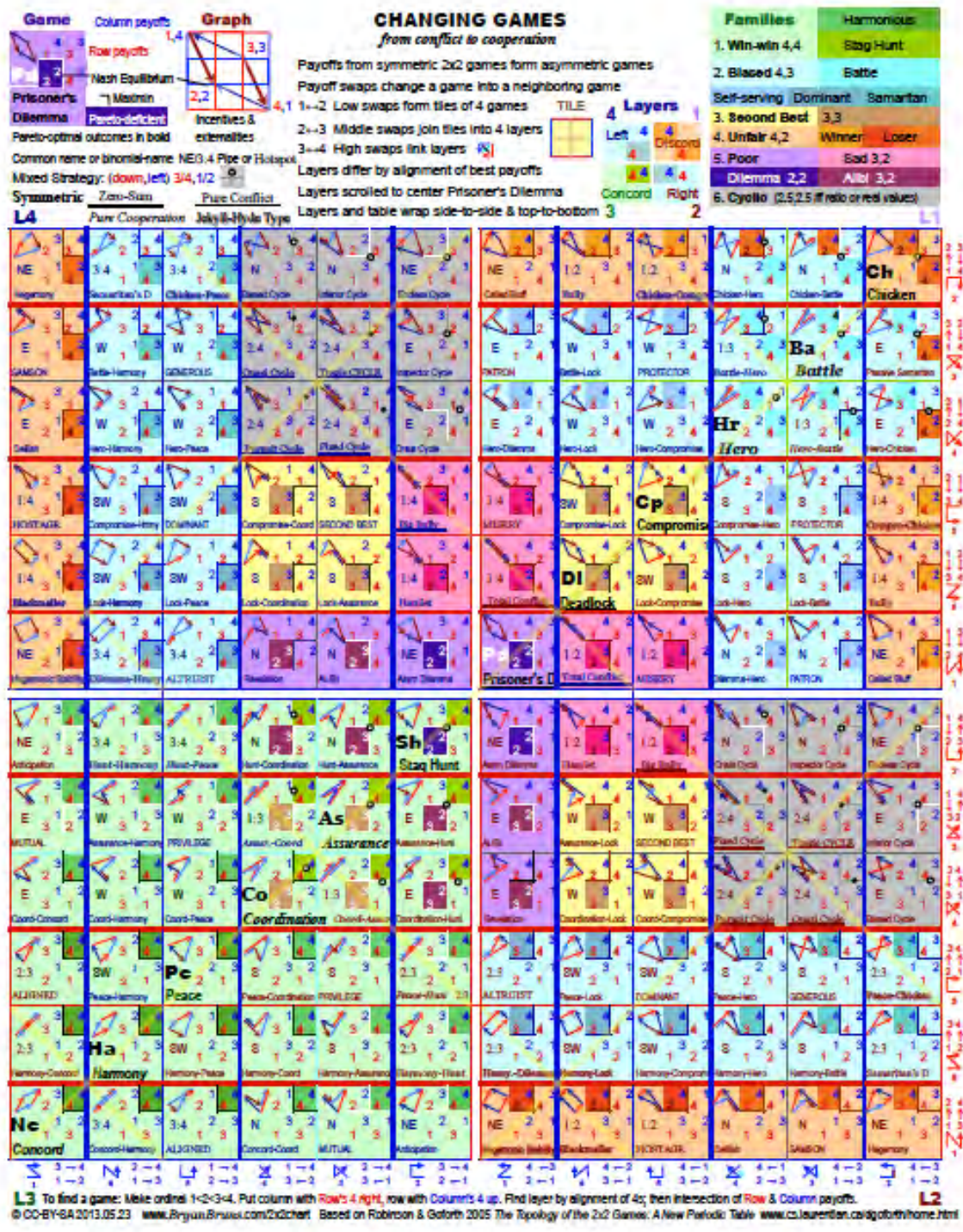


Figure 1.8: Changing Games: from conflict to cooperation. Games periodic table.

	PAYOFF FAMILY	NASH EQUILIBRIA	PARETO OPTIMAL	DOMINANT STRATEGIES		SYMETRIC	ASYMETRIC	TOTAL	PERCENTAGE	
1. WIN-WIN	4-4	1	1	1	2	6	30	36	25%	
	HARMONIOUS	1	1	1	2		24	27	19%	
	STAG-HUNT	2	1		0	0			6%	
2. BIASED FAMILIES	4-3	1	2	0	2	2	42	44	31%	
	ALTRUISTIC	1	2		1		24	24	17%	
	SELF-SERVING	1	2		1		12	12	8%	
	BATTLES	2	2		0		6	6	6%	
3. SECOND BEST	3-3	1	3	1	2	2	10	12	8%	
4. UNFAIR	3-2	2	2	3	1	2	1	18	19	13%
	CHICKEN	2	3	3		0				1%
	WINNER	1	7	3		2		6	6	4%
	LOSER	1	2	3		2		12	12	8%
5. PD FAMILY		1	2	3	1	2	1	14	15	10%
	Prisoner's Dilemma	1	2	3	1	2		2	2	2%
	Alibi	1	2	3		1		4	4	3%
	Tragic	1	2	3	1	2		8	8	6%
CYCLIC		0	2	4		0	0	18	18	13%
						<b>12</b>	<b>132</b>	<b>144</b>	<b>100%</b>	

Figure 1.9: Family of 2X2 games and characteristics such as: Nash and Pareto solution and symmetry.

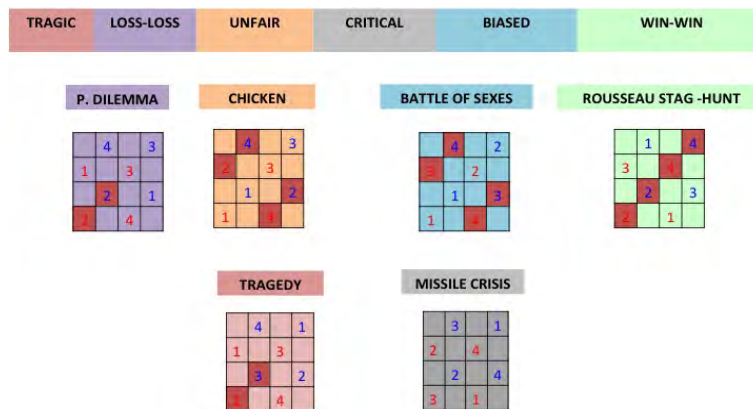


Figure 1.10: The most important 2X2 social-economic dilemmas by family. Blue numbers indicate the payoffs for the first player. Red numbers indicate the payoffs of the second player. Red boxes represents the Nash equilibria.

### 1.1.8 Navigating 2X2 games.

Permutations within the payoff matrix give rise to the concept of neighborhood. Let us analyze for instance how the permutation 1->2 creates a neighborhood in the Chicken game. The orange box in Figure 1.11 shows two players (blue and red), which together can take four different actions  $\{CC, CD, DC, DD\}$ . The preferences for the blue player are  $\{CD(4) \succ CC(3) \succ DC(2) \succ DD(1)\}$ . The preferences for the red player are  $\{DC(4) \succ CC(3) \succ CD(2) \succ DD(1)\}$ . The red player is able to transform the game from the Chicken to the Called Bluff game by using permutation 1->2;

$$\{CD(4) \succ CC(3) \succ DC(2) \succ DD(1)\} \rightarrow \{CD(4) \succ CC(3) \succ DD(2) \succ DC(1)\}.$$

The Called Bluff game has one Nash Equilibrium where the red player gets 4 and the blue 2.



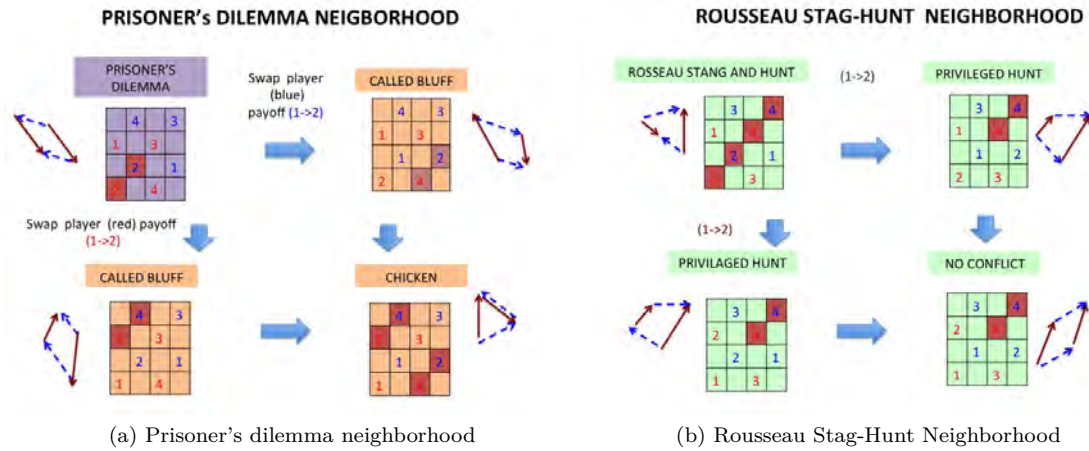


Figure 1.12: Main neighborhoods in a currency war

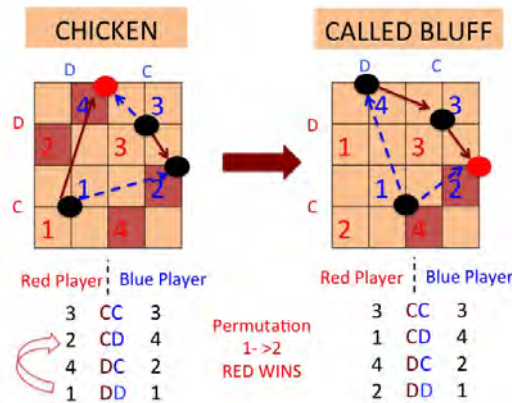


Figure 1.11: Transformation to the Chicken game into the called bluff game

A neighborhood is defined as the set of games linked by permutation 1->2 [3]. In the case of the PD, swapping the columns payoffs for the blue player and the row payoffs for the red player creates a 4 games neighborhood. Figure 1.12a shows the games inside the PD's neighborhood: Called Bluff (red wins), Chicken, Called bluff (blue wins) and the PD (loss-loss). Permutation 1->2 is the less costly permutation. Therefore, the games that are inside the neighborhood are the most probable to occur.

Figure 1.12b shows the games inside RSH's neighborhood: Privileged Hunt (win-win), No Conflict (win-win) and the RSH (win-win, loss-loss). In the RSH neighborhood three games have a win-win Nash equilibrium and only the RSH have two equilibria.

There are other permutations that are also game changing strategies. For instance the cheapest is to create a tile 1->2 and a layer 2->3. 1->3 implies a move to a different tile but in the same layer. Following this logic, changes in layers are more expensive. The easiest way for changing the layer is by using permutation 3->4, it implies just one swap in the adjoint payoff. Permutation 2->4 implies two swaps in the payoff matrix while permu-

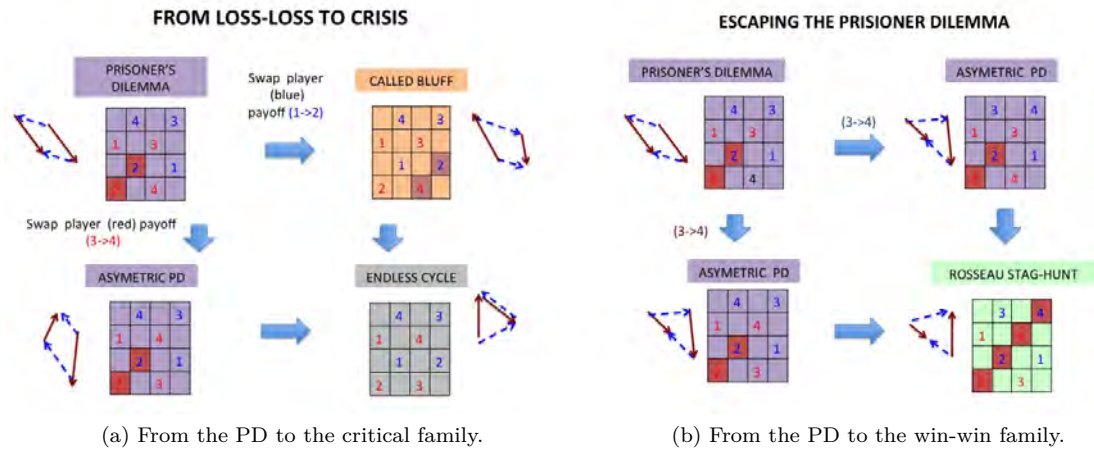


Figure 1.13: Transforming the Prisoner's dilemma into the critical or win-win family.

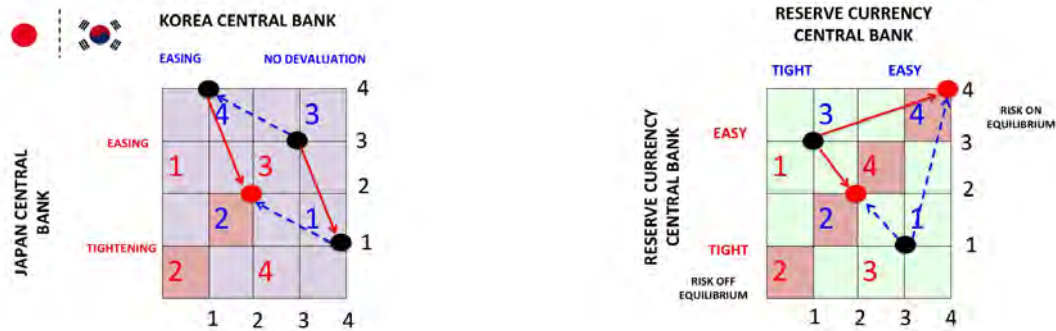
tation  $1 \rightarrow 4$  implies three swaps. I assume the ranking for the permutation order as follows:  $1 \rightarrow 2 \succ 2 \rightarrow 3 \succ 1 \rightarrow 3 \succ 3 \rightarrow 4 \succ 2 \rightarrow 4 \succ 1 \rightarrow 4$

Figure 1.13a shows how to transform the prisoner's PD into a critical game. If the blue player makes permutation  $1 \rightarrow 2$ , the PD is transformed into the Called Bluff game. If afterwards, the red player makes permutation  $3 \rightarrow 4$ , both players will be in the Endless Cycle. This is a game from the critical family.

On the other hand, Figure 1.13b shows how to transform the PD into the RSH neighborhood. If the blue player makes a permutation  $3 \rightarrow 4$ , the PD is transformed into the asymmetric prisoner's dilemma. If afterwards, the red player makes the permutation  $3 \rightarrow 4$ , both players will be able to enter into the RSH neighborhood.

## 1.2 Macroeconomics of a currency war

The elements introduced above can be used to model the two historical approaches to understand a currency war: "beggar-thy-neighbor" and "enrich-thy-neighbor" policies. The modern equivalent for the first is competitive currency devaluations while for the second the equivalence are the monetary coordination spillovers.



(a) PD between central banks with a reserve currency (blue) and satellite central banks (red) after the 2008 great financial crisis. The red box represents the Nash Equilibrium. The arrows the inducement correspondence.

(b) Countries with reserve currencies playing a Rousseau stag-hunt (RSH) coordination dilemma. Red boxes represents the Nash Equilibria. The arrows the inducement correspondence.

Figure 1.14: Currency War core games: prisoner’s dilemma and Rousseau stag-hunt.

### 1.3 “Beggar-thy- neighbor”

Adam Smith described “beggar-thy-neighbor” policies as a common practice for mercantilist empires. They attempted to remedy their economic problems by means that tend to worsen the economic problems of other empires [11]. In a competitive currency devaluation the first mover has an initial advantage by boosting the exports. Subsequently, the other country retaliates with an equivalent competitive devaluation. The end of the story is a loss-loss situation because raw materials and inputs become more expensive for every country.

Competitive currency devaluations resemble a socioeconomic situation known as the prisoner’s dilemma (PD). Figure 1.1a shows a 2X2 matrix representation for the PD now in the context of a currency war. Two players Korea and Japan has each two strategies: devaluation or no devaluation. Japanese payoffs are in red and Korean payoffs are in blue. These payoffs could be understood as the ordinal ranking of the preferences for every player. For example, Very Bad =1, Bad= 2, Good=3, Very good=4. For instance Japan ideal situation is devaluating the Yen while Korea does not devaluates the Won. This representation introduces two additional notions: the “position” and the “inducement correspondence”. The “position” describes the current state as well as the set of feasible outcomes. Nevertheless, the alternatives of player are not confined only to choices among the outcomes for their current position; they may be able “to induce” an altogether different position. This information is provided by the “inducement correspondence”[12]. The inducement correspondence is based on two assumptions: both players are rational<sup>9</sup> and they both have common knowledge<sup>10</sup>. In the matrix the inducement correspondence is represented by the blue and red arrows. The Nash equilibrium is the set of induced positions where no player could be better off without worsen the position of the other player. The arrows show the inducements for each player. The convergence of the inducements arrows

<sup>9</sup>In its mildest form, rationality implies that every player is motivated by maximizing his own payoff. In a stricter sense, it implies that every player always maximizes his utility, thus being able to perfectly calculate the probabilistic result of every action <http://www.gametheory.net/dictionary/Rationality.html>.

<sup>10</sup>Common knowledge is a special kind of knowledge for a group of agents. There is common knowledge of p in a group of agents G when all the agents in G know p, they all know that they know p, they all know that they all know that they know p, and so on ad infinitum [http://en.wikipedia.org/wiki/Common\\_knowledge\\_\(logic\)](http://en.wikipedia.org/wiki/Common_knowledge_(logic)).

indicate the Nash Equilibrium. In the PD the Nash equilibrium is (2,2). The purple color of the whole matrix indicates that the PD belongs to the loss-loss family. The boxes without payoffs inside have no meaning.

## 1.4 “Enrich-thy-neighbor”

“Enrich-thy-neighbor” claims for the need for a coordinated increase in global liquidity in order to face a deflationary crisis. Both countries end in a win-win situation because coordinated monetary policy fosters global investments and consumption thanks to the coordination spillovers [13, 14].

Monetary coordination spillovers in turn resemble a socioeconomic situation known as the Rousseau stag-hunt dilemma (RSH). The RSH dilemma describes a situation in which two individuals go out on a hunt. Each can individually choose to hunt a stag or hunt a hare. Each player must choose an action without knowing the choice of the other. If an individual hunts a stag, he must have the cooperation of his partner in order to succeed. An individual can get a hare by himself, but a hare is worth less than a stag [15]<sup>11</sup>. Figure 1.8b shows the RSH coordination dilemma in the matrix format. The players in this case are the Central Bank of Japan and the US Federal Reserve. Each player has two strategies by using easy or tight monetary policy. The inducement arrows indicates the existence of two Nash equilibria. One, if both central banks expect monetary coordination, they will reach a mutual benefit by reaching a win-win equilibrium (4,4). But, if one of them acts without coordination then they will both reach the loss-loss equilibrium (2,2). The two Nash equilibria in this strategic confrontation are shown in red. The green matrix color indicates that the Rousseau stag-hunt game belongs to the win-win family.

In both situations and as any model, the use of game theory to understand a currency war requires a set of plausible assumptions. The three main assumptions that I will maintain during this thesis are: 1) Countries involved in a currency war have their own agenda; 2) decision makers in the main geopolitical powers only care about their national or economic block interests; and 3) they are able to think strategically, try to predict the behavior of the other competitors, and have in mind that every player in the currency war is thinking strategically. I will not spend time justifying these assumptions, as I will argue that they are not only plausible, but also the minimum required to conduct any structured analysis.

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<sup>11</sup>[http://en.wikipedia.org/wiki/Stag\\_hunt](http://en.wikipedia.org/wiki/Stag_hunt)

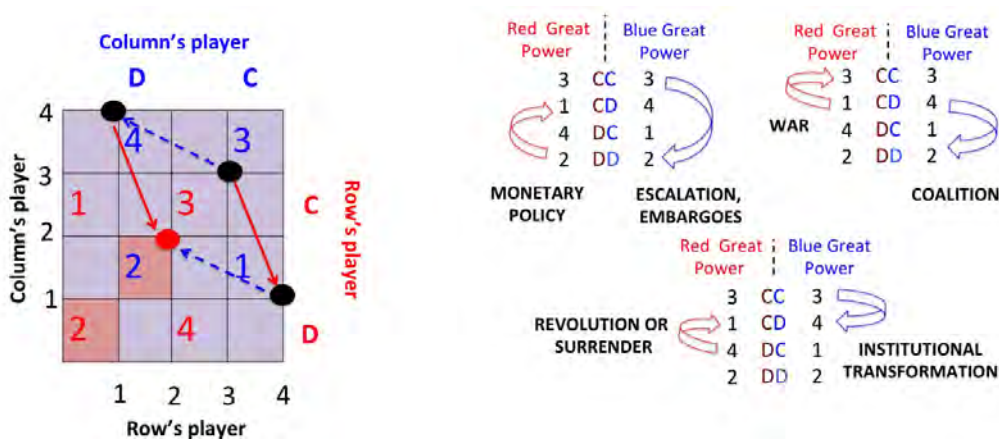


# Chapter 2

## The framework

### 2.1 Currency war game theory framework

The framework developed in this thesis stems from a combination of elements from history, game theory and chess. I developed a systematic way to understand how monetary policy, protectionism, wars, structural reforms, coalitions and revolutions affect the outcome of a currency war. The departure point of this framework is the assumption that both scholar views about currency wars are true. In fact, either a loss-loss or a win-win situation could be a valid partial outcome of a currency war. What I propose is a framework to understand their dynamics. That is, analyzing the intermediate strategic configurations along them. Thus, how a loss-loss initial strategic configuration could be transformed into conflict, unfair, critical or win-win strategic configurations.



(a) The prisoner's dilemma is the initial strategic setting (b) Game-changing strategies (permutations) over the prisoner's dilemma

Figure 2.1: Game-changing strategies in a currency war.

The framework consists of several different components. First, I start with the analysis of a set of 12 attributes for every currency war in the twentieth and twenty first century. These attributes are listed as follows: 1) The geopolitical powers involved in a currency war 2) The new emerging

economies 3) Economic crises 4) The international monetary standard in decadence 5) The set of protectionism or trade barriers 6) Wars and new domains of warfare 7) Structural reforms and reformers 8) Reforms procrastinators and highly autocratical geopolitical powers 9) Political revolutions 10) Technological revolutions 11) Geopolitical coalitions or military escalations, and 12) The new emerging international monetary standard.

Second, I model a currency war as a 2X2 games tournament between different geopolitical powers. The tournament is described as follows:

- Every geopolitical power has six strategies with an associated fixed cost.
- They are: monetary policy, trade barriers, wars, structural reforms, coalitions and revolutions.
- The ranking of preferences for the politician in charge are represented by the follow order: *Mon Policy*  $\succ$  *Trade Barriers*  $\succ$  *Wars*  $\succ$  *Reforms*  $\succ$  *Coalitions*  $\succ$  *Revolutions*
- The rationale to determine the cost for every strategy is to think about them in terms of the decision makers. What is less costly for the political leader in charge. For example, printing money is costless. Import quotas and trade tariffs are laws easy to implement. Intuitively, war seems a very expensive strategy. However, if a politician has to decide between an aggressive foreign policy agenda that fosters his political capital, or an internal structural reform that will undermine his political power, it is rational to choose war. Indeed, wars trigger national pride and they increase the tolerance for autocratic leaderships [16]. Coalitions or escalations are very expensive strategies in terms of resource allocation. Actually, they imply splitting of power on terms of foreign policy. Furthermore, it also could cause a tradeoff between internal political independence and honoring international agreements. Finally, a revolution is the worst strategy for a politician in charge. At the end of the day, it will probably imply his physical or political funeral.
- I assume the cost of every strategy as the square of the ranking of preferences, that is, monetary policy=1, trade barriers=4, wars=9, structural reforms=16, coalitions=25, Revolutions 36. An cost function of the form  $-x^2$  is a valid because it is a monotonic transformation of a convex ranking of preferences<sup>1</sup>.
- Every geopolitical power begins with an initial score equivalent to the sum of the cost all strategies, that is  $1^2 + 2^2 + 3^2 + 4^2 + 5^2 + 6^2 = 91$ . The idea behind is that every player can play every strategy at least once.
- Every match (sub-currency war) begins with the PD. I assumed that, because a currency war begins with loss-loss situation (global economic crisis).
- Every player uses the strategies sequentially.
- I map every strategy into row or column payoffs permutations. Based on the Burns' periodic table introduced in Chapter 1, these permutations are 1->2, 2->3, 1->3, 3->4, 2->4, 1->4.
- Figure 1.13a and 1.13b show an example of how the permutations operate over the prisoner's dilemma payoffs. For instance, in the prisoner's dilemma the preferences of the blue player are represented as  $\{CD \succ CC \succ DD \succ DC\}$ . In order to understand how a permutation

<sup>1</sup>A utility function assigns numerical values to all bundles so that if  $x \succ y$ , we have  $u(x) \geq u(y)$ . All that matters is the ordinal ranking, not the cardinal ranking. The numerical values we get for utility functions only matter in that we can say one utility level is higher than another, but the actual values don't mean much. For example, if  $u(x) = 100$  and  $u(y) = 200$ , we can't say that  $y$  is twice as good as  $x$  (that's a cardinal statement), only that  $y$  is preferred to  $x$ . [http://njsanders.people.wm.edu/100A/Prefs\\_and\\_Utility\\_Examples.pdf](http://njsanders.people.wm.edu/100A/Prefs_and_Utility_Examples.pdf)

changes the payoff structure, let us say the blue player implements a structural reform. That means, the blue player will use permutation 3->4 transforming his preferences from  $\{CD \succ CC \succ DD \succ DC\}$  into  $\{CC \succ CD \succ DD \succ DC\}$  creating a new game known as the asymmetric prisoner's dilemma. Chapter 1 showed that if the red player decides to use permutation 1->2 the game will be transformed into a game of the critical family. On the other hand, if the red player decides for permutation 3->4 the game will be transformed into the RSH.

- The payoffs in every game are the square of the Nash equilibrium value. Therefore the score in every match is defined by  $(NashEquilibria)^2 - Strategy\ Cost$ . In the case of multiple equilibria, it is calculated as  $\frac{(NashEquilibria_1 + NashEquilibria_2)^2}{2} - Strategy\ Cost$
- For the games from the critical family, the lack of a Nash equilibrium in pure strategies, implies an extra cost for both parties. It is equivalent to the cost of a structural reform. In fact, these are games that require immediate actions and consume resources for both parties. Kasparov, the mythical chess grandmaster, identifies this situations as only move to avoid a catastrophe. *“While strategy is abstract and based on long-term goals, tactics are concrete and based on finding the best move right now. Tactics are conditional and opportunistic, all about threat and defense. If you don't immediately exploit a tactical opportunity the game will almost certainly turn against you. Here we can also introduce the concept of the 'only move', where everything else loses. We even have a special symbol in chess literature to mark a move that was absolutely essential. Not good or bad, or difficult or easy, but simply required to avoid disaster”*(author?) [17].
- The game is repeated until either all players reach a win-win outcome or there is a hegemonic situation where the accumulated earnings of a group of players is far superior than other groups.

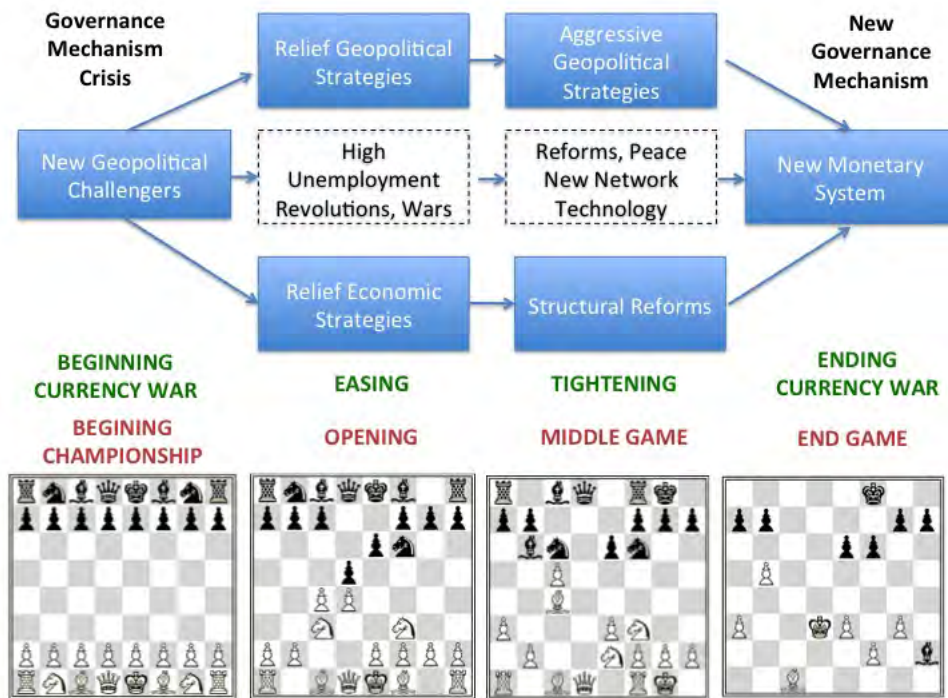


Figure 2.2: Analogical comparison between the general model for a currency war and chess. Currency war general model. Chess game analogy to a currency war. Chess Board from the World Championship in 1972 between Spassky and Fisher. The two routes illustrates the interplay between geopolitical and economic strategies in a currency war.

Although every currency war is different, this game theoretical framework is useful to understand the common underlying mechanisms, i.e. their phases. As in chess, nobody can determine who will win the game between two grandmasters. However, if we understand the rules, after some training it is easy to recognize three phases: the opening, the middle game and the end game.

Figure 2.2 shows a block diagram with the key phases of a currency war compared analogically with the phases in chess. The Chess board corresponds to the match between Boris Spassky and Robert Fisher for the World Championship in 1972.

Table 2.1 shows the mapping between permutations and the game-changing strategies in a currency war. It also shows the cost function associated to every strategy. The last column shows an analogical equivalence between game-changing strategies and pieces in chess. For instance, monetary policy is equivalent to the pawns. Protectionism to the knights. Wars to the bishops. Structural reforms to the rooks castling. Coalition or escalation to the Queen. Finally, revolution or surrender to the check mate.

Permutation	Game-changing strategy in a currency war	Cost	Chess Equivalent
1->2	Monetary Signals	1	Pawns
2->3	Trade Barriers	4	Knights
1->3	War	9	Bishops
3->4	Structural Reforms	16	Rook, (Castling)
2->4	Coalitions	25	Queen
1->4	Revolutions or Surrender	36	King

Table 2.1: The mapping permutations into game-changing strategies. Analogical comparison to chess.

In the opening, there is a global crisis and high unemployment rates. Geopolitical powers use monetary policy and trade barriers in order to alleviate unemployment. In chess that means a combination of moves with the pawns and knights. In the middle game, some geopolitical powers use wars and military coalitions in order to get a geopolitical advantage, others prefer structural reforms. In chess that is analogous to players that prefer an aggressive attack by using the bishops and the queen. And other players which are more defensive and they prefer a castling and a slow improvement in the positional game. In the end game, the countries with earlier reforms are able to reach a win-win situation, they use military coalitions and war, while the other either have to dissolve the former coalitions, make structural reforms or being susceptible to a political revolution. In chess, the positional player is able to use bishops and the queen taking advantage of the former positional game. On the other hand, the most aggressive player either reform its game to improve the positional game and threats with checkmate the other player. Or, it faces an important loss (in the worst case the queen). Moreover, this could have a checkmate threat coming from the other player.

As complex as the combination of moves in chess, are the combination of strategies in a currency war. Therefore, to try to forecast the moves in detail makes no sense. However, we can understand the phases of a currency war as a special regimens where the use of certain strategies is more probable.

## Chapter 3

# Currency War I: From the Gold Standard to the Bretton Woods. (1907-1945)

*“A democracy which makes or even effectively prepares for modern, scientific war must necessarily cease to be democratic. No country can be really well prepared for modern war unless it is governed by a tyrant, at the head of a highly trained and perfectly obedient bureaucracy”. Aldous Huxley*

In order to analyze CW I this chapter is divided into three sections. Section 3.1 begins with a historical review of the main geopolitical and economic events during CW I. Section 3.2 shows the representation of CWI part I into the game theoretical framework. CW I part I began with the panic of 1907 and lasted until the Great Depression in 1929. Section 3.3 shows the representation of CW I part II into the game theoretical framework. CWI part II began with the Great Depression and lasted until the setting of the Bretton Woods standard and the international monetary fund in 1945.

At the end of the nineteenth century the world was dominated by the empires. The British empire was the capitalistic empire with maritime trade dominance. Consequently, it had the leading position in terms of international trade and financial development. Moreover, the international monetary system, the gold standard, gravitated around the British hegemony. The city of London was the epicenter of global finance.

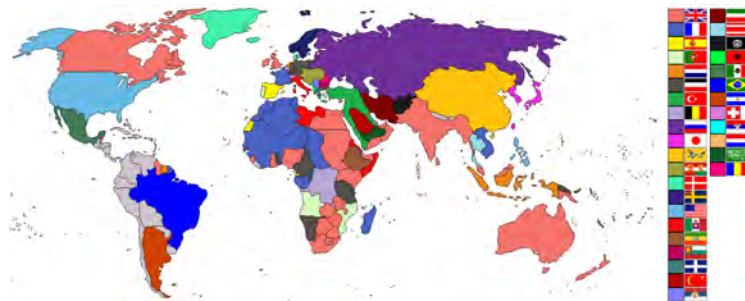


Figure 3.1: The Empires at the beginning of the twentieth century. Source: Wikipedia

Figure 3.1 shows that the British empire was not alone. It shared geopolitical control in Europe with the Austro-Hungarian, Prussian, French and Russian empires. In Asia with the Ottoman, Russian and Japanese Empires. In Africa, with the French, Prussian and Belgian empires. In North America with the United States; the emergent economy by then.

Furthermore, a structural transformation was undergoing in the global economy. Two new key inputs for the production and allocation of goods had emerged; electricity and oil. Additionally, a new way of producing and allocating goods was developed in the US. In particular, a new labor organization mechanism- the assembly line- enabled the development of a dominant design for massive production and consumption: the automobile Ford T-Model.

However, the boom in the US productivity was translated into a deflationary crisis for the dominant empires. As a consequence, unemployment rates rose in the developed world. Figure 3.2a shows that the unemployment rates of the developed countries -UK, Germany, - were higher than 12% between 1910 and 1939. For the US, it fluctuated reaching a maximum of 25% in the Great Depression of 1929.

CW I began with a major global financial crisis; the panic of 1907 caused by the fall of the Knickerbocker Trust Company. In order to restore the US financial system, J.P Morgan along with several bankers made a coordinated action to inject liquidity into the American financial system. The compelling need of a lender of last resort with the power to restore financial stability caused the creation of the US Federal Reserve (FED) in 1913.

One of the biggest advantages of the US to manage an economic crisis was being out of the gold standard. The US had the flexibility to increase the monetary supply without the need of an equivalent amount in gold. Therefore, monetary policy was key to alleviate unemployment. In contrast, empires inside the gold standard adopted protectionist policies and wars in order to gain a competitive advantage in a zero sum game for global domination.

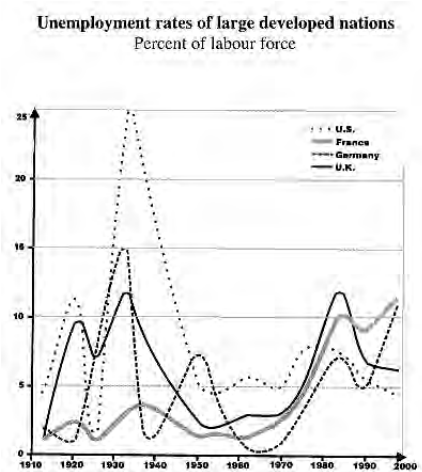
Imperial protectionist policies were unsuccessful. Indeed, some researchers argue they prolonged the deflationary crisis for decades [14]. The mercantilist gold standard was in decadence. It was not compatible anymore with the need of capital and liquidity for the new global economy. Structural reforms in order to improve the global governance mechanisms in politics and economics were needed. However, these reforms also implied a decrease of power in the dominant autocracies. The empires were trapped in a loss-loss situation where economic crisis, war and revolutions were very recurrent events.

In fact, Japan was the military challenger of the Tsar Russian empire in Asia. Prussia the military challenger of the British empire in Europe. In 1913 the British Empire was out the Gold Standard in order to print money to finance the military race. WW I broke out in 1914. The UK, Russia and France formed an alliance in order to face the threat coming from the central powers: Prussia, the Austro-Hungarian and Ottoman Empire.

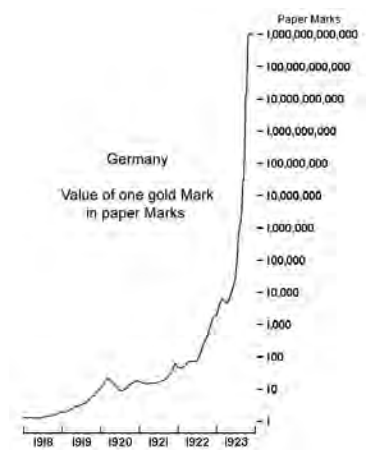
In the aftermath of the WW I the international distribution of geopolitical power changed. The Ottoman, Prussia, Austro-Hungarian and Tsar Russian empires disappeared. In fact, in 1917, the Russian revolution ended with autocratical Tsar Russia. It was replaced by the USSR in 1924.

Although, Britain was one of the winners of WW I, the massive military spending plunged the British empire into a severe deflationary crisis. Britain incurred debts equivalent to 136% of its gross national product. Its major creditor was the US. Staple wartime industries such as: coal, ship-building and steel, contracted. Working women were forced to cede their jobs to returning soldiers. Figure 3.4c shows how the UK consumer price index changed abruptly from 25% inflation rate in the war time into a deflation rate of -15%.

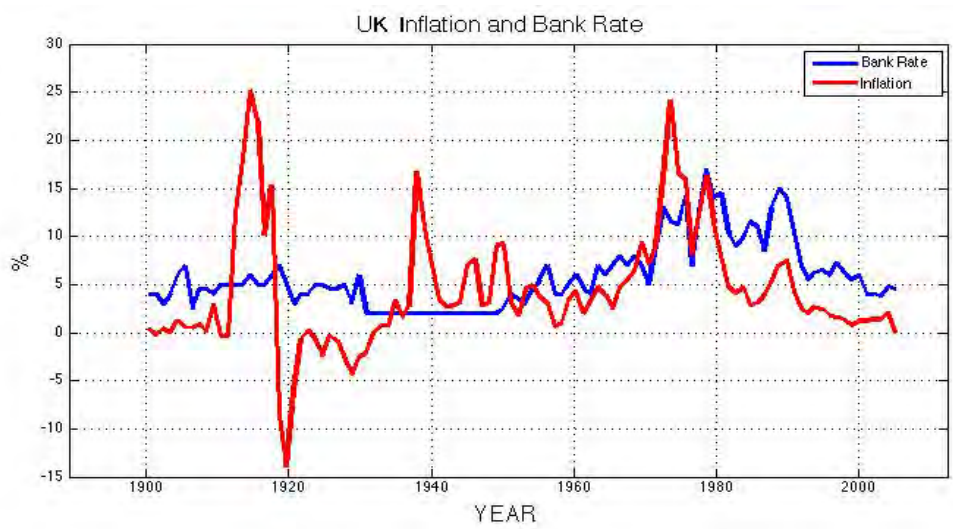




(a) Unemployment rates in the developed nations. Source: Unemployment: risks and reactions / Nikolai Genov, <http://library.fes.de/fulltext/bueros/sofia/00621toc.htm>



(b) Value of one Gold Mark in paper Marks. Source: Wikipedia, based on numbers in Table IV (page 441) of The Economics of Inflation by Costantino Bresciani-Turroni, published 1937.



(c) UK 3 months bills interest and consumer price index rate. Source: Bank of England

Figure 3.2: Some macro indicators in CW I



Germany had the worst outcome after WW I . The Versailles treaty trapped Germany in a harsh and unsustainable economic situation. Belgium and France occupied strategic raw materials regions in order to ensure war reparation payments. German mines were on strike. The German central bank financed in silence the worker's resistance by printing money. The use of monetary policy with political aims beyond the economic needs ended in a massive hyperinflation in the Weimar Republic. Figure 3.4b shows the equivalence of one Gold Mark into paper Marks. In 1924 one gold mark was equivalent to 1 trillion paper marks.

In general , unemployment and social unrest was a major problem in the aftermath of WWI . Figure 3.4a also shows the high unemployment rates in Europe after WW I . As a consequence, *“the reconstruction of the international order after World War I put great emphasis on social reforms through the International Labor Organization (ILO). Three types of arguments were used to promote social reform. The first asserted that international economic competition meant that social reform had to be coordinated internationally in order to maintain the relative competitiveness of countries. The second proposed that social reform was necessary to preserve the stability of states, and hence the stability of the international system. The third appealed for international action on the basis of common notions of human dignity. The idea that common concern about human dignity demanded international action became an assertion of human rights.”*[18]

On the contrary, the unemployment level in the United States was low. The US was focused on free market structural reforms<sup>1</sup> able to foster the massive production and consumption of goods. Indeed, the US proved that a capitalistic democracy is more efficient than trade empires focused on geopolitical dominance.

After WW I the US emerged as the new economic leader. When the war began, the US was a net debtor in international capital markets. But following the war, the US began investing large amounts internationally. Particularly, to Latin America, thus taking on the role traditionally played by Britain and other European capital exporters. With Britain weakened after the war, New York emerged “as London's equal if not her superior in the contest to be the world's leading financial center.”[19]

However, the US president Wilson's market de-regularization structural reforms along with great innovations in productive techniques, before and after the war, raised the output of industry beyond the purchasing capacity of US farmers and wage earners. Natural monopolies emerged in the oil, banking and infrastructure industries. The savings of the wealthy and middle class, increased far beyond the possibilities of sound investment. The frenetic speculation in stocks and real estate triggered the global stock exchange crash. In 1929, the world entered in a global depression.

The salience for reforms was drastic around the world. President Roosevelt in the United States promoted a set of policies in order to recover the US economy. These policies were divided in the trilogy of -relief, recovery and reforms- known as the New Deal. In contrast, the new democracies in Europe adopted again protectionism policies with the aim of defending local employment. Nationalism movements emerged in Germany, Japan and Italy. Fascism and militarism emerged as an autocratic movement promising geopolitical leadership and economic growth. Moreover, in the USSR, Stalin transformed the USSR into an autocratic regime. The lack of reforms and high unemployment levels in Europe, triggered military coalitions and wars as the only way to get a competitive advantage in a zero sum game for global domination.

WW II began in 1939 and it ended in 1945 with the US use of the nuclear bomb in Hiroshima

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<sup>1</sup>The Wilson reforms can be resumed in three acts the UNDERWOOD-SIMMONS ACT into law in 1913, which reduced tariff rates. The FEDERAL RESERVE ACT, which made the nation's currency more flexible. The gold standard still made currency too tight, and loans were too expensive for the average American. Wilson signed the FEDERAL RESERVE ACT, which made the nation's currency more flexible. Finally, the CLAYTON ANTITRUST ACT OF 1914 clarified the Sherman Act by specifically naming certain business tactics illegal.

and Nagasaki. The aftermath of WW II was a new technological and geopolitical era. There was a global technological revolution in the automobile, petrochemicals, airplanes and electrical industries. The world was divided into two blocs under the leadership of the US and the Soviet Union. Japan's defeat consolidated the Communist revolutionary party in China. The international monetary system was updated to the new reconfiguration of geopolitical power. The Bretton Woods standard together with the International Monetary Fund were created.

Table 3.1 summarizes the most important historical attributes of CW I.

Attribute	Currency War I
Players Part I	
Capitalistic Empires	The United Kingdom, France
Mercantilist Empires	Tsar Russia, Prussia, Austro Hungarian, Ottoman
Capitalistic States	The United States
Players Part II	
Parliamentarian Democracies	The United Kingdom , France
Nationalistic States	Nazi Germany, Japan , Italy
Communist States	Soviet Union
Capitalistic States	The United States
Major Economic Crisis	Panic 1907, Great Depression 1929-1939
Monetary Policy	Floating currencies out of the gold standard
International monetary standard in decadence	Gold standard.
Protectionism	Trade barriers to cotton, trade taxes
Wars and new domains of warfare	WWI & WWII
Structural Reforms and Reformers	Wilson pro-market and Roosevelt new deal
Procastinators and Autocracies	Tsar Russia, Otoman and Austro Hungarian.
Political revolutions and surrender treaties	Russian Revolution, Versailles, Yalta, Postdam.
Technological Revolutions	Oil, Automobile, Airplanes, Chemistry, Electricity.
Geopolitical Coalitions	Allies- Central Powes. Allies- Axis.
New emerging international monetary standard	Bretton Woods and the international monetary fund (IMF).

Table 3.1: CW I main historical attributes

### 3.1 Games' sequences Currency War I part I

In order to make easier the analysis of CW I part I with the game theory framework, I divided the "tournament" in six groups. They are classified according to the differences between the governance mechanisms in politics and economics. For instance, Figure 3.3a shows capitalist empires (UK and France) versus central mercantilist empires (Prussia, Austro-Hungarian, Ottoman empires). Figure 3.3b shows allied mercantilist empires (Tsar Russia) versus central mercantilist empires. Figure 3.3c shows capitalist empires (UK and France) versus allied mercantilist empires (Russia). Figure 3.4a shows capitalistic empires (UK and France) versus the capitalistic state (US). Figure 3.4b shows allied mercantilist empire (Russia) versus the capitalist state (US). Figure 3.4c shows mercantilistic empires (Prussia, Austro-Hungarian, Ottoman empire) versus the capitalist state (US).

Moreover, the sequence of games is divided in 9 games. They are compared analogically with the phases in chess: Opening, Middle Game, End Game. In general, I will show that the opening

is about protectionism and monetary policy. The middle game about coalitions and wars. The end game is about structural reforms, failures in the coalitions and revolutions.

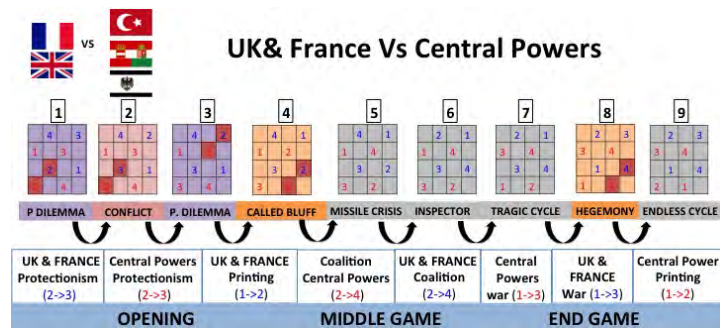
The most used strategies in CW I part I by the mercantilist empires were: protectionism, trade barriers, wars and coalitions. They avoided reforms that undermined their political power. Capitalistic empires also used protectionism and geopolitical strategies. However, the coalition with the United States allowed them to benefit from the US reforms and technological innovations.

Figure 3.3a shows that currency war between capitalistic and mercantilist empires began with global crisis represented by the PD. Capitalistic and mercantilist empires used trade barriers in order to protect local employment. This strategy is equivalent to permutation 2->3. This transformed the PD into the conflict and loss-loss game families. The British empire was out of the gold standard and printed money to finance the arms race. However, the combination between trade barriers and monetary policy transformed these games into the unfair family. Prussia, the Austro-Hungarian and Ottoman empires made a military coalition known as the Central Powers. The UK, France and Russia retaliated with a military coalition known as the Allies. These strategies transformed the games from the unfair family into the crisis family. Central Powers began WWI. Allies retaliated also with war. Both players were trapped inside the unfair and critical game families. Figure 3.3a shows the payoff of this confrontation. In the opening both players had positive payoffs. However, in the middle and end game they had heavy losses.

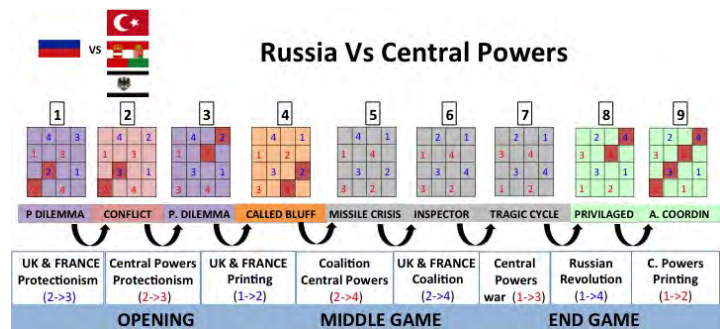
Although Russia was also an allied empire, Russia's governance mechanisms were less modern than capitalistic empires. For instance, Tsar monarchy were more autocratic than the imperial parliamentary republics such as Prussia, Austro-Hungary, UK or France. In fact, the lack of reforms and the infra human conditions of the Russian citizens triggered a political revolution.

Figure 3.3b shows that the currency war between Russia versus the Central Powers resembles that between UK & France and the Central Powers until the seventh game in the sequence. What makes a difference is the Russian revolution. In this framework a revolution is represented by permutation 1->4. It changed the game from the critical into the win-win family. Indeed, Both Soviets and Central Powers benefited from having the Imperial Russia out of the war. Figure 3.5b shows the game's sequence payoff for this strategic confrontation. It shows that after the revolution (game 7) the Central Powers stopped losses. Russia needed one step more (after game 8) because of the costs associated to a revolution in our framework.

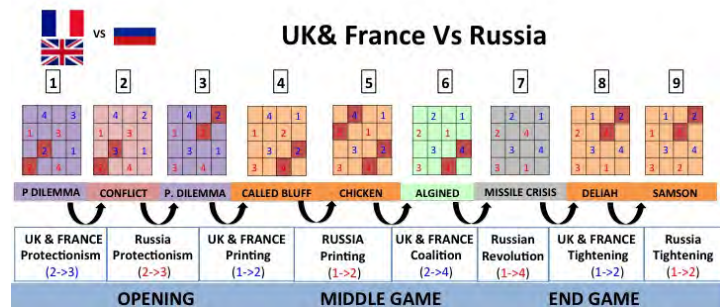
Figure 3.3c shows that the currency war between the capitalistic and mercantilist empires only had economic characteristics. Moreover, it shows that both geopolitic blocs competed by using trade barriers and printed money by being out of the gold standard. Easing monetary policy transformed the prisoner's dilemma into the Chicken game. Then by forming a coalition between them (allied empires), they transformed the Chicken game into the Aligned game from the win-win family. Subsequently, the Russian revolution transformed the Aligned game into a critical situation represented by the Missile Crisis game. The figure also shows that by using monetary policy, the game was transformed from the critical family into the unfair family. In this strategic setting the Soviet Union was better off than the capitalistic empires. Figure 3.5c shows the game's sequence payoffs for this particular strategic situation. In the opening both geopolitical blocs had a positive payoff. In the middle game they had heavy losses. In the end game they had a strong recovery.



(a) UK & France versus Central Powers games' sequence



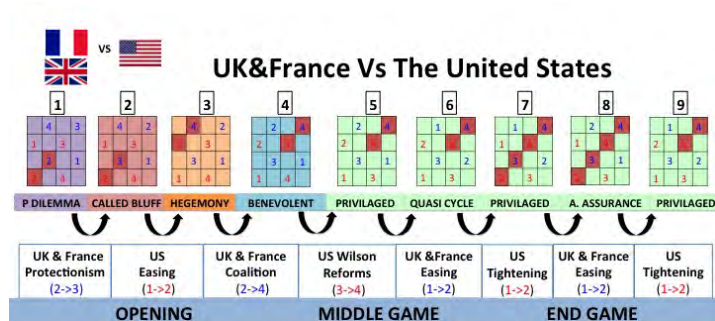
(b) Russia Vs Central Powers games' sequence



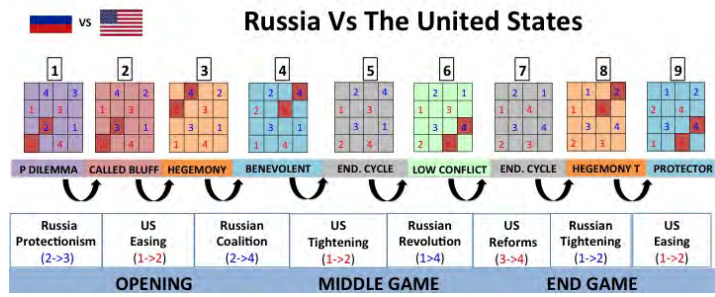
(c) UK & France versus Russia games' sequence

Figure 3.3: The strategic confrontation between Empires.CW I part I. Game sequence empires and the United States. Flags indicates geopolitical powers in conflict. The boxes' color indicates the game family. Purple: Loss-Loss. Pink: Conflict. Orange: Unfair. Yellow: Second Best. Gray: Critical. Blue-Marine: biased. Green: Win-Win. Red boxes represent the Nash equilibria in pure strategies.

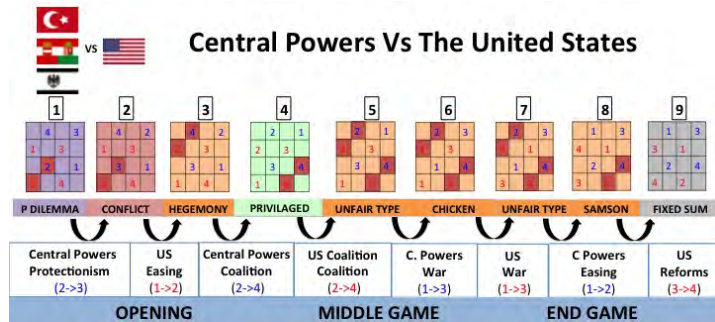
The strategic confrontation between the UK & France and the US was the less intense. It ended in a win-win situation. Figure 3.4a shows that while capitalistic empires used trade barriers in order to protect local employment, the US used monetary easing policy in order to inject liquidity to the economy. Indeed, this transformed the initial PD into the Hegemony game from the unfair family. The Nash equilibrium of this game is the US win (4) and UK & France loss (2). Subsequently, the geopolitical coalition between UK, France and the US, transformed the Hegemony game into the Benevolent game from the biased family. In the Benevolent game the UK & France get the best outcome while the US the second best. Finally, the US Wilson structural reforms transformed the Benevolent game into the win-win family. Figure 3.5d shows



(a) UK and France versus the United States games' sequence



(b) Russia versus the United States games' sequence



(c) Central Powers versus the United States games' sequence

Figure 3.4: CW I part I. Game sequence empires and the United States. Flags indicates geopolitical powers in conflict. The boxes' color indicates the game family. Purple: Loss-Loss. Pink: Conflict. Orange: Unfair. Yellow: Second Best. Gray: Critical. Blue-Marine: biased. Green: Win-Win. Red boxes represent the Nash equilibria in pure strategies.

the game's sequence payoffs. In the opening both geopolitical blocs had positive payoffs. In the middle game losses. In the end game after the US reforms (game 6) both geopolitical blocs benefited from the mutual coordination spillovers.

The currency war between the Russia and the US was almost the same as that between UK & France versus the US. However, the Russian revolution transformed the game from the win-win family into a neighborhood with games from the critical, unfair and biased family. Figure 3.5e shows the games' sequence payoffs. It shows Russia was better off than the US in the first 5 games, however, after the Revolution the US was better off than Russia. Both geopolitical powers ended with a favorable outcome.

Finally, the currency war between the US and the Central Powers was represented by games' from the unfair family. In particular, the US and the Central Powers were playing a Chicken game where wars did not change the structure of the game. However, at the end of the sequence the US structural reforms transformed the games from the unfair family into the critical family. Figure 3.5f shows the game sequence payoff. In the opening by avoiding confrontation both geopolitical blocs had a positive payoff. In the middle game, war benefited more Central Powers than the US. In the end game the implementation of US structural reforms created a critical situation for both geopolitical powers.

The US general strategies were to use monetary policy, to avoid initial confrontations and finally to implement structural reforms. On the other hand, capitalist and mercantilist empires used trade barriers, wars and coalitions. They avoided or procrastinated reforms. Figure 3.6 shows the total payoffs by geopolitical power. It shows that the losers of CW I were the mercantilist empires. They are Prussia, Austro-Hungarian, Ottoman and Russian empires. Russia was an allied country, however his inefficient governance mechanisms in politics and economics and the intensity of the war triggered the Russian revolution. The coalition between UK, France and the US allowed the creation of a win-win situation that benefited from the innovation coming from the US.

Although WW I ended, the currency wars had not ended. The governance mechanisms in politics and economics had deep transformations. After the war, the strategic confrontation is between, Capitalistic Empires (UK & France), Capitalistic State (US) the Nationalistic States (Nazi Germany, Italy, Japan) and the Communist State ( The Soviet Union).

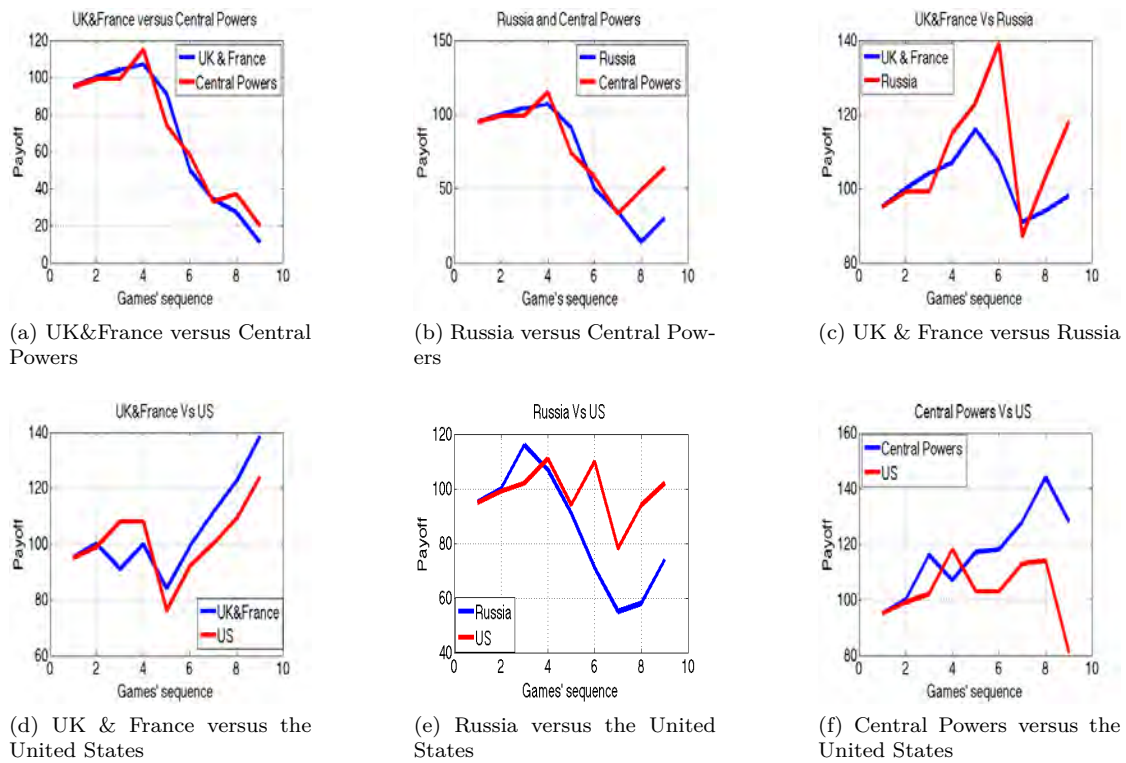


Figure 3.5: CW I part I games' sequence payoff.

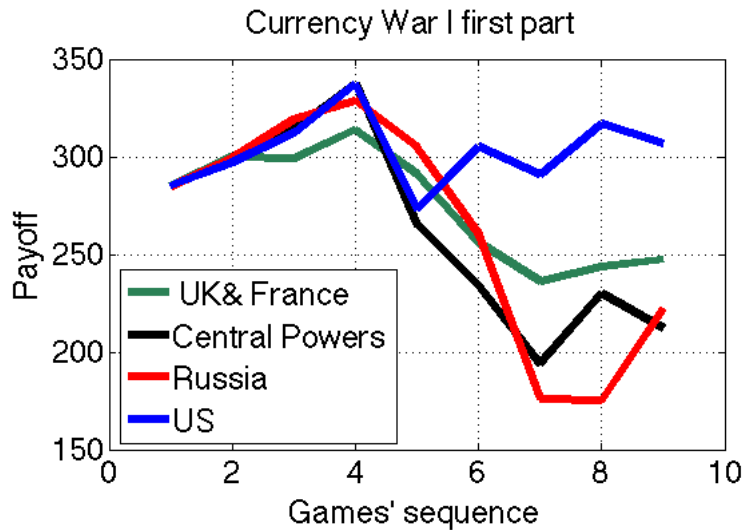


Figure 3.6: The total payoff is computed as a sum of the payoffs of each player's games.

## 3.2 Game sequence CW I part II

Again the “tournament” is classified in six groups based on the governance mechanisms in politics and economics. In this case the confrontation is between capitalistic empires (UK and France), the only capitalistic state (US), the nationalist states (Axis: Nazi Germany, Italy and Japan) and the Communist state (USSR). Figure 3.7a shows the currency war between the UK-France versus the Axis. Figure 3.7b shows the currency war between UK-France versus the USSR. Figure 3.7c shows the currency war between the Axis and the USSR. Figure 3.8a shows the currency war between the UK & France versus the United States. Figure 3.8b shows the currency war between the US versus the USSR. Figure 3.8c shows the Axis versus the United States.

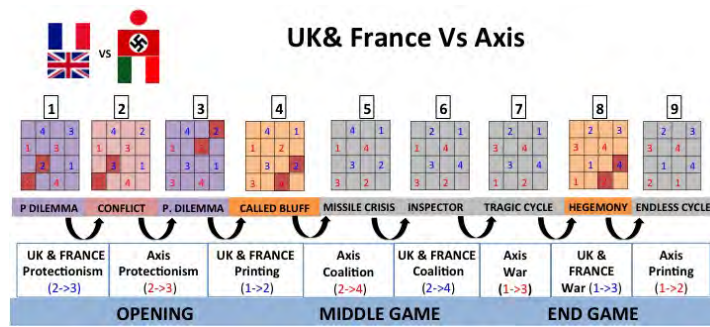
The strategies in the confrontation between capitalist empires (UK & France) and nationalistic states (Axis) were focused on protectionism, monetary policy, military coalitions and wars. Both blocs avoided reforms. Figure 3.7a shows that both geopolitical blocs were trapped inside the loss-loss, unfair and critical families. In particular the opening of the currency war was defined by the combination of protectionism and monetary policy. The middle game was defined by coalitions or conflict escalations. The end game was defined by the combination of wars and monetary policy. Figure 3.9a shows the games’ sequence payoffs. In fact, it shows that in the opening both blocs had positive payoffs. In the middle and end game both blocs had heavy losses.

In the currency war between the Germany and the Soviet Union both geopolitical powers were trapped in protectionism and political chaos. The emergence of Nationalism in Germany and the Stalin’s autocratic Communism in the USSR focused the attention of their citizens on foreign policy rather than on structural reforms. Moreover, the USSR did not have a defined position about the Nazi Germany. In spite of the fact that one of the natural enemies of the Nazis were the Communists, both geopolitical blocs have an initial peace agreement at the beginning of the WW II. Indeed, they split Poland among them. However, the Nazi Germany did not honor this agreement for a long time. In June 1941, the Axis attacked the USSR in the operation Barbarossa. The USSR was in war against Germany. Subsequently, it was forced to form a coalition with the allies in order to join forces to face the Axis.

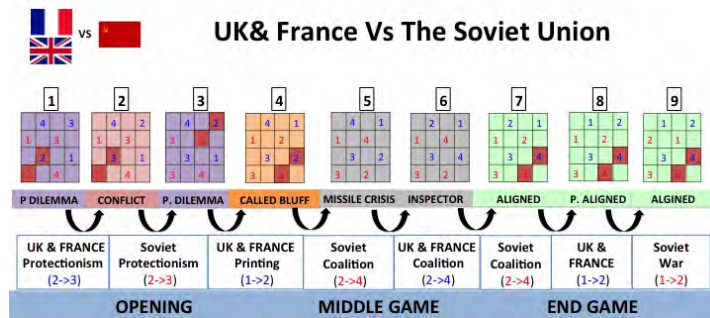
Figure 3.7b shows the currency war between UK & France versus the Soviet Union. Before the war, the strategic situation was defined by trade barriers and the lack of an international monetary system. The initial agreement between the Soviets and Nazis transformed the games from the loss-loss and unfair family into the critical family. In this configuration both blocs had heavy losses. However, with the attack of the Nazi Germany and the setting of the new coalition between UK & France and the Soviet Union transformed the game from the critical family into the win-win family. Figure 3.9b shows the game sequence payoffs. In the opening both countries get a mutual benefit. In the middle game both blocs have heavy losses. In the end games both blocs have a strong recovery, however the USSR recovery came one step later.

Figure 3.7c shows the currency war between the USSR and the Axis countries. In particular, it shows that before the war they were trapped in loss-loss and unfair family. By means of the peace agreement they managed to transform the game into a second best situation. However, the Axis attack to the USSR transformed the second best game into a game from the critical family. The Soviet war retaliation created a situation from the loss-loss family where the Soviets had the worse outcome. By forming a new coalition with the allies, they managed to transform the game from the loss-loss family into the battle of sexes type game. Figure 3.9c shows the game’s sequence payoff. In the opening the Soviets get a tiny advantage over the Axis. In the middle game the Soviets had heavy losses while the Axis payoff had a slight increment. In the end game both countries had a recovery.

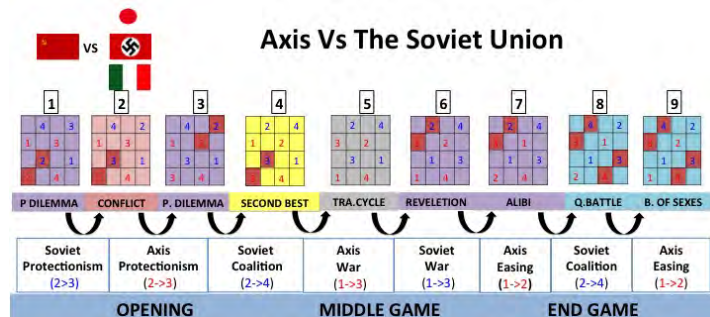




(a) UK & France versus Axis



(b) UK&France versus the Soviet Central Powers



(c) UK&France versus the Soviet Union

Figure 3.7: CW I Part II. Flags indicates geopolitical powers in conflict. The boxes' color indicates the game family. Purple: Loss-Loss. Pink: Conflict. Orange: Unfair. Yellow: Second Best. Gray: Critical. Blue-Marine: biased. Green: Win-Win. Red boxes the Nash equilibria in pure strategies.

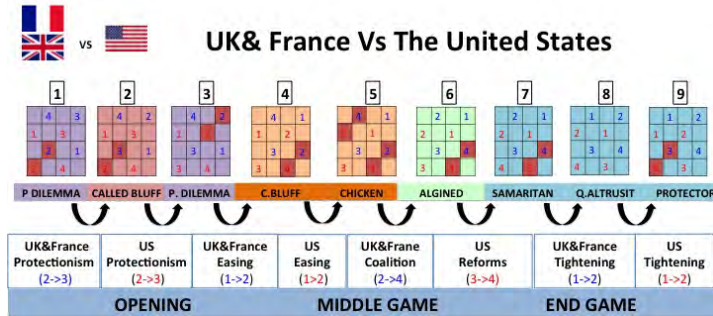
The general strategy for the US was to use monetary policy, be active in reforms (New deal)<sup>2</sup> and postpone the war until the last moment. Figure 3.8a shows the currency war between the UK & France and the US. In the opening of the currency war the strategic conflict was trapped in the loss-loss, conflict family. In the middle game, the strategic situation was transformed into the unfair family. UK & France coalition with the US along with the Roosevelt transformed the game from the unfair family into the win-win and biased families. Figure 3.9d shows the games' sequence payoffs. In the opening both geopolitical blocs had positive payoffs. In the middle game

<sup>2</sup>In the Roosevelt new deal the key acts were: EMERGENCY BANKING ACT. In 1933 the GLASS-STEAGALL BANKING REFORM ACT. Source: <http://www.ushistory.org/us/43g.asp> This work by The Independence Hall Association is licensed under a Creative Commons Attribution 4.0 International License.

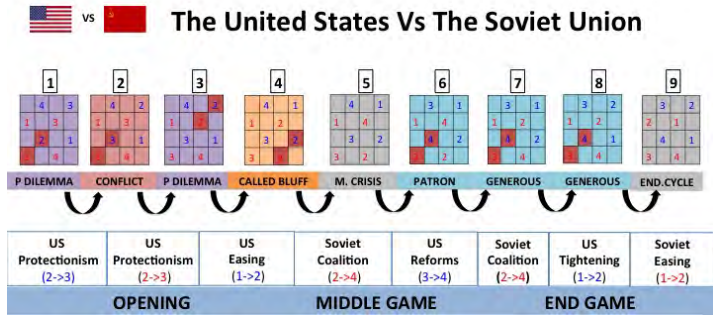
the UK & France payoff remained stable while the US payoffs were positive. In the end game both geopolitical blocs were able to benefit from the mutual coordination spillovers. However, the US had a stronger recovery than UK & France.

Figure 3.8b shows the strategic confrontation between the US and the USSR. The opening game was characterized by the use of monetary policy and trade barriers. The initial PD was transformed into conflict and unfair games' families. In the middle game, the Soviet coalition with the axis transformed the game into the Missile Crisis game. The US structural reforms transformed the game into the biased family. The Axis attack over the Soviet Union along with the new coalition between the Soviets and the Allies, transformed the game from the biased family into the endless crisis game. Figure 3.9f shows that the soviets had heavy losses in this confrontation. For the US this confrontation only provided a tiny competitive economic advantage.

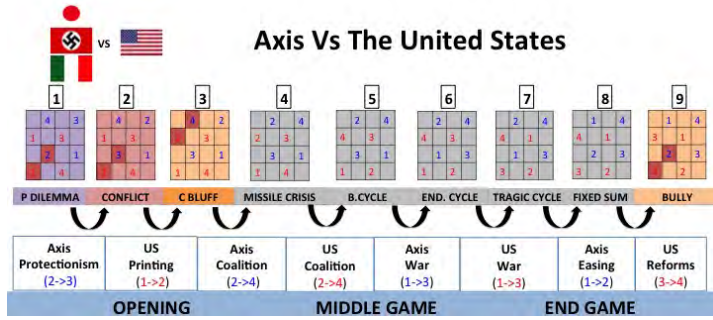
Figure 3.8c shows the strategic confrontation between the Axis and the United States. In the opening both blocs were trapped in the loss-loss and conflict family. The middle game began with the Axis military coalition that transformed the PD into the critical family. The US strategy was to postpone its entrance to the war. Meanwhile, they used monetary policy and structural reforms as a way to gain a competitive economic advantage. In the end game the reforms and war transformed the game into the conflict and the biased games' family. Figure 3.9g shows the game's payoff sequence. In the opening both blocs had a positive payoffs. In the middle game they had heavy losses while in the end game both had a strong recovery.



(a) UK & France versus the United States



(b) The Soviet Union versus the United States



(c) The Axis versus the United States

Figure 3.8: CW II Part II game's sequence. Flags indicates geopolitical powers in conflict. The boxes' color indicates the game family. Purple: Loss-Loss. Pink: Conflict. Orange: Unfair. Yellow: Second Best. Gray: Critical. Blue-Marine: biased. Green: Win-Win. Red boxes represent the Nash equilibria in pure strategies.

### 3.2.1 Payoffs' sequence Currency War I part II

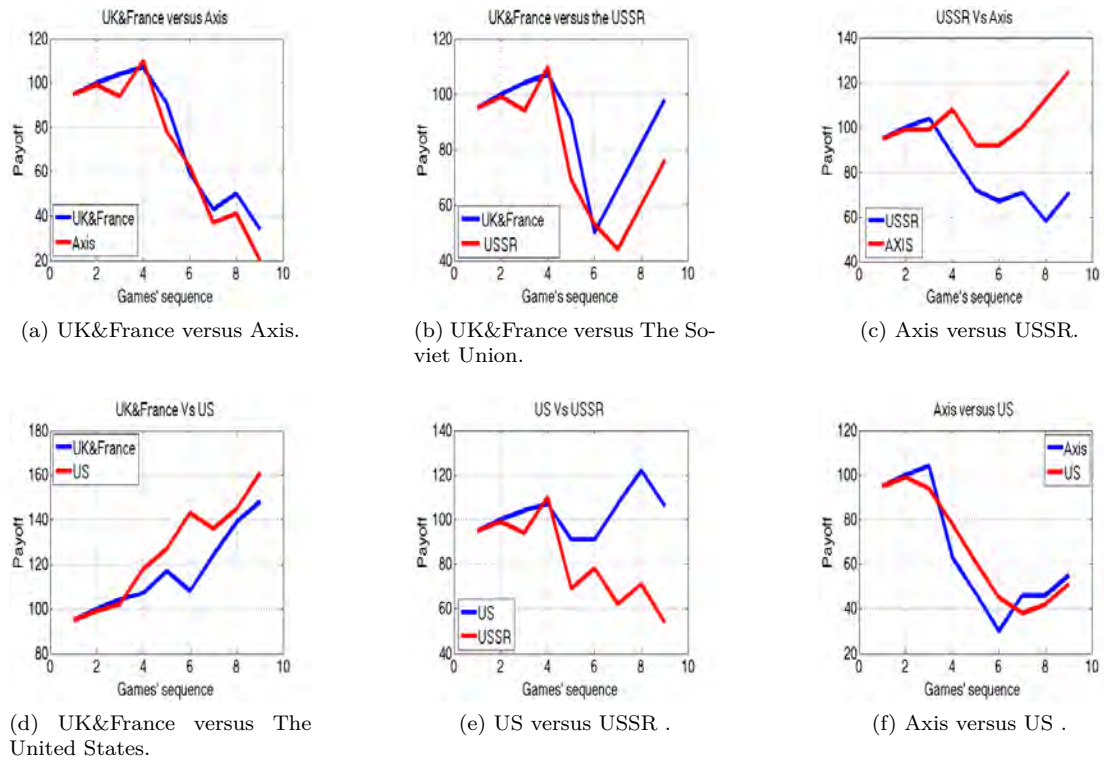


Figure 3.9: CW I Part II payoffs.

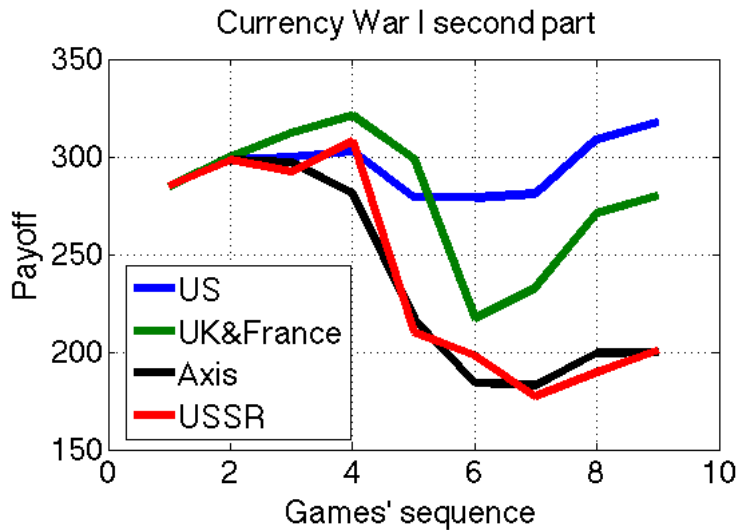


Figure 3.10: Total payoffs CW I part II by geopolitical power. The total payoff is computed as a sum of the payoffs of each player's games.

The winner of the CW I was the US. The rest of geopolitical powers had heavy losses. The US postponed the military confrontation until the end of WW II. The US was focused on monetary policy, coalition and structural reforms. The UK & France benefited from the coordination spillovers after the coalition with the US. The Soviet Union coalition ambiguous strategy, first in a no aggression pact with the Axis and after in a coalition against the axis was very costly. Figure 3.10 shows that the geopolitical power with more losses were the Axis and the Soviet Union. UK and France had also heavy losses, however thanks to the US reforms and their coalition with the US they managed to recover a lot of their losses.

Both sub currency wars showed common patterns. The opening is characterized by protectionism and monetary easing policy. In general every player involved in a currency war had a positive payoff in the opening. The middle game is characterized by coalitions and wars. Countries had heavy losses. The end game is characterized by reforms and wars. There is a strong recovery in the countries with reforms and their allies.

In the aftermath of CW I the autocratic regimes as the Empires and National States disappeared. The world is divided in two governance mechanism in politics and economics: the Welfare and Communist states. Humankind experiment a surreal transformation from the belle époque into blood, panic and self destruction. The international monetary system was the finger print of this transformation. The gold standard based on no trust among geopolitical powers, was replaced by the bretton woods standard. It was based on US dollar-gold parity. A global technological revolution in the automobile, petrochemicals, airplanes and electrical industries allowed countries to remain coordinated in a win-win situation.

## Chapter 4

# Currency war II: From the Bretton Woods to the Petrodollar (1971-1992)

*The dollar is our currency, but your problem.* John Connally Secretary of Treasury 1971

### 4.1 Historical review

In the middle of the twentieth century the world was divided into two geopolitical blocs. The western capitalistic coalition led by the US and the Communist bloc lead by the USSR. Moreover, Japan and the Federal Republic of Germany emerged as new economic powers.

In the backbone of the Cold War, there was a mutual annihilation scenario. For instance, submarines with nukes ready for retaliation in case of a nuclear attack, persuaded these two geopolitical powers from avoiding a direct military confrontation. However, the Cold War triggered global political instability in the form of proxy wars and guerrillas [20].

For example, military confrontations and guerrillas wars were common in Latin America and Africa. In Asia, Vietnam was the most important proxy war. Furthermore, the Korean peninsula, Cambodia, Laos and the Middle East were heavily affected by the struggle of power between the US and the Soviet Union.

In the heart of Europe, Germany was divided into two blocs: West and Eastern Germany. West Germany was part of the US Marshall plan while Eastern Germany was controlled by the Soviet regime. The Berlin wall was the physical materialization of the iron curtain in the Cold War. Figure 4.1 shows a map with the geopolitical influence of the US and USSR.

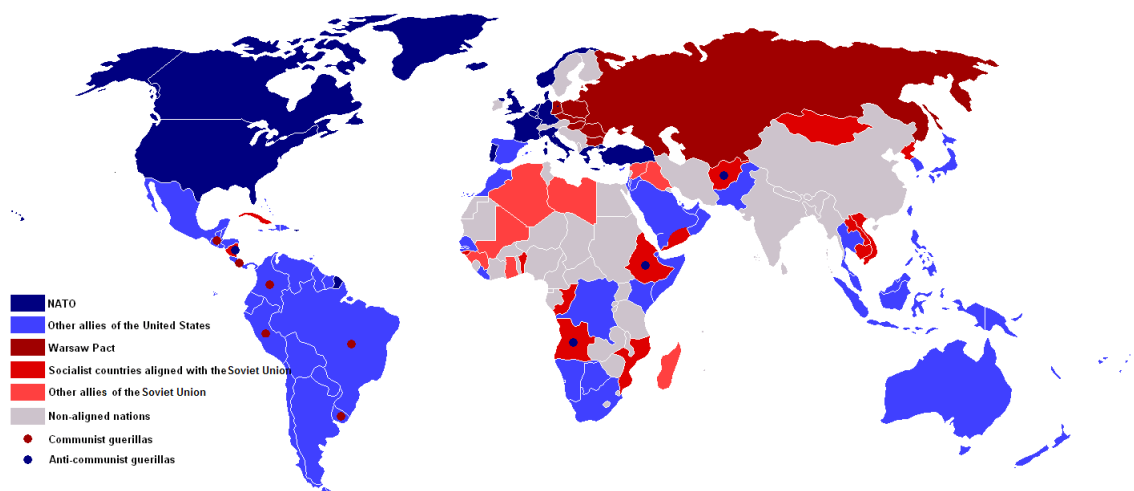


Figure 4.1: .Cold War geopolitical distribution among the US and USSR allies. Source: University of Notre Dame. <http://ocw.nd.edu/physics/nuclear-warfare/images-1/Cold-War-Map.jpg/>

The UK and France succeeded in re-building their economies after the US Marshall plan. Their geopolitical power was reestablished. Both of them had a permanent chair in the security council of the United Nations (UN) and the North Atlantic Treaty Organization (NATO). However, French president De Gaulle protested the United States' strong role in the NATO and what he perceived as a special relationship between it and the United Kingdom[21]. In fact, France withdrew from the NATO in 1958 [22]. France inconformity was not only about a secondary role in the geopolitical sphere but also in the international monetary system. In 1960, Valéry Giscard d'Estaing, French minister of Finance, coined the term "exorbitant privilege" referring to the fact that the United States had a reserve currency they could print [14].

The race for global domination between the United States and the Soviet Union reached the space. The Soviets were the first to orbit the earth in 1964, while the American reached the moon 1969. However, the contest for being a hegemonic power was not for free. Every geopolitical power racked up huge costs. This was reflected in the international monetary system, where the core of the Bretton Woods standard -the parity between dollar and gold- was under question.

The Vietnam War was going to cost the USD 500 Billion. The stark reality was the US simply could not print enough money to cover its war costs, it's gold reserve had only USD 30 billion, most of its reserve was already backing existing USD dollars [23]. The government refused to raise taxes, therefore the only option remaining for the Nixon government was to make the dollar float freely.

Currency War II began with the collapse of the Bretton Woods standard in 1971 with the Executive Order 11615, pursuant to the Economic Stabilization Act of 1970. This act was divided in three orders. 1) the gold window must be closed. Foreign governments could no longer exchange their dollars for gold. 2) A 90-day freeze on wages and prices was to be implemented in order to counter inflation 3) An import tariff was set at 10 percent to ensure that American products would not be at a disadvantage because of the expected fluctuation in exchange rates[24].

But how to make the US dollar a sounding currency when the US was explicitly targeting a currency devaluation? The answer was by using its hegemonic military power. Nixon signed a deal with Saudi Arabia exchanging petrodollars for military protection in the region, ensuring a new international demand for US dollar assets independent of the US internal economic growth.

*“In a nutshell, any country that wants to purchase oil from an oil producing country has to do so in U.S. dollars. This is a long standing agreement within all oil exporting nations, aka OPEC, the Organization of Petroleum Exporting Countries. The UK for example, cannot simply buy oil from Saudi Arabia by exchanging British pounds. Instead, the UK must exchange its pounds for U.S. dollars. . .*

*This means that every country in the world that imports oil—which is the vast majority of the world’s nations—has to have immense quantities of dollars in reserve. These dollars of course are not hidden under the proverbial national mattress. They are invested. And because they are U.S. dollars, they are invested in U.S. Treasury bills and other interest bearing securities that can be easily converted to purchase dollar-priced commodities like oil. This is what has allowed the U.S. to run up trillions of dollars of debt: the rest of the world simply buys up that debt in the form of U.S. interest bearing securities.” [25]*

The international monetary system was no longer gravitating around the Bretton Woods gold-dollar but around the new oil-dollar hybrid. The “petrodollar” agreement made the dollar stability more susceptible to geopolitics and the relationship between Islamic countries and Israel. The Soviets were able to exploit this vulnerability. In 1973 they backed Syria and Egypt in the Yom Kippur war [26]. On October 19, President Nixon authorized a major allocation of arms supplies and USD 2.2 billion in appropriations for Israel. In response, Saudi Arabia declared an embargo against the United States, later joined by other oil exporters and extended against the Netherlands and Japan, causing the 1973 energy crisis [27]. As the dollar was floating freely, the oil barrel raised from USD 3 to nearly USD 12. Every major economy in the world was under an inflationary shock. Figure 4.2 shows the inflation of major economies - US, Average Euro Area, Japan, UK, Canada and Australia- during currency war II.

Japan was an early victim of the currency warfare. First the tariff imposed by the Nixon Government 1971 and then the oil embargo of 1973 put the Japanese economy under pressure. The Japanese economy was particularly vulnerable to the fluctuation of the yen/dollar exchange rate for several reasons. 1) Japan’s trade and virtually all of its financial transactions were conducted in dollars. 2) Japan, as the largest creditor country by that time, had accumulated a huge amount of unhedged dollar assets which were concentrated in US government bills and bonds, and whose values would depreciate whenever the dollar fell. 3) Japanese industries exhibited relatively low exchange pass-through (the degree of domestic price response to exchange fluctuations) and their products contained relatively high domestic added value. If the yen is appreciated, their yen-denominated costs would also rise almost proportionately, leading to the loss of competitiveness. As a result, Japanese output and investment was stagnating, prices and wages were suppressed, and financial strain was created[28].

Some economists argue that the Japanese economy had structural advantages to deal with oil shocks in the long-run. For example, the Japanese cars were more fuel efficient than their American competitors. Moreover, the Japanese economy shifted its emphasis away from primary and secondary activities (notably agriculture, manufacturing, and mining) to processors, telecommunications and computers [29].

Nevertheless, from the perspective of the Americans, Japan was using unfair competitive strategies such as dumping. Indeed, US politicians accused Japan of deliberately currency devaluation with respect to the US dollar in order to boost Japanese exports. The result was an American “Japan bashing”, with threats of tariff and quotas on imports of goods from Japan, unless the yen appreciated[24].

Japan was not the only country affected by the Nixon policies. The European Community countries (ECC) developed a monetary coordination mechanism known as the “Snake in the Tunnel ” in order to ensure European currencies’ stability with respect to the US dollar. The Snake set bands of  $\pm 2.25\%$  for currencies to move relative to their central rate against the US



dollar. This provided a tunnel in which European currencies traded. However, it implied much larger bands in which they could move against each other: for example if currency A started at the bottom of its band it could appreciate by 4.5% against the dollar, while if currency B started at the top of its band it could depreciate by 4.5% against the dollar [30].

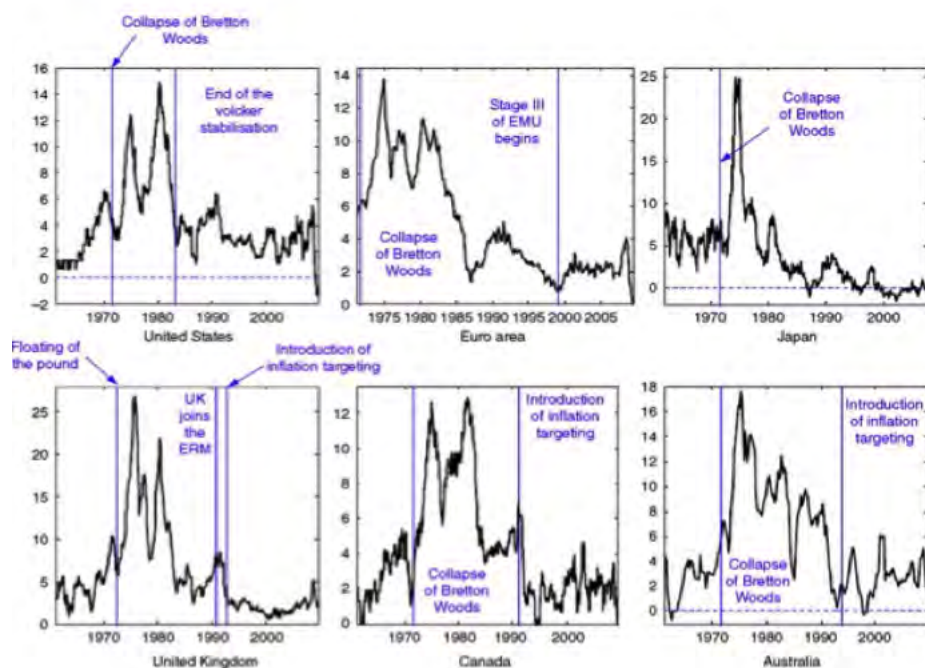


Figure 4.2: Inflation in the developed countries during currency war II. Source: ECB

Despite of the geopolitical success of the Soviets in the Middle East, the Communist bloc was not stable. Communism in China and the USSR was very divergent. In 1964, China tested its first nuclear bomb. Differences were evident in border conflicts between China and the USSR. In 1966, the Chinese had revived the matter of the Russo-Chinese border that was demarcated in the 19th-century. In 1971 the Republic of China was out of the UN security council, and the People's Republic of China took their place, despite of the US opposition.

China was facing three enemies at the same time, USSR, US and the risk of a political revolution. A reestablishment of relationship with the US was key for the survival of the Mao movement [31]. In 1972 US president Nixon made a historically important visit to the People's Republic of China. The three objectives for the Nixon trip were: 1) to embrace People's Republic of China for peaceful settlement of Taiwan. 2) to settle peacefully the Vietnam War and 3) to deter Soviet Union's sphere of Communist influence after the Sino-Soviet Split[32]. China began its road to modernization and reforms.

In 1979, the Iranian revolution<sup>1</sup> led to a sudden jump in oil prices. Stagflation (high inflation and low growth) was a threat for the global economy. Reforms and a change in foreign policy were needed around the world. That was exactly what the leadership of Reagan in US and Thatcher in the UK was about - doing structural pro-market reforms-. In fact, the pillars of the

<sup>1</sup>Iran was a not aligned country in the Cold War

Reagan economic agenda were: 1) reducing government spending, 2) reducing the federal income tax and capital gains tax, 3) reducing government regulation, and 4) tightening the money supply in order to reduce inflation.

Consequently with these policies, Paul Volker, the US Federal Reserve Chairman raised the federal funds rate, which had averaged 11.2% in 1979, to a peak of 20% in June 1981 in order to control inflation expectations. Although these anti-inflationary measures triggered a recession in the US in the short term, they also enabled the path for a new economic boom in US in the mid-term.

In the UK, Thatcher's political philosophy and economic policies emphasized deregulation (particularly of the financial sector), flexible labor markets, the privatization of state-owned companies, and the reduction of power and influence of trade unions. In foreign policy Reagan and Thatcher were natural allies facing the soviet threat. The "Reagan Doctrine" controversially granted aid to paramilitary forces seeking to overthrow communist or leftist governments, particularly in Latin America and Afghanistan[33]. Whereas, Thatcher's cold war policy was focused on reestablishing the diplomatic channel with USSR. She was able to read from the beginning that Gorbachev was a very different Soviet leader.

*"I am cautiously optimistic. I like Mr. Gorbachev. We can do business together. We both believe in our own political systems. He firmly believes in his; I firmly believe in mine. We are never going to change one another. So that is not in doubt, but we have two great interests in common: that we should both do everything we can to see that war never starts again, and therefore we go into the disarmament talks determined to make them succeed. And secondly, I think we both believe that they are the more likely to succeed if we can build up confidence in one another and trust in one another about each other's approach, and therefore, we believe in cooperating on trade matters, on cultural matters, on quite a lot of contacts between politicians from the two sides of the divide". Margaret Thatcher BBC Interview May 1984*<sup>2</sup>

In Asia, the Japanese prime minister Nakasone embraced the privatization initiative, which led to the breakup of Japan National Railways into the modern Japan Railways Group. Nevertheless, Japan procrastinated the reforms needed after the catch-up period. Japan was reluctant to US free markets changes because they wanted to keep the characteristics of their own economic model[28]. In foreign policy Japan normalized international relationships with China and Russia, however geopolitically Japan remained military allied of the US.

The most radical reforms in Asia were not in Japan but in China. Led by Deng Xiaoping in 1978, China began a program of reforms summarized in -change, reform and "open up"-. The reforms, also known as Socialism with Chinese characteristics, were divided in two stages. The first stage, in the late 1970s and early 1980s, involved the decollectivization of agriculture, the opening up of the country to foreign investment, and permission for entrepreneurs to start-up businesses. However, most industries remained state-owned. The second stage of reform, in the late 1980s and 1990s, involved the privatization and contracting out of much state-owned industry and the lifting of price controls, protectionist policies, and regulations, although state monopolies in sectors such as banking and petroleum remained. [34]

In Continental Europe, Kohl, the German chancellor was focused on strategies to ensure German unification. In France, president Mitterrand was focused on the industrial modernization and the creation of the European Union. Moreover, the exchange rate mechanism (ERM) was introduced in 1979. Its main objective was to reduce exchange rate volatility and to achieve monetary stability in Europe, in preparation for Economic and Monetary Union.

The ERM was based on the concept of fixed currency exchange rate margins, but with exchange rates variable within those margins. Exchange rates were based on the European Currency Unit (ECU), the European unit of account, whose value was determined as a weighted average

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<sup>2</sup><http://www.margaretthatcher.org/document/105592>

of the participating currencies. The core of the ERM was the German D-Mark, the strongest European currency by that time. A grid (known as the Parity Grid) of bilateral rates was calculated on the basis of these central rates expressed in ECUs, and currency fluctuations had to be contained within a margin of 2.25% on either side of the bilateral rates (with the exception of the Italian lira, the Spanish peseta, the Portuguese escudo and the pound sterling, which were allowed to fluctuate by  $\pm 6\%$ ). Determined intervention and loan arrangements protected the participating currencies from greater exchange rate fluctuations.<sup>3</sup>

The latecomer to the reforms was the USSR when Gorbachev took power as the General Secretary of the Communist Party of the Soviet Union. As de facto ruler of the USSR, he tried to reform the stagnating Party and the state economy in February of 1986 by introducing glasnost ("openness"), perestroika ("restructuring"), demokratizatsiya ("democratization"), and uskoreniye ("acceleration" of economic development).

In Geopolitics Gorbachev foreign policy agenda improved relations and trade with the West by reducing Cold War tensions. He established close relationships with several Western leaders, such as West German Chancellor Helmut Kohl, U.S. President Ronald Reagan, and British Prime Minister Margaret Thatcher. On 11 October 1986, Gorbachev and Reagan met in Reykjavík, Iceland, to discuss reducing mid-range nuclear weapons in Europe. In 1988 the Soviet Union withdrew its troops from Afghanistan.

A turning point in the nuclear race between US and USSR was the Chernobyl nuclear tragedy on the 26 April 1986. This nuclear tragedy was very different from former ones in the cold war. This time information about Chernobyl was not secret, it was open to the public and media. The Glasnost policy introduced some months before by Gorbachev was proven right at his remedy for widespread censorship and government secrecy. The explosion and attendant tumult, was a signal, that in the words of Gorbachev, "made absolutely clear how important it was to continue the policy of glasnost." Chernobyl gave Gorbachev the political capital to achieve reforms aiming to have a more transparent government and a less autocratic state. In 1989 a series of radical political changes occurred in the Eastern bloc. They were associated with the liberalization of the Eastern Bloc's authoritarian systems and the erosion of political power in the pro-Soviet governments in nearby Poland and Hungary. The Berlin wall fell down in November of 1989 and with that the cold war iron curtain. Fear and uncertainty was in the mind of European policy makers, as the future of Europe was difficult to predict.

*"We do not want a united Germany. This would lead to a change to postwar borders and we cannot allow that because such a development would undermine the stability of the whole international situation and could endanger our security", Thatcher told Gorbachev*".<sup>4</sup>

The 8th of December of 1991 the USSR was dissolved when the presidents of the new Russia, Ukraine and Belarus (formerly Byelorussia), signed the Belavezha Accords, which declared the USSR dissolved and established the Commonwealth of Independent States (CIS) in its place. The cold war finished and with that a new rebalance of economic power. The new international monetary system was based on the USD dollar.

The European Monetary Union emerged as integration project to ensure peace and political stability in the region, containing the fears of a unified Germany. The European Monetary Union had two stages: first, the abolishment of capital movement restrictions. Second, the creation of a common currency: the Euro. The UK joined the ERM in 1990 boosting the political support for the Euro project. The German unification had a deep impact in the European Rate Mechanism. A reunified Germany implied more fiscal spending and a divergence between the policies needed by Germany and the rest of the ERM countries. Germany financed the reunification by borrowing

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<sup>3</sup>This is based on the European Commission reports about the evolution of the European Monetary System [http://ec.europa.eu/economy\\_finance/euro/emu/road/ems\\_en.htm](http://ec.europa.eu/economy_finance/euro/emu/road/ems_en.htm)

<sup>4</sup><http://www.margaretthatcher.org/document/112006>

money. It went from a budget surplus country the year before the unification to a deficit of 153 billion German D-Marks.

Germany had a structural need of a stronger German D-Mark reflecting the import of foreign capital to fund the unification. France was reluctant to a Franc devaluation respect to the German D-Mark, because it would imply an abandonment of the “Franc Fort”, the center piece of its internal economic policy. The only adjustment mechanism for this trade imbalance was inflation. Germany extraordinary fiscal spending and the lack of a flexible foreign exchange system caused an increase in inflation expectations. The Bundesbank had to rise interest rate to contain inflation in a moment where many ERM economies were close to a recession[30]. In particular, Italy and the UK. In 1992 , George Soros took advantage of the vulnerability in the ERM system. He designed a massive short trade over the British pound against the German D-Mark based in the rationale that the UK macroeconomic policy was contradictory with the ERM pegged system. In fact, he was in the “hall of fame” of finance with the equivalent of 1 billion USD in profits.

Table 4.1 summarizes the most relevant events in geopolitics and economics necessary to use the game theory framework.

Attributes	Currency War II
Geopolitical Powers	US, UK , FRANCE
Geopolitical Challengers	Soviet Union (USSR)
Emergent Economy	Japan and Germany
Wars	Proxy Wars: Yom Kippur, Vietnam, South America and Africa guerrillas
Reforms	US (Reagan) , UK (Thatcher), China (Deng Xiaoping)
Reform Procrastinators	USSR, JAPAN
Revolutions	Iran
Hyperinflationary Episodes	Latin America (80s)
Technology Revolutions	Microprocessor, electronics, telecommunications
Important Coalitions	Economic: ERM, NATO , German Unification
Monetary standard in decadence	Bretton Woods
Emergent monetary standard	US dollar, petro-dollar

Table 4.1: Summary Currency War II

## 4.2 Games’ sequences Currency War II

The most important geopolitical powers in Currency War II were: US, UK, France, Germany, USSR, Japan and China. For convenience, I will reduce this set of seven countries into 5 geopolitical blocs based on the similarities and differences in the governance mechanisms in politics and economics.

For instance, the most important governance mechanisms were the capitalist states and Communists states. The US was the reference model from the first and the USSR for the second. However, there were different versions. For example in the case of capitalistic states the US and the UK capitalism was focused on the geopolitical agenda. Welfare States (Germany and France)

were focused in the protection and promotion of the well-being of their citizens. Collective capitalism was focused on long-term relationships, resulting in an economy based on “relational markets”. On the other hand in the case of Communist States there were two variants. A less autocratic Communist along with a planned economy (USSR) and a highly autocratic Communist along with a market economy (China).

I divided Currency war II in ten games’ sequences. They correspond to a 2X2 tournament between US & UK, Germany & France, USSR, Japan and China. There were two blocs in military confrontation the US & UK and USSR. The Germany & France bloc had common geopolitical incentives with US & UK to face the USSR. However, their economics interest diverged. Japan was aligned with the NATO countries, however it was not involved in any proxy war. In the times of Mao and Stalin, the USSR and China had common geopolitical interests. However, since the Sino-Soviet split there were strong economic divergences.

Moreover, as in CW I, the sequence of games is divided in 9 games. They are compared analogically with the phases in chess: Opening, Middle Game, End Game. In general, I will show that the opening is about protectionism and monetary policy. The middle game about coalitions and wars. The end game is about structural reforms, failures in the coalitions and revolutions.

Figure 4.3a shows the currency war between the US & UK and the USSR. It shows that in the opening both blocs used trade barriers and monetary policy strategies. The games in this phase were from the loss-loss, conflict families. In the middle game geopolitical powers used coalitions and proxy wars. The games in this phase were from the critical family. The end game was defined by proxy wars and the dissolution of the soviet coalition. The games in this phase were from the critical, unfair and win-win families. Figure 4.6a shows the payoffs for the US&UK and USSR currency war. It shows that in the opening both geopolitical blocs had positive payoffs. In the middle game both blocs had heavy losses. In the end game, the US&UK had a recovery while the USSR high costs associated with the USSR collapse.

Figure 4.3b shows the currency war between US & UK and Germany & France. It shows that in the opening both blocs used trade barriers and monetary policy strategies. In the middle game, both blocs had a geopolitical coalition among them. However, they used different monetary policy strategies to get a tactical advantage. Games in this phase were from unfair and loss-loss families. In the end game, the coalition transformed the games into the biased family where both blocs had a favorable outcome. Figure 4.6b shows the payoff for the US & UK versus Germany & France currency war. In the opening both blocs had positive payoffs. However, Germany& France had a higher advantage. In the middle game this advantage continued due the cost of the US & UK structural reforms. In the end game both blocs had positive payoff. However, this time the advantage is for the US & UK.

Figure 4.3c shows the currency war between US & UK and Japan. It shows that in the opening both blocs used trade barriers and monetary policy. The games from this phase were from the loss-loss, conflict and unfair family. In the middle game both geopolitical blocs used monetary policy as the main strategy. The end game happened after the US structural reforms. It transformed the games into the critical family. Figure 4.6c shows the payoffs for the US & UK and Japan currency war. In the opening both blocs had positive payoffs. In the middle game both had positive payoffs. However, Japan had a higher advantage than the US & UK bloc. In the end game both blocs had heavy losses.

Figure 4.3d shows the currency war between US & UK and China. It illustrates that in the opening both geopolitical blocs used trade barriers and monetary policy. The games of this phase were from the loss-loss, conflict and unfair family. In the middle game both blocs used monetary policy and the US structural reforms. The games of this phases were from the unfair and loss-loss families. In the end game China also did structural reforms which transformed the games into

the win-win family. Figure 4.6d shows the payoffs for the US & UK and China currency war. In the opening both blocs had positive payoff. In the middle game China had an advantage over US & UK. In the end game both blocs had a win-win situation.

Figure 4.4a shows the currency war between Germany & France and USSR. It shows that in the opening both blocs used trade barriers and monetary easy policies. In this phase the games were from the loss-loss and conflict family. In the middle game both blocs had military coalitions with opposite geopolitical interests. Moreover, they used proxy wars between them. In this phase the games were from the critical family. In the end game both countries avoided proxy wars and just competed with monetary policy strategies. Transforming the game from the critical family into the second best family. Moreover, the dissolution of the Soviet coalition transformed the game into the original PD. Figure 4.6a shows the payoffs for the Germany & France and USSR currency war. It shows that in the opening both blocs had a positive payoffs. In the middle game both blocs had heavy losses. In the end game Germany & France had a weak recovery while the USSR had the cost associated to the collapse of the soviet coalition.

Figure 4.4b shows the currency war between Germany& France and Japan. It shows that in the opening both blocs used trade barriers and monetary policy. The games of this phases are from the loss-loss and the conflict family. Both blocs had aligned geopolitical interest therefore the confrontation among both focused on monetary policy in the middle and end game. The games from this phases were from the unfair and loss-loss family (PD Neighborhood). Figure 4.6b shows the payoffs of Germany & France and Japan currency war. It shows that in every phase both blocs had positive payoffs. However in the opening Japan had a higher advantage. In the middle game Germany & France had the advantage. In the end game Japan had the advantage again.

Figure 4.4c shows the currency war between Germany & France and China. In the opening both blocs used trade barriers and monetary policy strategies. The games were from the loss-loss family and the conflict family. In the middle game both blocs avoided military confrontations and the strategies were based on monetary policy. The games of this phase were from the unfair family. In the end game Chinese structural reforms transformed the games into the critical and biased families. Figure 4.6c shows the payoffs of Germany & France and China currency war. In the opening and the middle game both blocs had positive payoffs. In the end game both blocs had losses.

Figure 4.5a shows the currency war between Japan Vs China. The game sequence is equal to the the currency war between Germany & France where the Chinese structural reforms transformed the games from the unfair family into the critical and biased family. Figure 4.6d shows the the payoffs of Japan and China currency war.

Figure 4.5b shows the currency war between Japan and the USSR. In the opening both blocs used trade barriers and monetary policy strategies. In this phase the games were from the conflict and unfair family. In the middle game both blocs avoided geopolitical confrontation between them, competing only by means of monetary policy strategies. The games in this phase were from the unfair family. In the end game the dissolution of the USSR transformed the games into the critical family. Figure 4.6e shows the payoffs of the Japan & USSR currency war. Both blocs had positive payoffs in every phase until the dissolution of the USSR where they had losses.

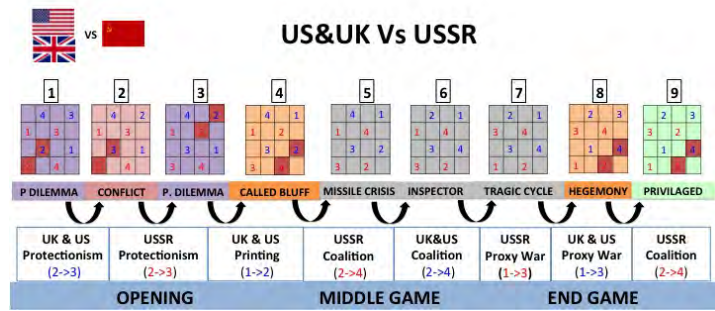
Finally, figure 4.5c shows the currency war between the USSR and China. It shows that in the opening both blocs used trade barriers and monetary policy strategies. The games of this phase were from the loss-loss and conflict families. In the middle game both blocs avoided geopolitical confrontations between them. They competed with monetary policy strategies. In the end game, the Chinese structural reforms and subsequently the USSR dissolution, transformed the games into the critical and biased families. Figure 4.6f shows the payoffs from the USSR and China currency war. It shows that in the opening and the middle game they had positive payoffs. In

the end game they began with heavy losses but ended with a recovery. Chinese recovery was stronger than the USSR.

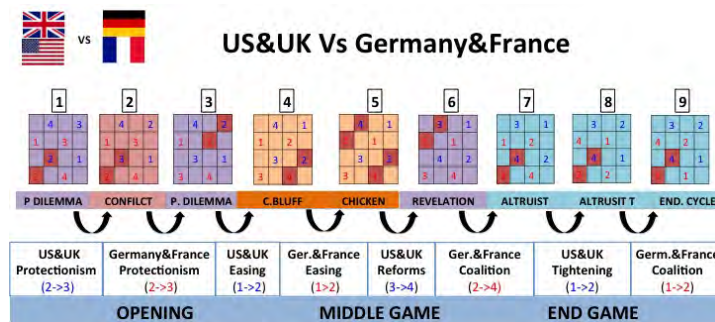
Figure 4.7 shows the total payoff of CW II. It shows that in the opening the USSR, US & UK and Germany & France had the best payoffs. In the middle game Japan and China had the best payoffs while the other blocs had losses. The USSR had the worst outcome in this phase. In the end game Japan and China had losses while Germany & France and the US & UK had a strong recovery. The USSR was the loser of CW II.

The patterns observed in CW I persist. The opening is characterized by protectionism and monetary easing policy. In general every player involved in a currency war had a positive payoff in the opening. The middle game is characterized by coalitions and wars. Countries had heavy losses. On the other hand countries which avoided geopolitical strategies had favorable outcomes. The end game is characterized by reforms, wars and coalition dissolutions. There is a strong recovery in the countries with reforms. The avoidance of reforms transformed the games into the critical family.

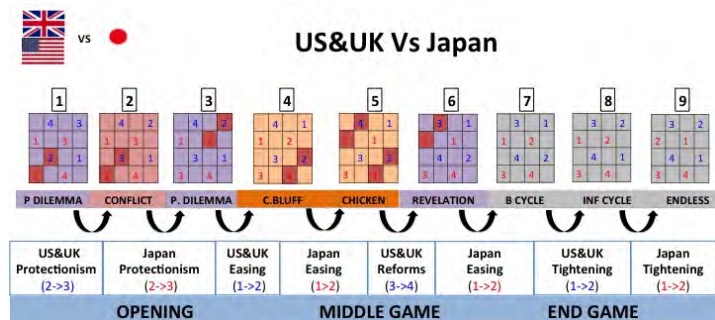
In the aftermath of CW I the USSR disappeared. The US was the new hegemonic geopolitical power. The world is divided in three governance mechanism in politics and economics: the Welfare and Capitalist States along with communist autocracies with capital markets. Humankind experiment transformation from mutual annihilation fear to a period of tremendous optimism and technological development. In fact, the global technological revolution in microprocessors, electronics and telecommunications enabled geopolitical powers to remain coordinated in a win-win situation. The international monetary system was the fingerprint of this transformation. The Bretton Woods standard, which in turn, was replaced for a pure fiat dollar monetary system.



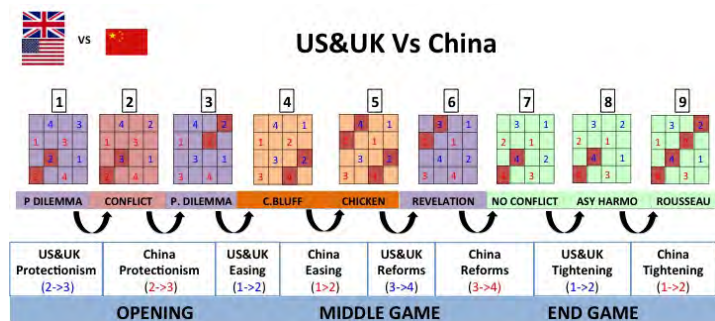
(a) US&UK Vs USSR



(b) US&UK Vs Germany&France



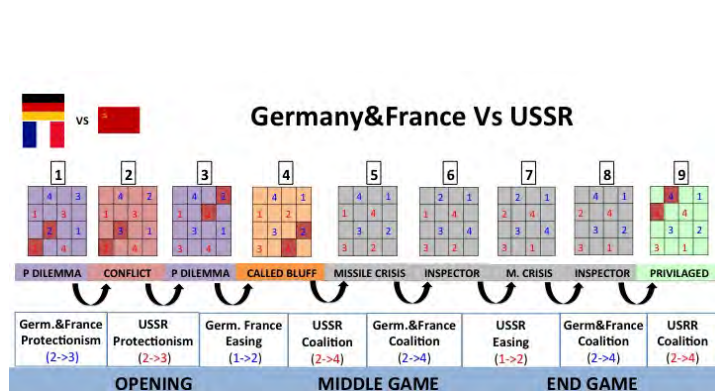
(c) US&UK Vs Japan



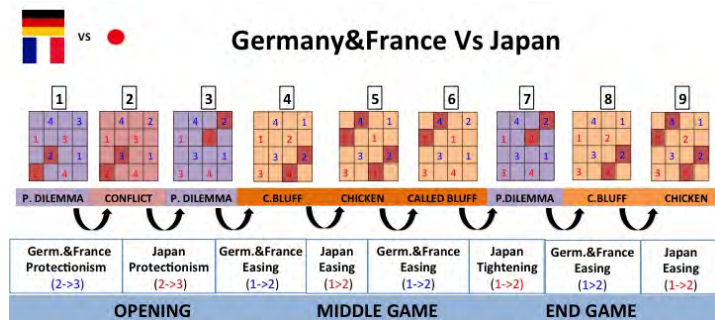
(d) US&UK Vs China

Figure 4.3: 'Currency War II games' sequence. Flags indicate geopolitical powers in conflict. The boxes' color indicates the game family. Purple: Loss-Loss. Pink: Conflict. Orange: Unfair. Yellow: Second Best. Gray: Critical. Blue-Marine: biased. Green: Win-Win. Red boxes the Nash equilibria in pure strategies.

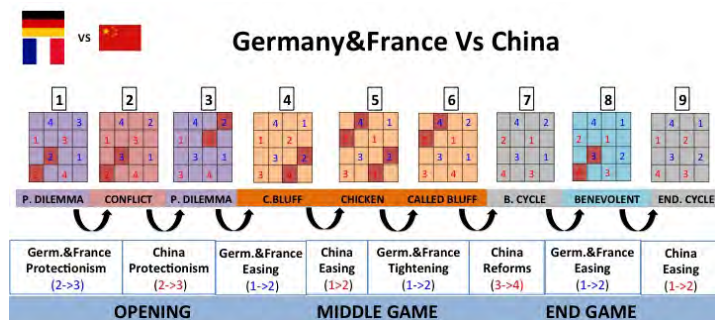




(a) Germany & France vs USSR

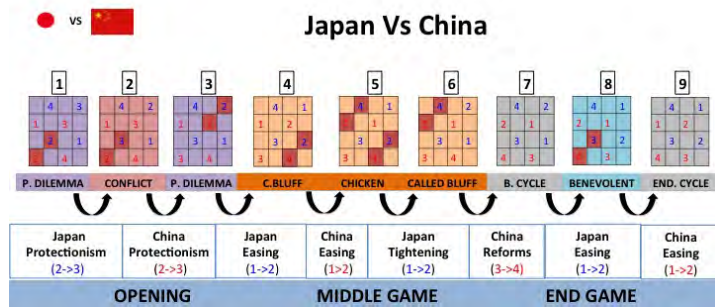


(b) Germany & France vs Japan

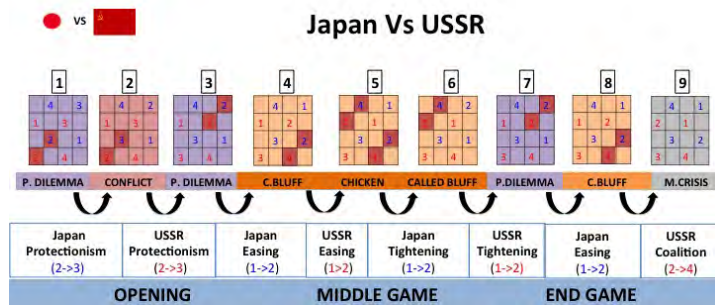


(c) Germany & France vs China

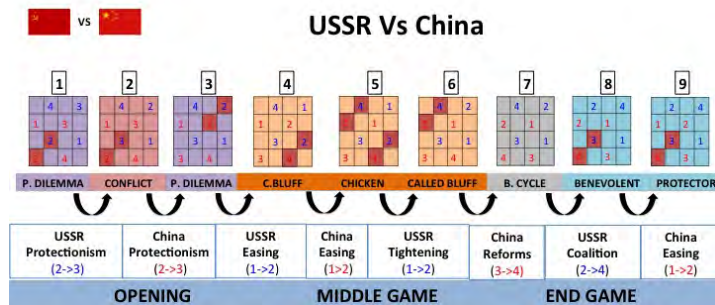
Figure 4.4: Currency War II games' sequence. Flags indicate geopolitical powers in conflict. The boxes' color indicates the game family. Purple: Loss-Loss. Pink: Conflict. Orange: Unfair. Yellow: Second Best. Gray: Critical. Blue-Marine: biased. Green: Win-Win. Red boxes the Nash equilibria in pure strategies.



(a) Japan vs China

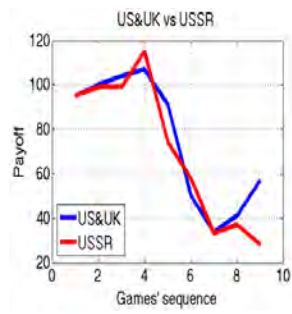


(b) Japan Vs USSR

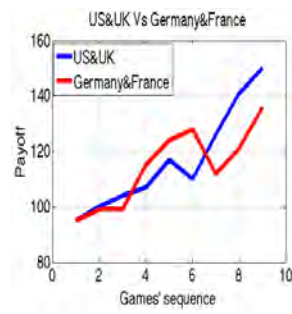


(c) USSR Vs China

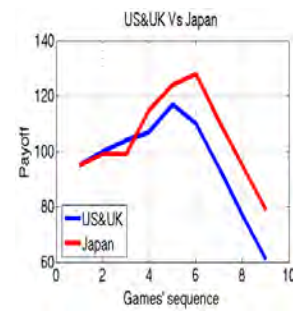
Figure 4.5: Currency War II Japan, China, USSR.



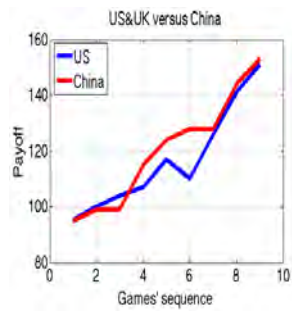
(a) Currency War II US&UK versus USSR payoffs.



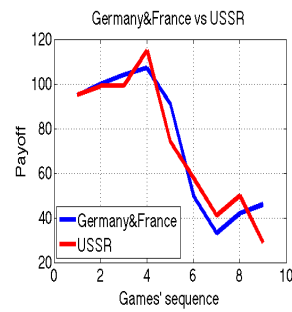
(b) US&UK versus Germany&France



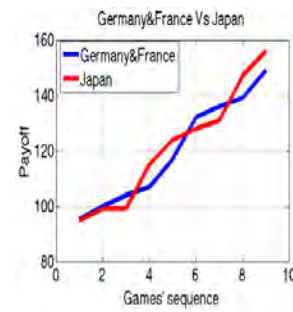
(c) US&UK versus Japan



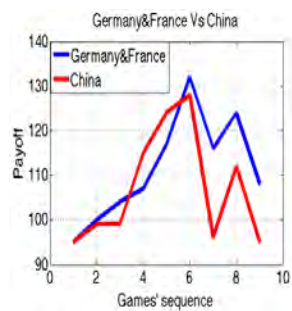
(d) US&UK versus China



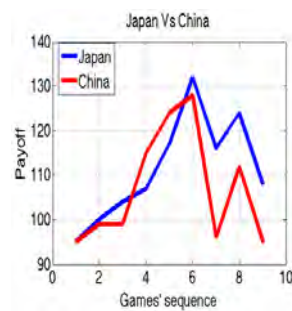
(e) Germany&France versus USSR



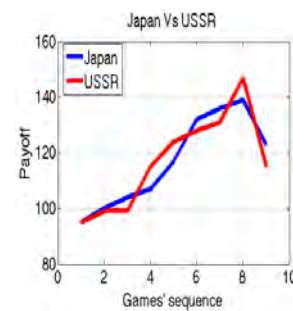
(f) Germany & France versus Japan



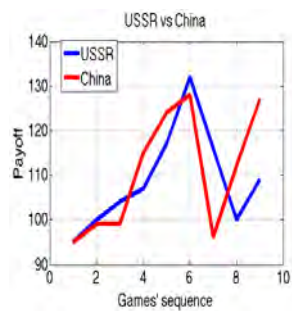
(g) Germany & France versus China



(h) Japan versus China



(i) Japan versus USSR



(j) USSR versus China

Figure 4.6: Currency War II game sequence payoffs.

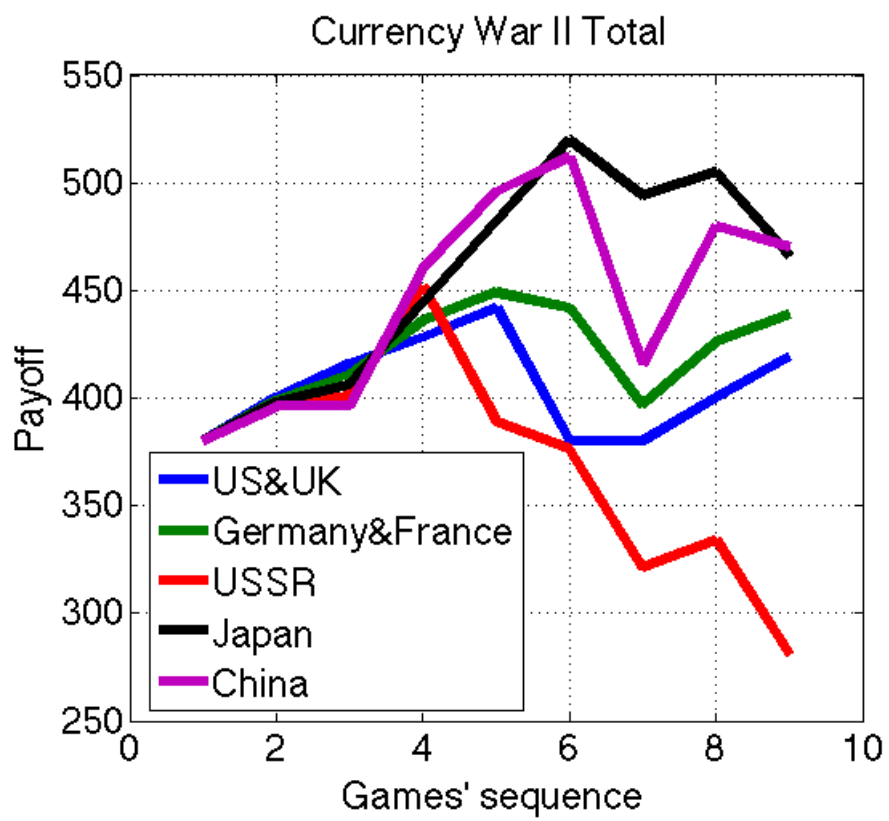


Figure 4.7: CW II total payoffs by geopolitical power. The total payoff is computed as a sum of the payoffs of each player's games.

## Chapter 5

# Currency War III : From the petro-dollars to a multipolar international system

*The current international monetary system is product of the past* , Hu Jintao General Secretary of the Communist Party of China 2011.

### 5.1 Historical Overview

By the end of the XX century, the world's economy has been divided between- the United States, UK, Germany, France, Italy, Russia, China, India and Brazil-. In particular Global trade was backed by the military hegemonic power of the United States. Figure 5.1 shows the most important countries in currency war III.

At that time the most important change in the global economy was the emergence of China as the cheapest factory in the world. China's biggest competitive advantage was its low labor cost and a potential internal market of 1.3 billions consumers. The rise of China redefined the global supply chain. Multinational corporations converged to a model where the production was based on China, the R&D facilities in the US or Europe and the financial consolidation in countries or special districts with low taxes (Switzerland, Netherlands, Hong Kong, Singapore).

The emergence of China as a new competitor caused a decline in exports for the ASEAN countries (Indonesia, South Korea, Thailand, Hong Kong, Malaysia, Laos and the Philippines). With the aim of counteracting low exports, ASEAN governments boosted economic growth by using monetary easing policy and fiscal stimulus. Subsequently, international capital inflows along with the excess of credit, inflated the real estate and equity prices. In 1997, the ASEAN equity bubble collapsed. The high dependence of ASEAN countries on international capital caused a currency crisis. Moreover, the shut-down of the ASEAN production engine also implied a decrease in world demand for oil and non-ferrous metals, the most important capital inflows for Russia. Russian fragile economy was no resilient to the global emerging markets capital outflows, resulting in the 1998 Russian crisis. International flows moved into the US. In particular, into technology stocks. High interest rates in the USD holdings along with dot-com boom attracted the international flows. The motto of creating a "network effect" able to monopolize the market at the expense of the net income created a huge overvaluation in the Nasdaq Index prices. The dot-com bubble crashed in 1999 and with that the US entered in a recession.

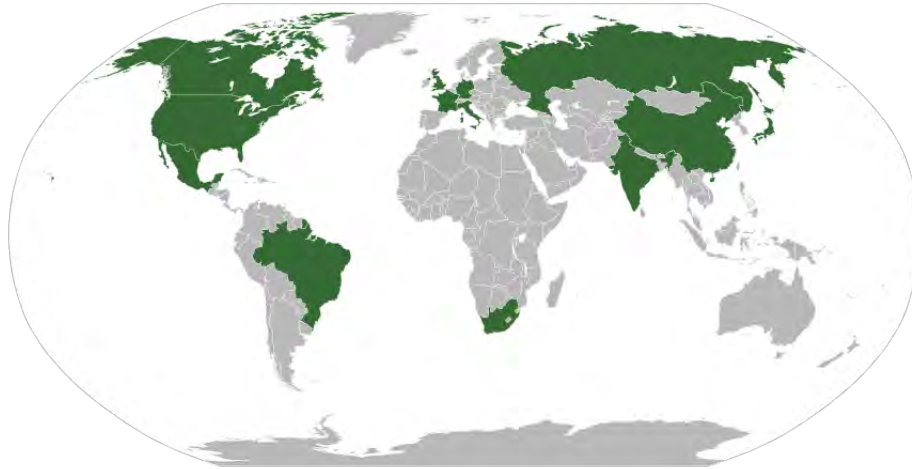
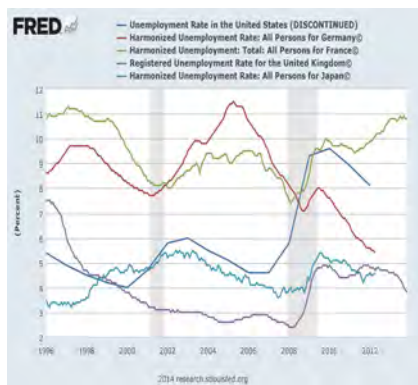
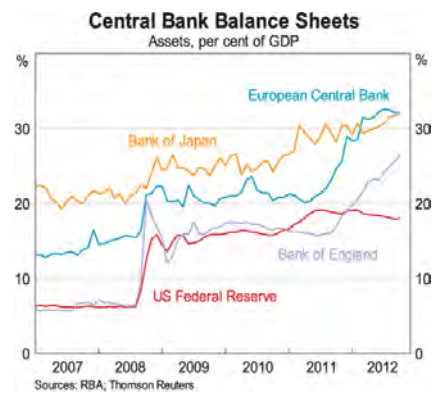


Figure 5.1: Main geopolitical actors currency war III



(a) Unemployment rates of developed countries and China



(b) Major central banks balance sheet after the 2008 great financial crisis.

Figure 5.2: Currency War III

Natural monopolies emerged around common pool resources. Industries such as banking, technological infrastructures and energy were highly concentrated. Moreover, the labor advantages in China were not for free. Labor conditions were very poor [35] and in some cases resembles the US labor conditions at the beginning of the century.

Currency war III began in 1999, after the Asian, Russian, and dot-com crisis along with the emergence of the Euro as global reserve currency. Because of the crisis, unemployment soared in the US and Europe. Figure 5.2a illustrates that Germany's unemployment rate reached the 11% level, France's 9.5%, US and UK's approximately 6%.

Major economies used monetary easing policy to alleviate unemployment by stimulating investments and consumption. The Euro monetary system was also of great advantage in times of the crisis. For instance, it enabled the peripheral countries (Portugal, Italy, Greece and Spain) to get access to international credit at German's bond rates. For the core countries (Germany, France, Netherlands, Austria) the Euro gave a weaker currency for boosting their exports. However, low interest rates in the Eurozone periphery also means that their members



can finance their fiscal spending via the international bonds market at very low rates without transforming their internal economic institutions.

Many researchers and financial professionals argue that the world wide monetary easing policy along with home loans programs backed by the state prompted the real estate bubble in US, UK and Europe[36, 37]. This rationale is based on the belief that easy monetary policies accentuated the debt financed booms-bust cycles[38, 39, 40, 41, 42].

The US, UK and Eurozone real estate bubble crashed in the 2008 Great Financial Crisis. The credit boom in the Euro periphery was over. Many members of the Eurozone experimented a sovereign debt crisis by 2009. As a consequence, the most important world's central banks used a massive coordinated monetary expansion to reestablish the international financial stability. Figure 5.2b illustrates the ratio of monetary assets versus GDP. It shows a coordinated jump in central banks' assets since the 2008 financial crisis.

Geopolitical strategies have been very intense in the currency war III. Terrorism and cyber wars had emerged as a new format of geopolitical confrontation. Proxy wars for the control of the oil- rich middle east had triggered a lot of instability in the region. In fact, since 2011 there is a wave of revolutions spread across North Africa and the Middle East.

Russia was also very active in geopolitical strategies. It was in war against Chechenia, Georgia and recently involved in two geopolitical crisis in Syria and Ukraine. There are two strategic regions where the major geopolitical powers have an intense foreign policy agenda: Iran and the Korean Peninsula (the Communist North Korea and the Capitalist South Korea). The US, Russia and China have conflict of interests in Iran. Russia, US, China and Japan have a conflict of interests in the Korean Peninsula.

Governments has been active in structural reforms. In US Obama's reforms are focused on more regulation in the financial system, restructuring the health care system and decreasing oil consumption in a 30% by 2030. In the Eurozone, the focus is on financial regulation and narrowing the competitiveness divergence between its members. In the UK the focus is on restructuring the welfare state and support sustainable employment. In Japan reforms are focused on the labor markets, agricultural and electricity sectors along with a general deregulation in markets. In China reforms are focused on restructuring the State Owned Companies, pro-markets reforms, while fostering the power of the State. In, Russia reforms are focused on the consolidation of Putin's leadership. India's reforms are focused on a more efficient government. India's reforms are emphasized in increasing investment, completing infrastructure projects in a time-bound manner, and efficiently utilizing natural resources. In Brazil the reforms agenda is still unclear. Table 5.1 summarizes the most important attributes of currency war III.

Attributes	Currency War III
Geopolitical Powers	US, Germany, UK, France, Japan
Geopolitical Challengers	Russia, Iran , North Korea
Emergent Economies	China, India, Brazil
Wars	Afghanistan, Iraq, Syria Crisis, Terrorism , Cyberwars
Reforms	US , UK China , Japan
Reform Procrastinators	GIIPS, Russia, Brazil?, India?
Revolutions	"Arab Spring", Ukraine, Venezuela
Hyperinflationary Episodes	?
Technology Revolutions	Robotics , Biotech , Big Data , New energies?
Important Coalitions	Economic: European Union. Geopolitics: NATO
Monetary standard in decadence	USD, Pretro-dollar
New monetary standard	Polycentric (multi-polar) international monetary system?

Table 5.1: Summary Currency War III. Question marks means that currently is uncertain.

## 5.2 Games' sequences: two foreseeable scenarios.

As we illustrated in the historical review the most important geopolitical powers in Currency War III were: US, UK, France, the Eurozone, Russia, Japan, China. Two emerging nations rich in natural resources are also relevant in this currency war: India and Brazil. Figure 5.3 shows the geopolitical powers grouped by the level of debt over GDP. Gray circles are highly indebted nations. Light blue creditor nations and commodities exporters. For instance, the upper triangle shows the US, UK and Japan are highly indebted countries. Moreover, they also have aligned geopolitical interest. Below at the left is located China and the countries rich in natural resources (Russia, India and Brazil). In the middle the Eurozone. An economic and geopolitical bloc with two important groups: the core (dark blue) and the periphery (light blue). The core (Germany, France, Netherlands, Austria) are the most global competitive economies. The periphery (Greece, Ireland, Italy, Portugal, Spain) are highly indebted countries with a lag in institutional development.

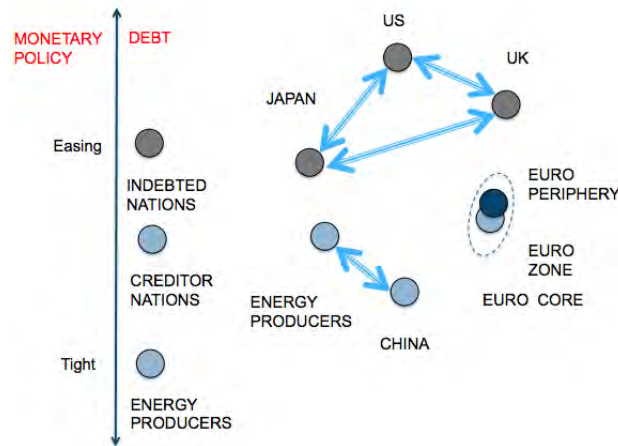
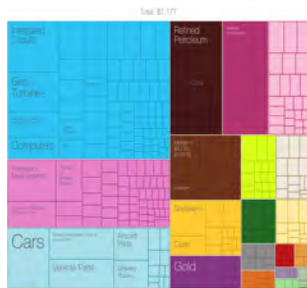


Figure 5.3: Incentives geopolitical power in CW III

Figure 5.4 shows what every major geopolitical power exports by product category. For instance, US, Germany and China exports more than 1 trillion USD each one. Moreover, the major exports are in high-tech sectors (Machinery, Computer and Chemicals). Japan, France and UK also have a similar exports product composition. Together exports add up to 1.5 trillion. Russia, India and Brazil export add up to 800 billions. Russia exports are concentrated specially in Oil and Gas. While India and Brazil have a more diversified portfolio of natural resources.

To analyze currency war III, I will consider 5 geopolitical blocs based on the different governance mechanism in politics and economics. The US & UK (democratic capitalism), Eurozone (welfare states), Japan (collective capitalism), China (state capitalism), India & Brazil (state Capitalism) and Russia (autocratic capitalism).





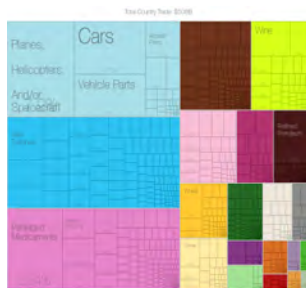
(a) US exports of 1.1 trillion USD.



(b) UK exports of 388 USD billion USD.



(c) Germany exports of 1.19 trillion USD.



(d) France exports of 508 billion USD.



(e) China exports of 1.77 trillions USD.



(f) Japan exports of 766 billions USD.



(g) Russia exports of 378 billions USD.



(h) India exports of 238 billions USD.



(i) Brazil exports 205 billions USD.

Figure 5.4: What every country trades. Blue: machinery, electrical and transportation. Pink: Chemical, allied industries and plastic/rubbers. Green: Textiles. Brown: Natural resources. Source: The Atlas of economic complexity. <http://www.atlas.cid.harvard.edu/>

In the current currency war major part of the countries are in the opening phase. They are focused on protectionism (capital controls, trade barriers) and monetary policy (easing and currency pegging) strategies. However every bloc also has a geopolitical and reforms agenda. The combination of reforms, proxy wars and coalitions can build many different scenarios. In particular in this section, I will analyze two scenarios. Scenario A is an ideal situation where major geopolitical powers are successful by doing reforms. The exception are the natural resources exporters countries. I assume reforms in these countries are not successful because oligarchic structures controlling the exports of natural resources have strong political influence. Moreover, in this scenario every geopolitical power avoids geopolitical strategies (wars, coalitions, revolutions). Scenario B is a situation where US&UK have a coalition with the Eurozone and Japan in order to face Russian threats. In this scenarios proxy wars in the middle east, Ukraine and Korea are highly probable. China and Russia have a coalition against US. However, China avoids proxy wars against US and also avoids the use of geopolitical strategies against the Eurozone. In this scenario there are proxy wars between China and Japan. India and Brazil avoid geopolitical confrontation and reforms. In both scenarios I assumed that the US is the first in implementing structural reforms.

Figures 5.6, 5.7 and 5.8 show the game's transitions in every pair of strategic confrontations. In general coordinated reforms and coalitions transform the games' sequence from the loss-loss and unfair family into games of the biased and win-win family. The use of proxy wars and coalitions transform the games' sequence into the conflict and crisis families. Figures 5.9 and 5.10 show the payoff for every pair of strategic confrontations. The thick line corresponds to the scenario A and the dotted line to scenario B. Figure 5.11a illustrates the total payoffs of scenario A. It shows that in this scenario all the countries with implemented reforms win. In the game sequence from 5-6 every country outperforms the US. In the game sequence in 6-7-8 US have strong recovery while the Eurozone and Japan have losses. After the 8th game in the sequence every geopolitical power losses and the US remain flat. Figure 5.11b illustrates the total payoffs of scenario B. It shows that the loser of the currency war is Russia. The winners are India & Brazil and China. However, with Russia out of the game along with the procrastination of reforms, the games' sequence will be transformed into games from the unfair the critical family. That means heavy losses. On the other hand, countries active in reforms will benefit from the structural reforms coordination in the win-win family. The less reform activity, the longer the currency wars. Indeed, structural reforms improves the governance of common pool resources such as technological infrastructures.

The US, UK, Japan and the Eurozone (in particular the Eurozone periphery) face two major challenges: the fossil energy dependency and the excessive level of public debt. The US and UK have used geopolitical strategies in order to ensure the oil and gas supply in the short term. In addition national programs supporting fossil energy independence have boosted investments in alternatives energies in every developed country. Moreover, in the US shale gas has emerged as an alternative to oil.

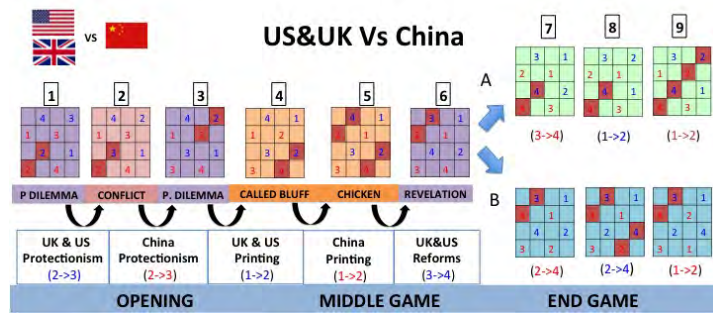
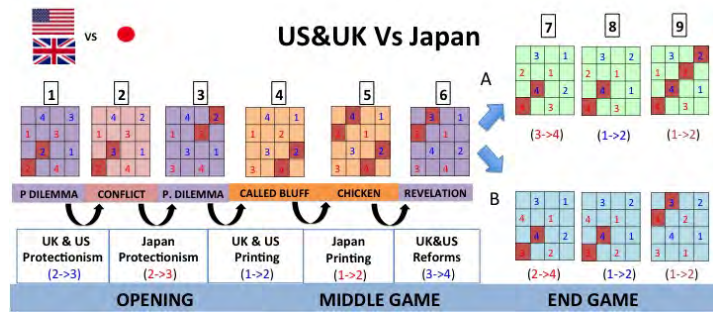
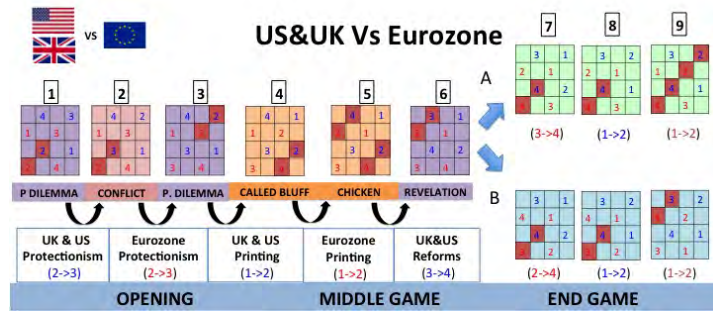
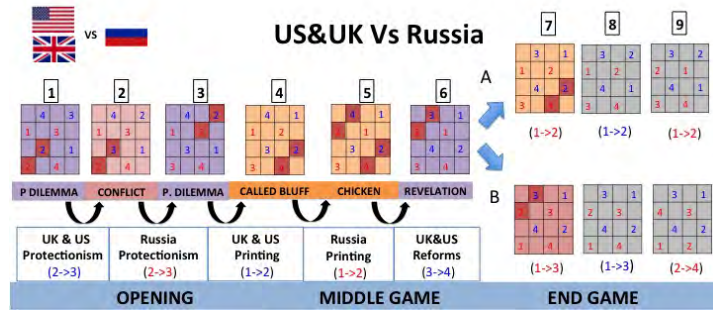
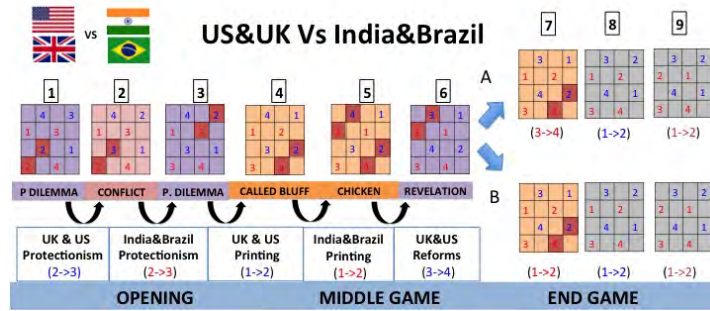
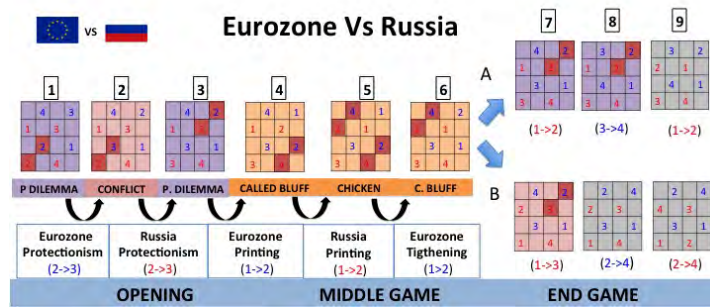


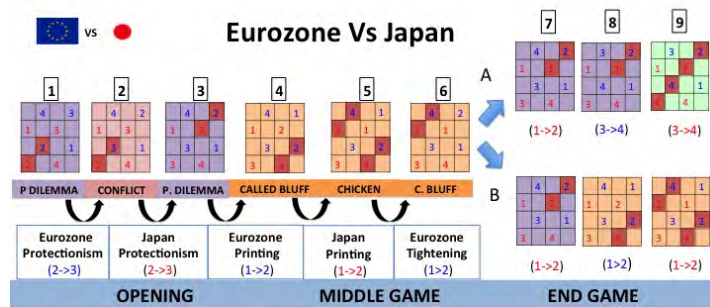
Figure 5.5: CW III games' sequence. Flags indicates geopolitical powers in conflict. The boxes' color indicates the game family. Purple: Loss-Loss. Pink: Conflict. Orange: Unfair. Yellow: Second Best. Gray: Critical. Green: Win-Win. Red boxes the Nash equilibria in pure strategies.



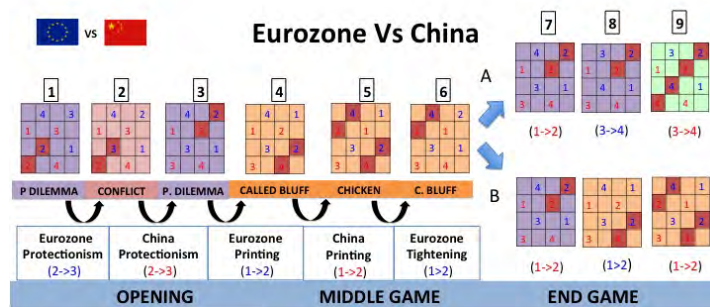
(a) Eurozone vs Russia



(b) Eurozone vs Japan



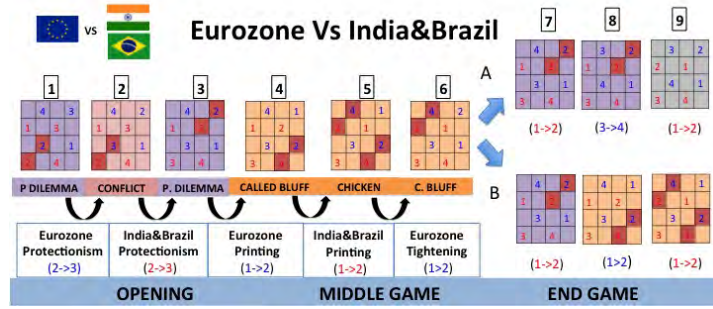
(c) Eurozone vs China



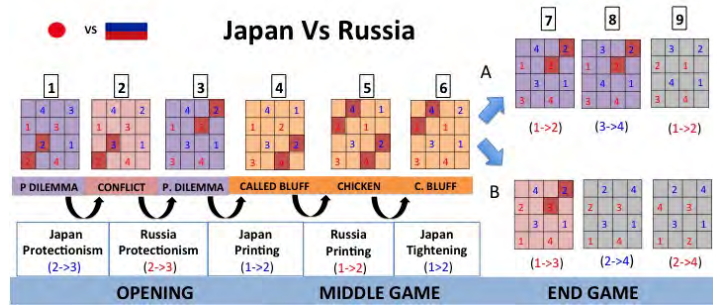
(d) Eurozone Vs China

Figure 5.6: Currency War III games' sequence. Flags indicates geopolitical powers in conflict. The boxes' color indicates the game family. Purple: Loss-Loss. Pink: Conflict. Orange: Unfair. Yellow: Second Best. Gray: Critical. Green: Win-Win. Red boxes represent the Nash equilibria in pure strategies.

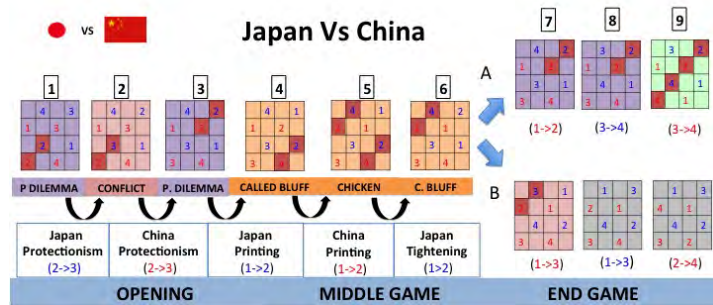




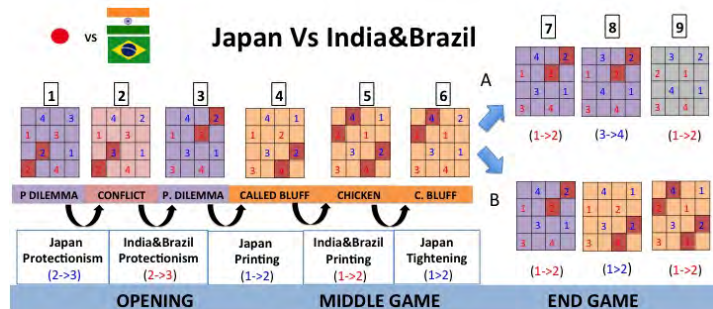
(a) Japan vs Russia



(b) Japan versus China

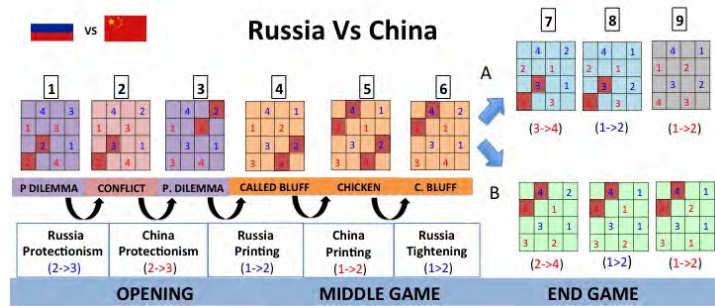


(c) Russia versus China

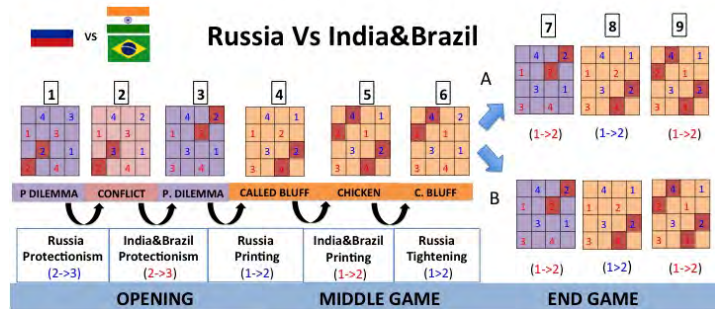


(d) Japan versus India&Brazil

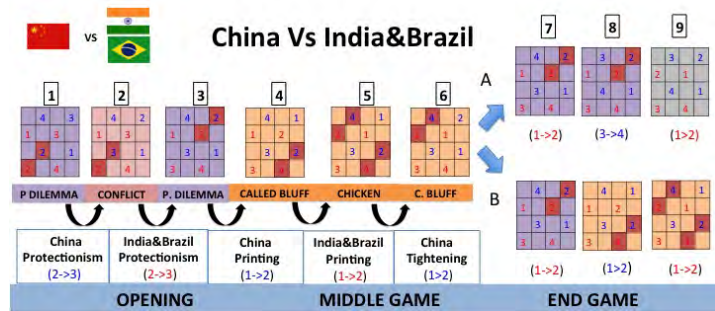
Figure 5.7: CW III games' sequence. Flags indicates geopolitical powers in conflict. The boxes' color indicates the game family. Purple: Loss-Loss. Pink: Conflict. Orange: Unfair. Yellow: Second Best. Gray: Critical. Blue-Marine: biased. Green: Win-Win. Red boxes represents the Nash equilibria in pure strategies.



(a) Russia versus China

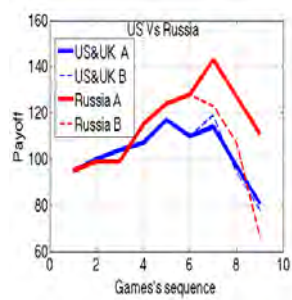


(b) Russia Vs India&Brazil

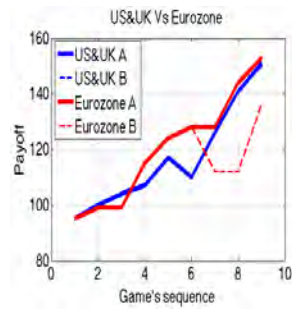


(c) China Vs India&Brazil

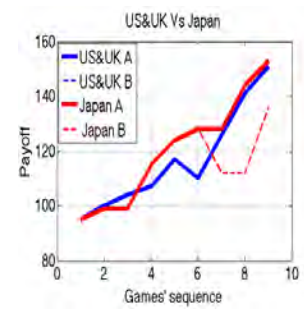
Figure 5.8: CW III games' sequence. Flags indicates geopolitical powers in conflict. The boxes' color indicates the game family. Purple: Loss-Loss. Pink: Conflict. Orange: Unfair. Yellow: Second Best. Gray: Critical. Blue-Marine: biased. Green: Win-Win. Red boxes the Nash equilibria in pure strategies.



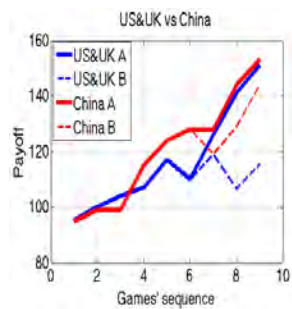
(a) US&UK versus Russia pay-offs.



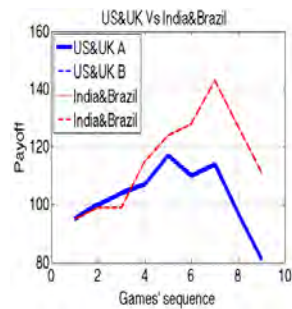
(b) US&UK versus Eurozone



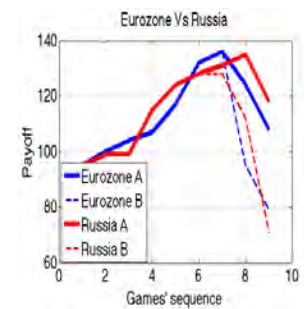
(c) US&UK versus Japan



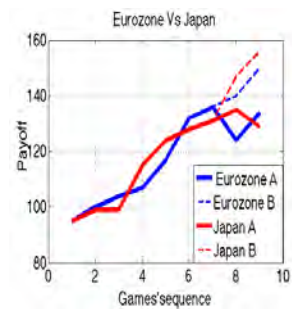
(d) US&UK versus China



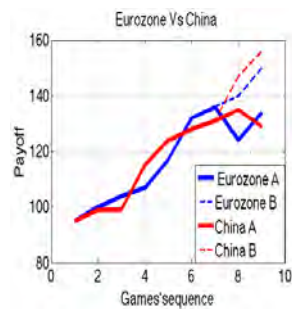
(e) US&UK versus India&Brazil



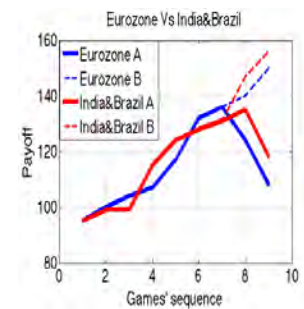
(f) Eurozone versus Russia



(g) Eurozone versus Japan



(h) Eurozone versus China



(i) Eurozone versus India&Brazil

Figure 5.9: CW III games' sequence payoffs.

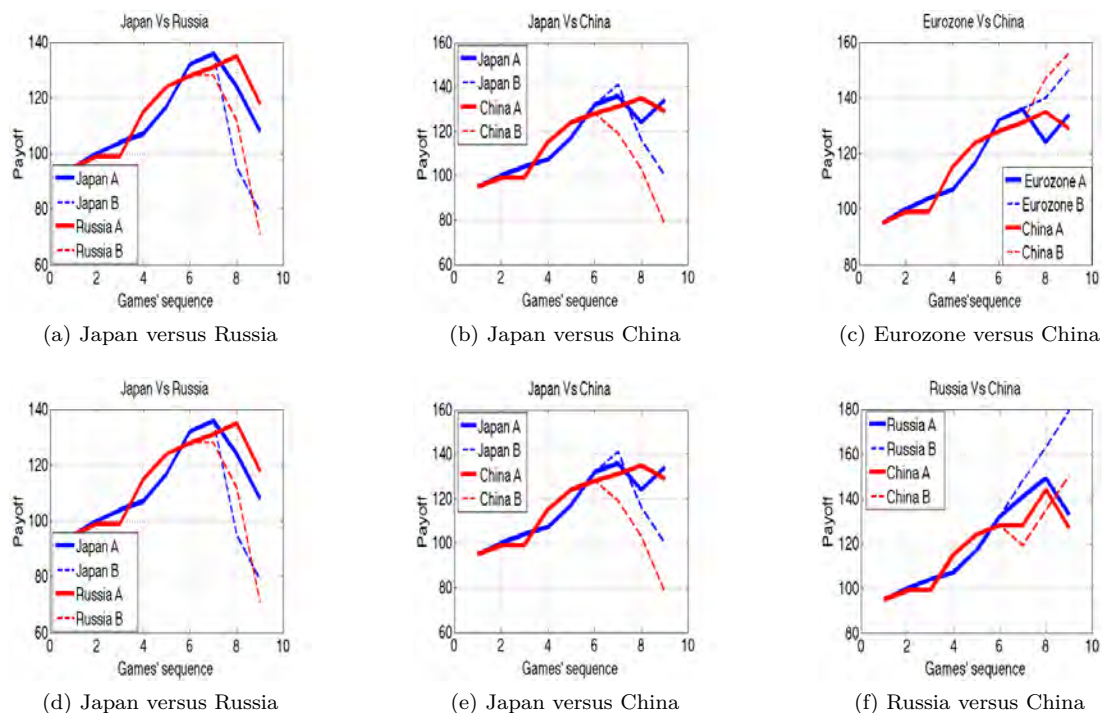


Figure 5.10: CW III Games' sequences payoffs.

In terms of public debt reforms are critical in many sectors. In particular the health care system in the US, the welfare state in the UK and the labor markets in Japan. The salience for reforms in Japan is higher because of the Fukushima tragedy and the negative demographic trends. Japan needs technologies able to do the job old people can not. If necessity is the mother of innovation that is exactly the atmosphere in Japan. Urgency along with the know how and installed capacity in Robotics could be the major drivers for a technological revolution in Robotics [43].

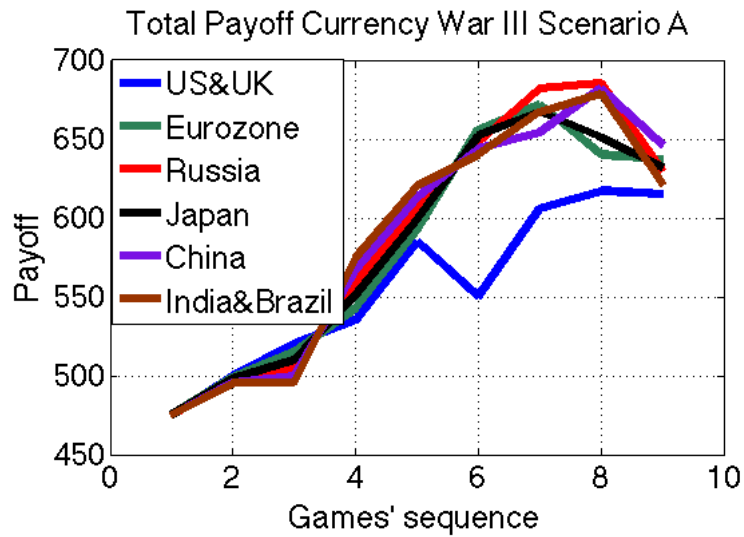
The Eurozone in some way is facing similar challenges to Japan. Fossil energy dependency, Negative demographics, and high public debt levels. Both scenarios A and B show that the success of the Eurozone depends on three things:

- The success of structural reforms. The eurozone needs institutional convergence between the core and periphery. For instance the global competitiveness index rank for Germany is 4/148 while for Greece is 91/148 (author?) [44].
- Avoiding a geopolitical confrontation with China in order to develop economic coordination mechanism with China and Japan.
- Facing geopolitical threats coming from Russia.

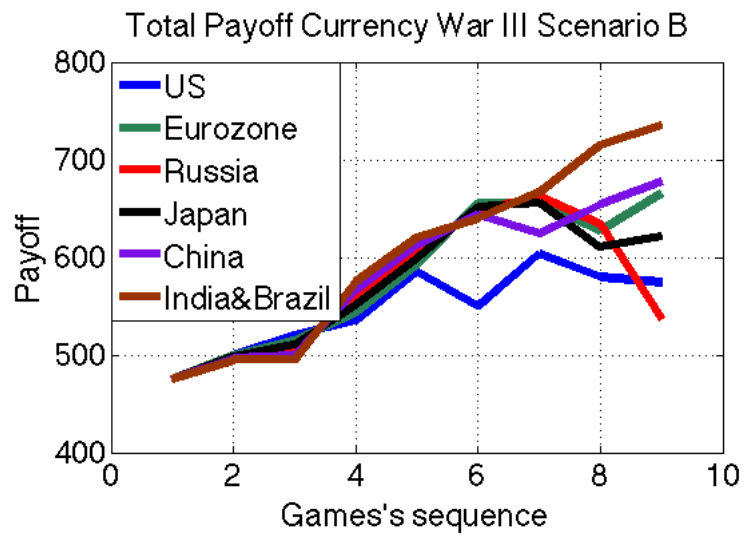
Both scenarios A and B are favorable for China. Nevertheless, there are far more scenarios. For instance, some analyst are very pessimistic about the success of the Xinjiping reforms in China. Indeed some claim that a political revolution in China is possible.

This game theory framework shows that a revolution scenario is possible if 3 things happen simultaneously.





(a) Scenario A



(b) Scenario B

Figure 5.11: Currency War III total payoffs by geopolitical power. The total payoff is computed as a sum of the payoffs of each player's games.

- China is active in the proxy wars and military coalitions against US and Europe.
- Xinjiping reforms are not successful.
- Japan is part of a technological revolution able to make robotic labor cheaper than Chinese labor.

However, if China is focused on reforms and the foreign policy agenda is only against Japan, it could take great benefit from the rivalry between the US, UK and Eurozone against Russia.

India and Brazil have favorable outcomes in both scenarios. They benefit from the rivalry between the major geopolitical powers. However, if they procrastinate reforms this initial advantage could be transformed into heavy losses in the strategic confrontation with the countries active in reforms.

In both scenarios A and B, Russia have a unfavorable outcome. Russia needs deep reforms that are very difficult to reach under the current autocratical regime. However, if Russia avoids proxy wars and develops a strong coalitions with China, India and Brazil, it could benefit from its geopolitical influence.

In fact, a coalition between these countries would be equivalent to 2.6 trillion in exports. A major exporting bloc compared to the approximately 2 trillions of the Eurozone, the 1.1 trillion of the US, the 800 billion USD from Japan. A new trade configuration also implies a redefinition of the international monetary systems around three poles: The US dollar, the Euro and the Chinese Renmimbi.

## Chapter 6

# Conclusions and future work

This chapter summarizes the findings and limitations of my research about currency wars by using a game theoretical model. Moreover, it shows two possible directions for future work: 1) Studying how the phases of a currency war are connected with switching regime models for global asset allocation 2) Studying how institutional transformation lead by wars, structural reforms and revolutions create important changes in the global governance mechanisms in politics and economics. In particular, how the upgrade of the global institutional setting creates large fluctuations in the business cycle.

### 6.1 Summary and limitations.

Throughout this study I have shown that a currency war is far beyond competitive currency devaluations or monetary coordination spillovers. In fact, the lack of an international monetary standard is a better definition.

A currency war happens because there is a new global configuration of economic and geopolitical power. Global powers are in a global struggle for controlling the factors of production– labor, energy and technology–. It begins with a loss-loss situation (global economic crisis) along with the collapse of the international monetary system. It ends in a win-win situation (technological revolution) that makes possible the settlement of a new international monetary standard.

In CW I the emergent power was the US, the monetary system in decadence was Gold Standard. The key energy resource was coal. In CW II the emerging economic power was Japan and the monetary system in decadence the Bretton Woods. The key resources were oil and nuclear energy. In CW III the emerging economy has been China and the monetary system in decadence the pure fiat US dollar. The key energy resources are oil and gas. After the Fukushima tragedy in Japan, the use of nuclear energy has been reviewed in many developed countries.

The emergence of a new economic challenger affects the dominant economies' labor markets and exports, thus boosting their unemployment rates and trade deficits. A decrease in the aggregated demand along with a slow down in exports, increases commercial and consumption credit defaults. This economic setting triggers banking crises and recessions in the developed economies.

Global economic crisis could be either deflationary or inflationary. A deflationary crisis happens because common pool resources (money-credit, technological infrastructure and energy) are governed by oligopolies, while in an inflationary crisis they are governed by the State. In both crises the poor governance of technological infrastructures inhibits the creation of economic

spillovers, then causing poor economic growth. Moreover, in both crises there is a struggle for controlling the access to energy (e.g. fossil fuels), thus, causing geopolitical instability.

The difference between both crises lies in the governance of money and credit. In a deflationary crisis there is a lack of regulation in the financial industry. Moreover, the credit supply is concentrated in the companies with the largest assets and consumers with collateral (real state, commodities). The lack of credit in the rest of the economy reduces the money multiplier of the whole economy, causing a reduction of consumer's prices<sup>1</sup>. On the other hand, when money and credit are controlled by the State, there is an excess of regulation in the financial system. Credit is allocated in State backed companies. Money printing is used to finance wars, for controlling the energy supply and to alleviate unemployment in the short run. The increase in the monetary base and credit supply beyond the potential output boost consumer's prices.

I have identified three phases in a currency war: opening, middle and end. In the first, after the global crisis, geopolitical powers use monetary easing policy and protectionism in order to alleviate unemployment. In the middle they use geopolitical strategies such as wars and military coalitions in order to have access to energy resources. In the end, some geopolitical powers adopt structural reforms allowing a better governance of common pool resources. They benefit from common coordination spillovers while structural reforms procrastinators are susceptible to revolutions, political turmoil or the dissolution of military coalitions.

Game theory was used as a tool to identify the most important strategic situations in the dynamics of a currency war. Moreover, this framework helps to understand how the six geopolitical and economic strategies- monetary policy, protectionism, (proxy) wars, structural reforms, geopolitical coalitions and revolutions- transforms the strategic configurations in a currency war.

Strategic situations are grouped by families of games. Loss-loss (Prisoner's Dilemma), Conflict (Conflict), unfair (Chicken), critical (Missile Crisis) , Biased (Battle of Sexes), Win-Win (Rousseau Stag-Hunt ).

The loss-loss and critical game family have nasty costs for every geopolitical power facing this strategic setting. While in the win-win family countries are able to be coordinated, they take advantage from the mutual economic spillovers.

Every phase has a more frequent set of game families. For example, in the opening the most recurrent families are the loss-loss, conflict and unfair families. In the middle: the unfair, biased and critical families. In the end: the critical, biased and win-win families.

In a currency war geopolitical powers tend to procrastinate reforms because they imply a reconfiguration of the internal distribution of power. In particular, politicians prefer foreign policy to foster political popularity rather than to give up the domestic power by means of reforms. This situation is extreme in countries governed by autocracies. Revolutions happen when the loss-loss or critical situation is unsustainable. In CW I the most important revolution was in Russia. In CW II in Iran. In CW III there has been a wave of revolutions in the arab world known as the "arab spring", there was a revolution in Ukraine and social unrest in Venezuela and Hong Kong. Furthermore, there are two highly autocratic regimes: North Korea and Iran that could be affected strongly after the reconfiguration of geopolitical power in the aftermath of the current currency war.

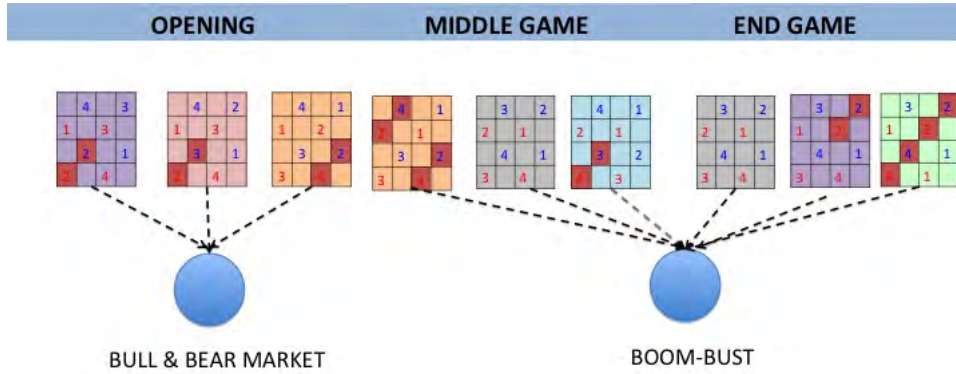
It is important to mention that this framework has many limitations. For instance, it is based on the assumption that all possible strategies in a currency war can be reduced to a set of six strategies. Furthermore, the mapping between strategies and row-column permutations is subjective. In fact, the sequential application of the strategies requires the input of an analyst able to estimate the strategies' success probability. For example: the success probability of a structural reform. Finally, there could be random events that modify the structure of the games

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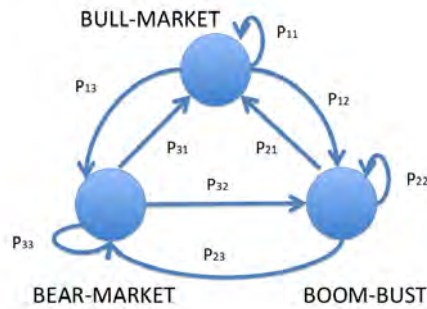
<sup>1</sup>The fisher equation  $MV = PQ$ , where M is the monetary base V the money multiplier P, the level of prices and Q the quantity of goods, relates velocity and prices.

in a currency war. For example: the discovery of a new planet plenty of natural resources, a nuclear tragedy.

## 6.2 Future work



(a) Mapping of games into market regimens



(b) Switching regimens in Equity and Commodities

Figure 6.1: Phases of a currency war and US equity and commodities regimens.

### 6.2.1 Currency war and switching regimens models

Many economic and financial time series exhibit dramatic breaks in their behavior associated with events such as financial crisis [45, 46] or abrupt changes in governmental policy [47, 48].

In a currency war the intensity of these changes is high. Therefore, the switching between different regimens in financial asset classes is probable. In fact, our game theoretical framework explains how governmental and central bank's strategies modify the structure of the game and sometimes the Nash equilibrium. The purpose of this section is to suggest a connection between the game theoretical framework and more general switching regimen models as a future direction of research.

In particular, I am interested in the mapping of the phases of a currency war into three regimens in financial asset prices: bull-market, bear-market, boom-bust. A bull market makes

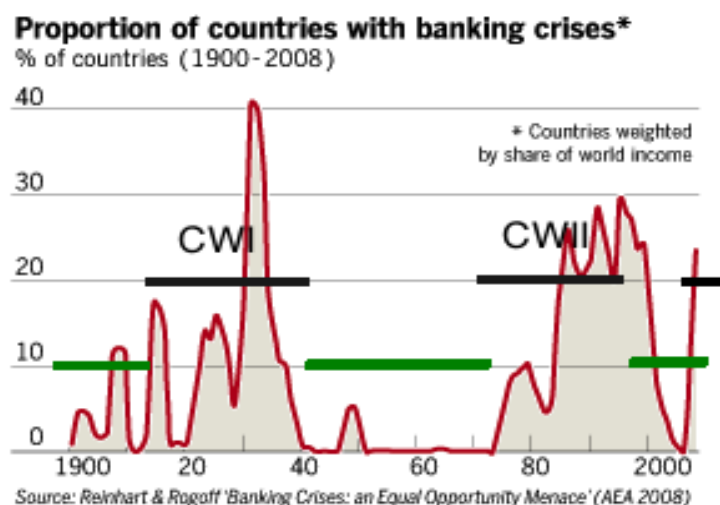


Figure 6.2: Currency Wars and Banking Crisis around the globe. Green: time interval of international monetary standard. Black line: time interval of a currency war. Adapted from Reinhart and Rogoff: “An Equal opportunity Menace” and the Economist

reference to long term positive momentum in the long term asset prices. A bear market refers to negative momentum in long term asset prices. The boom-bust regimen refers to an state of high increase in financial asset prices accompanied with subsequent bust.

Figure 6.1a shows the mapping of different phases of currency war into the bear-market and boom-bust regimen. Figure 6.1b shows a diagram with the transition probability between the three regimens. The arrows indicates the transition probability between regimens. In particular, when there is an international monetary standard the more probable regime is a bull-market in the equity market. That is caused by the coordinated reforms. In the switching regime model, that means, the transition probabilities  $P_{11} \rightarrow 1, P_{21} \rightarrow 1$  and  $P_{31} \rightarrow 1$ .

In an international monetary standard there is a global consensus about the hierarchy of geopolitical power. The global economy is in win-win situation with stable governance mechanism in politics and economics. Geopolitical powers are not competing anymore for the control of the factor of production. In the win-win situation countries benefit from the coordination spillovers of a new technological era. Corporation boost their earnings by the global decrease in transaction costs along with the new complementarities and growth opportunities. There is an structural bull market in the developed countries equity markets.

The US has been active in structural reforms in the three currency wars. Because of that, I use the S&P Index and the P/E ratios as proxies for the equity performance in developed countries. Figures 6.3a shows that in the time interval of an international monetary standard there was a bull market in the S&P index. Moreover, Figure 6.3b shows the upward trend of the S&P price earnings ratio in this time interval. The price earnings ratio is a proxy of the future earnings expectations.

For energy and monetary commodities the most probable regime is a bear market. That means, that the transition probabilities become  $P_{33} \rightarrow 1, P_{13} \rightarrow 1$  and  $P_{13} \rightarrow 1$ . New technologies improve global productivity decreasing the demand for energy commodities. Moreover,

geopolitical stability increases the energy supply. In the case of monetary metals trust in the new international monetary system along with tight monetary policy lead to a bear market. Figure 6.3c shows a bear-market in the prices of coal and oil in times of an international monetary standard (green line). Figure 6.3d shows a bear-market in the prices of gold and silver in the same time interval.

Inside a currency war the dynamic is more complex. There is a global banking crisis. Geopolitical powers are competing for the control of the factors of production. Deep transformation in the global institutional setting makes the potential output of many economies unstable. The global economy transits inside many strategic situations. Figure 6.2 shows the percentage of banking crisis as a macroeconomic indicator useful to identify the currency wars.

The most predictable dynamics in a currency war is in the opening phase. In this phase the bear-market regimen is the most relevant for developed markets equity. The use of monetary easing policy, protectionist and war strategies; trap the countries inside the loss-loss, conflict and the unfair families. The lack of technological spillovers plus the geopolitical instability make difficult for corporations to find growth opportunities. Margins are based on economies of scale by means of mergers and acquisitions. The survival of the largest creates an structural bear market in equity. Figure 6.3b shows a downward trend in the price earnings ratio of the S&P in times of a currency war.

On the other hand for energy and monetary commodities the most probable regimens is bull-market Monetary easing and political instability are upside drivers for commodities prices. Figure 6.3c shows an upward trend in the prices of coal and oil in the first half of a CWI, CWII and CWIII. Figure 6.3d shows the same pattern for gold and silver.

The middle and end phase are more difficult to predict depending on which combinations of strategies are in use. The many possible Nash equilibria, together with the existence of critical games make possible to create boom-bust cycles in both equity and commodities markets. Transition probabilities changes according to the use of the different strategies in a currency war. For example, coordinated structural reforms makes the transition probabilities  $P_{21} \geq P_{22}$  and  $P_{11} \geq P_{12}$ . On the contrary, for commodities prices the use of wars and geopolitical coalitions along with the avoidance of reforms make  $P_{22} \geq P_{23}$  and  $P_{32} \geq P_{33}$ .

Furthermore, changes of Nash equilibria can trigger jumps in the prices of many financial asset classes. Figure 6.3e shows the volatility of the S&P returns back to 1900. In particular it shows the largest volatility peaks are in time of a currency war. Figure 6.3f shows the probability distribution of the absolute value of the S&P returns in the three currency wars contrasted against the probability distribution in times of the Bretton Woods standard. These probability distribution follow a power law. In particular, the probability distribution in time of a Bretton Woods standard has less extreme events that in times of a currency war.

## 6.2.2 Institutional transformation and the business cycle

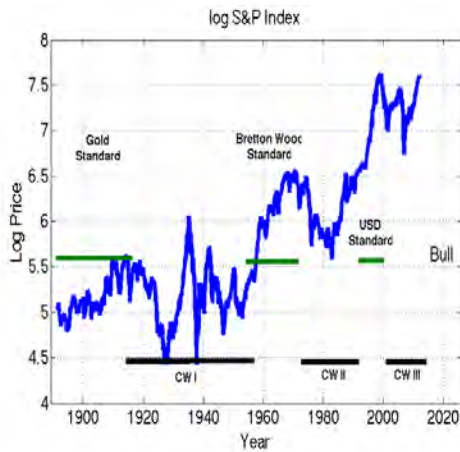
In order to track how changes in the institutional setting of the global economy create fluctuations in the business cycle I have designed the governance plane<sup>2</sup>

This tool helps to understand how the change in the governance mechanisms in politics and economics create a boom-bust regimen. In Figure 6.4 the red axis shows deflation versus monetary policy. The Y positive axis represents deflation, the negative axis inflation. The X-axis represent the monetary policy in the respective geopolitical power (e.g. real interest rates). The positive side indicates tight monetary policy. The negative side easing monetary policy.

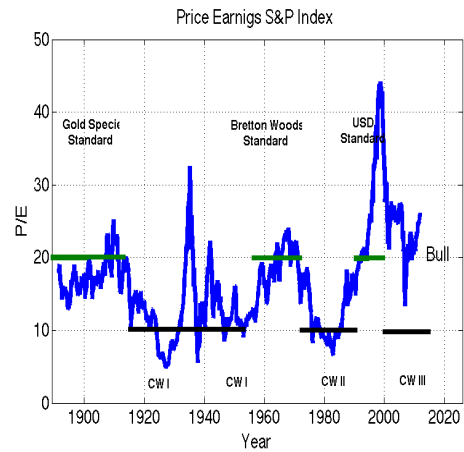
The blue quadrant represents the governance mechanisms in politics and economics. The vertical axis indicates the governance mechanisms in economics. For instance, the plane iden-

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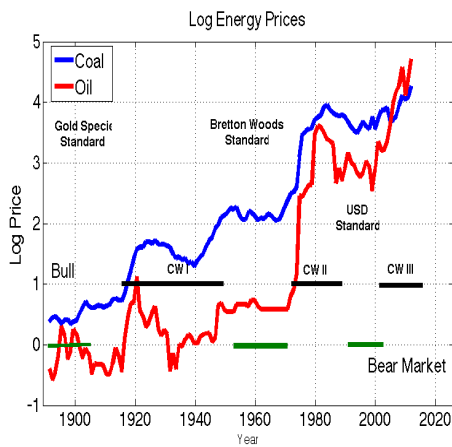
<sup>2</sup>This tool is inspired in a similar tool developed by Gavekal Research.



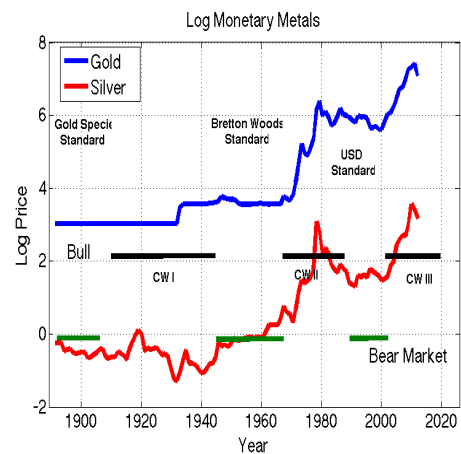
(a) Patterns in the US S&P Index



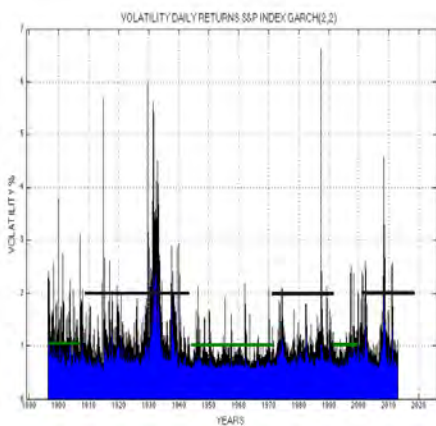
(b) S&P's price earnings ratio patterns



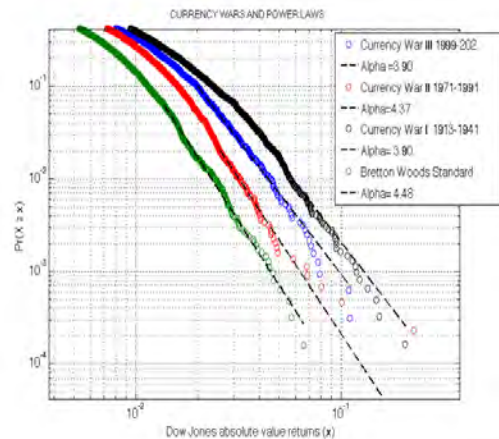
(c) Energy commodities patterns. Coal (Anthracite) and Oil.



(d) Monetary metals patterns. Gold and Silver



(e) Volatility S&P Index



(f) Probability distribution in a currency war regimen vs International monetary regimen

Figure 6.3: Patterns in US equity, energy and monetary commodities in times of a currency war and international monetary standard. The green lines represent the time interval with an international monetary standard. The black line represent the time interval with a currency war.



tifies five governance mechanisms. 1) State control: a total planned economy where the state controls the whole economical activity 2) State capitalism: the economy concentrated in a few State Owned Enterprises 3) Polycentric institutions: refers to an economy governed by several relational institutions between markets and the state. 4) Free markets: an economy without any state intervention. 5) Oligopolies: refers to an economy concentrated in a few big private enterprises. The horizontal axis indicates the governance mechanisms in politics. The axis also identifies five governance mechanisms. 1) Anarchy: refers to a society without a publicly enforced government 2) Plutocracy: defines a society dominated by the small minority of the wealthiest citizens 3) Democracy: refers a form of government in which all eligible citizens are meant to participate equally 4) Oligarchy: refers to a form of power structure in which power rests within a small number of people. These people could be distinguished by royalty, wealth, family ties, education, corporate, religious or military control. 5) Autocracy: refers to governance mechanisms in which a supreme power is concentrated in the hands of one person.

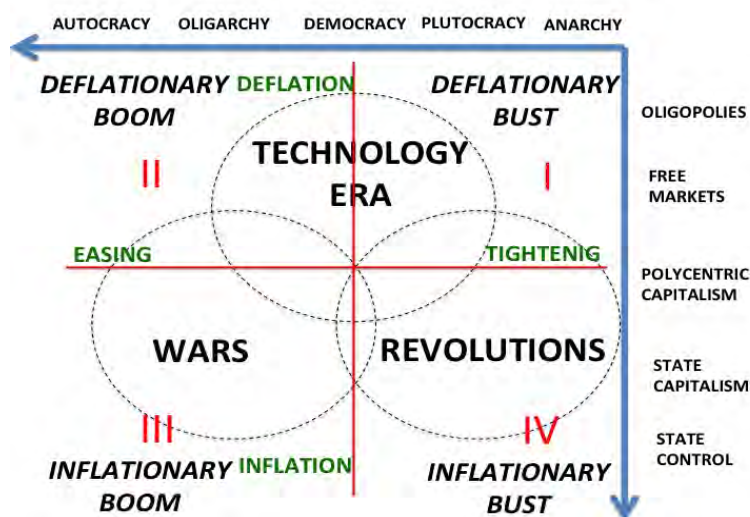


Figure 6.4: The governance plane. A tool to track the basic governance mechanisms in politics and economics in a currency war. Source: Adapted from GaveKal

The figure also explains the different phases of business cycles in every quadrant of the governance plane. For instance, quadrant I represents a deflationary bust. This is a situation in the business cycle when a country has deflation and tight monetary policy. Quadrant II represents a deflationary boom. It refers to a situation with deflation and easy monetary policy. Quadrant III represents an inflationary boom. It refers to a situation with high inflation and easing monetary policy. Finally, Quadrant IV represents an inflationary boost. It refers to a situation with tight monetary policy and high inflation levels. The dot-lined circles indicate the location in the governance plane where geopolitical powers are more susceptible to political turmoil, wars and a new technological era.

Figure 6.5 how to use the governance plane for CW III. It shows the location of the different countries in terms of the governance mechanisms in politics and economics. For example North Korea and Iran are highly autocratical regimens with a economy dependent on natural resources controlled by the state. China and Russia are governed by oligarchies in politics while in the

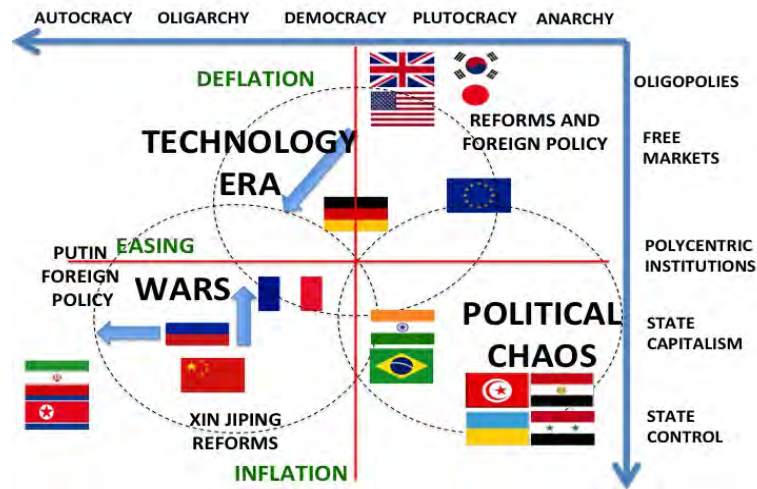


Figure 6.5: Governance plane: currency war III

economy is governed by a mix between State Owned Companies and markets (state capitalism). In China, Xinjiping reforms aim to liberalize the economy while staying in the same structure of political power. The blue arrow shows, that this policy implies a vertical move to the intersection between the circle of wars and a new technological era. In the case of Russia the Putin’s reforms agenda is less clear. Military escalation and the strong concentration of power could make Russia to resemble more an autocratic regime than a democracy.

In the case of Brazil and India the governance mechanisms in politics is a mix between plutocracies and democracies. In the economy, the governance mechanism is also a state capitalism. A combination of reforms aiming to more democratic institutions along with markets liberalization move this economies to the optimal position in the center of the red axis. Syria, Tunes, Ukraine, Syria were either autocracies or plutocracies that had suffered political revolution. The economy in major part of them was dependent heavily on oil or gas.

The Eurozone is divided between highly competitive economies that are close to the center of the plane and the periphery economies were the governance mechanisms are close to plutocracies and free markets. Reforms aiming to create a more efficient government and regulating the appropriation of common pool resources are needed in order to reach the center of the plane. The US, UK , Japan and South Korea are in a combination of plutocracy in the government and oligopolies in the economy. Reforms aiming to the regulation over the appropriation of common pool resources, along with more State leadership in industrial policy is necessary to reach the center in the plane.

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