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BACKGROUND MATERIAL

Comparative analysis of the national states capacities to face the challenges of the period 2010-2030

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ABSTRACT

The crisis of 2007-2008 occurred near the predicted start of the second half of the 5th Kondratieff cycle. This has reinforced the view that the long growth of the 1990´s and early 2000´s was part of the Kondratieff Cycle pattern, and also that it caused imbalances in the world economic system, leading to the creation of bottlenecks and risks for the whole system which in turn became barriers to its continued growth. This is typical of a business cycle causal network.

This raises the hypothesis that the period 2010-2030 will be typical of late Kondratieff cycles and characterized by exhaustion of the growth model leading to a crisis.

The most important perceived risks for the global economic system, in the period 2010-2030 are: the overdependence in petroleum, the shrinkage of glaciers, and unsustainable pension funds systems. Other risks can also be listed but are either lower in impact, or probability, or will develop in a longer time frame. These could include the ongoing war on terrorism, the spreading of weapons of mass destruction, pandemics and the rise in sea level.

Understanding that national states are the main actors in this scenario, it was selected a relatively small group of 24 nations to be analyzed, since this small number represent a large proportion of the world economy. The selection criterion is the GDP in purchasing power parity (PPP) as estimated in 2009. More specifically the nations analysed are USA, China, Japan, India, Germany, UK, France, Russia, Brazil, Italy, Mexico, Spain, South Korea, Canada, Indonesia, Iran, Turkey, Australia, Taiwan, Poland, Netherlands, Saudi Arabia, Argentina and Thailand.

These nations are grouped using an analysis based in their GDP per capita and population to understand which types of nations exist among this population.

A comparative analysis is made among these nations to evaluate their relative vulnerability to the three main risks and some other minor risks. This allows for an analysis on which are the possible responses of these nations to the risk, and what can unfold as a result of those responses.

A game theory analysis leads to an interpretation of how the interactions of those reactions work, and better understand how exhaustion can lead to a crisis in a Kondratieff cycle.

Finally a scenario technique is developed to predict possible developments of these responses and their interaction. Four scenarios are found and analysed qualitatively.

Keywords: Strategy, Kondratieff Cycle, Public administration, Scenario forecast, Game theory

INTRODUCTION

The crisis of 2007-2008 occurred near the predicted start of the second half of the 5th Kondratieff cycle. This has reinforced the view that the long growth of the 1990´s and early 2000´s was part of the Kondratieff Cycle pattern, and also that it caused imbalances in the world economic system, leading to the creation of bottlenecks and risks for the whole system which in turn became barriers to its continued growth. This is typical of a business cycle causal network

This raises the hypothesis that the period 2010-2030 will be typical of late Kondratieff cycles and characterized by exhaustion of the growth model leading to a crisis.

This brings up the central question of this article which is: how much the nation states are prepared to deal with the perceived risks of the period 2010-2030?

To explore this subject it's necessary to first map the main perceived risks and grade then in terms of time frame and impact.

Second it's necessary to point the main actors in this drama, and a sample of 24 nation states was selected based in the criterion of GDP in purchasing power parity (PPP) as estimated in 2009. This relatively small group of nations represent a large proportion of the world economy, and is more practical to examine them than all nation states.

These nations can be grouped into group types in order to further reduce the complexity of the interaction and then be capable of being modeled by game theory. Finally a qualitative scenario study can be designed based in the previous results.

KONDRATIEFF CYCLES AND CAUSAL MODELS

Kondratieff Cycles have been identified in early 20th century, and matured along the years into a relatively stable consensus described by Freeman and Perez (1988). In general they are cycles with a length of 50-60 years that can be subdivided into four sub-phases which can be described as: recovery, growth, exhaustion and crisis.

As described by Freeman and Perez (1988) the cycles so far are show in table 1 below.

Table 1 – Kondratieff Cycles

Cycle	Period	Description
1st Cycle	1770-1820	Initial mechanization
2nd Cycle	1820-1870	Steam power and railroads
3rd Cycle	1870-1930	Electricity and heavy engineering
4th Cycle	1930-1980	Mass production and fordism
5th Cycle	1980-2030	Telecommunications and informatics

Source: adapted from Freeman and Perez, 1988

The identification of the cycles led to a discussion on what was causing them and if this causality would maintain itself in the future or if it was purely temporary in nature.

So far the best explanation for the causes of Kondratieff cycles is the nature of innovation itself. During the crisis sub-phase of a cycle, innovation is stimulated as a reaction to the risks and threats generated by the crisis, mainly in military or prototype technology. In this way a new cycle is started with a recovery from the crisis as the technology moves from military field or scientifical prototypes into commercial field, generating new markets and driving economical growth. This growth expands in to next sub-phase generating economical and social imbalances that lead to the creation of bottlenecks and barriers for the growth to sustain itself. Eventually the growth reduces in the exhaustion sub-phase leading to an increased competition. With no new technologies entering the market the growth is reduced to near zero, and the response of the societies is to become increasingly competitive, which in turn leads to a crisis that can be aggravated by some external reason.

In all crisis sub-phases there have been one or more large wars as shown in table 2 below.

Table 2 – Crisis subphases

Cycle	Crisis sub-phase	Large wars
1st	1805-1820	Napoleonic wars
2nd	1860-1870	Crimea war, American civil war, Unification of Germany
3rd	1914-1930	First world war, interwar period
4th	1965-1980	Vietnam war, space race, middle east wars (1967, 1973)
5th	2015-2030	???

Source: Author

The Second World War (WWII) is an anomaly in this view since it occurred in the start of a Kondratieff cycle. This can be explained as it's being a war of hegemonic transition and thus part of a 30-year war occurring between hegemonic periods.

In this hegemonic cycle view, presented by Arrighi (1996), there had been four hegemonic cycles in the last five centuries, each separated by a 30-year period of hegemonic transitions as shown in table 3 below.

Table 3 – Hegemonic periods and transitions

Type	Period	Explanation
Hegemony	1492-1618	Genovese-Habsburg Hegemony
Transition	1618-1648	Thirty years war
Hegemony	1648-1785	Dutch hegemony
Transition	1785-1815	Revolutionary and Napoleonic wars
Hegemony	1815-1914	British hegemony
Transition	1914-1945	World wars (WWI & WWII)
Hegemony	1945- 2065?	USA Hegemony
Transition	2065-2095?	??

Source: Adapted from Arrighi, 1996

In the table 3, the length of the American hegemony is guessed based in the mean duration of the previous hegemony cycles, and is succeeded by a transition of 30 years length which is purely conjectural in nature, in the present.

It's possible to observe that the transition from the Dutch to British hegemony is coincident with the first Kondratieff cycle, and the crisis sub-phase corresponds to the climax of the transition wars.

In the other hand the transition between British and American hegemonies is set at the passage from the end of the second and the beginning of third cycle of Kondratieff. The climax of the transition occurred at the WWII, when with British Empire already weakened by both wars, four contenders claimed hegemony (USA, USSR, Germany, and Japan) but only the USA was capable of achieving hegemony, not surprisingly the one that best embraced mass production as a new Kondratieff technological paradigm.

It's still a matter of discussion what causes this larger hegemonic cycle, but this is not the subject of this article. Discussions, evidences and arguments can be found in Olson (1982), Kennedy (1989), Tilly (1992), North and Thomas (1993), Fischer (1996) and Arrighi (1996). For purposes of this article it's necessary only to explain why WWII is an anomaly.

It's also possible to explain why the crisis sub-phase is turned into a global war, like in the first and third cycles and when they are a series of wars that don't merge into a major war, like in the second and fourth cycles. This causality is tied to the occurrence of a hegemonic transition in parallel or not. Also, this explains why the third cycle is 60 years long while the others are only 50-years long, this has occurred because the hegemonic transition occurring at the boundary of the cycles extended one of them.

THE 5TH KONDRATIEFF CYCLE

The focus of this article is on the near future, the predicted end of the 5th Kondratieff cycle. The current cycle has began in 1980 as a recovery from the crisis of the 1970's, when not only oil prices went high causing economic slowdown but also the space race peaked while there were wars being fought in Vietnam and between USA and USSR client states in Middle east.

The cold war and the space race have induced a very high investment in technology, particularly in telecommunications and informatics. This occurred during the crisis sub-phase of the fourth cycle and led to a new innovation cycle that began in 1980.

The introduction of the PC's in 1980 marks the start of the recovery sub-phase of the fifth cycle as a new technological paradigm began to form. This period also marks the start of a transition from an industry based economy to a service based one.

Although the 1980's were incredibly innovative the big innovation was still to come in form of the internet in the 1990's. Its roots can be clearly traced to the cold war when US armed forces decided to invest into a non-centralized form of computation to avoid destruction by a nuclear strike. Literally the main technology of the 5th cycle had its roots in a crisis occurring 30 years early and that was perfected by military reasons until it reached maturity to become, not only a market product, but a new way of doing business, a new paradigm into itself.

The growth of the 1990's was not only due to the technology but also due to a geo-political shift created by the end of USSR and a shift to a global exchange rather than the previous bipolar alignment. Why the USSR failed is a matter of discussion, but certainly the lack of internal competition played an important role in not driving innovation.

The growth of the 1990's was big and some predicted a "new economy" was rising, but in the Kondratieff model this growth was predictable as well was its end around 2005. The reason was simply that the growth was not, and could not be, uniform. Some nations and societies were better prepared to leverage in the new technologies

while other could not get any, or lesser advantages from it. As globalization and the internet created a new growth model, also grew the imbalances. The model was not sustainable in the long run.

In the year of 2001 the world awakened to a new millennium but also to the bust of the internet bubble and the 9/11 attacks in USA. It became suddenly clear that the system growth was creating barriers to its continued growth.

In this way 2001 was an analog of other first indications of an impending crisis after a long growth like the fall of Bastille in 1789 (1st cycle), Paris commune in 1848 (2nd cycle), hispano-american war in 1898 (3rd cycle) and the Cuban revolution in 1959 (4th cycle). Each of these events marks the approximate change from the growth sub-phase into the exhaustion sub-phase around the middle of the cycle.

Although the mathematical halfway of the cycle was 2005, it was in 2003 that USA attacked Iraq in order to depose the dictatorial regime, but until that point recovery from the 2001 crisis was on the way. The Kondratieff midpoint was navigated without problems.

In 2007 a new crisis appeared this time a result of the excess risk absorbed by the banking system to sustain the growth of the 1990's. This crisis deepened in 2008 creating havoc in the global financial system.

Once again this is not something new to the cycles. The 2008 crisis has its analogues in the crisis (or panics) of 1796-97 (1st cycle), 1857 (2nd cycle) and 1907 (3rd cycle). Notice that there is no comparable crisis in the fourth cycle. It should have happened in 1967, and although there was the six-day war in this date, no accompanying crisis existed, perhaps this due to the large amount of spending from governments in the space race and cold war. However when in 1973 another similar war occurred in the middle east but this time with an oil cartel formation the crisis was very acute. This also remembers us that the cycle model does not work like a clock, and there are unexplained variations as history is unique. Each of these events occurred at the start of the exhaustion sub-phase but before a generalized crisis.

This brings us to the point where we are now in 2010. What will unfold is a matter of speculation and modeling. If the Kondratieff model is correct and be used as a prediction tool than the 2005-2020 period will be of exhaustion, and the 2020-2030 will be of a crisis.

If this proves to be true, the exhaustion will go on along the 2010's becoming increasingly worse until in the 2020's a crisis will be sparkled by one of the possible perceived risks, and there are many potential risks around.

PERCEIVED RISKS

The next logical step in this article is to list the main perceived risks within the time frame 2010-2030. Using the PESTEL framework it's possible to list the main threats perceived as of 2010. These are show in Table 4.

These risks were listed by trying to observe at least two risks for each dimension. This is a qualitative search based on issues commonly discussed in the news media and the academy but seldom put together to form a bigger picture.

However some of these risks listed below have a larger probability of occurring than others. Some are certain like the ageing population of world, while some are purely a wild possibility such as a volcanic winter and a new Maunder minimum. Other risks will develop at a longer time frame and can have a smaller impact until 2030 such as the rise in sea level and deforestation.

Also some may have a very high impact if they occur while others will have a medium to high impact. Some of these lower impact risks are already affecting the nation states but they are under control in one way or other.

A classification on these three factors is also in table four indicating whether it has a high impact, is highly probable and occurring within the time frame chosen. This classification is qualitative but based on data available at the present.

Table 4 – Perceived risks

Dimension	Risks	Impact	Time frame	Probability
Political	New geopolitical map inducing new conflicts	X	X	X
	Continuing conflict with terrorism		X	X
	Political Instability in the Middle East	X	X	
Economical	High commodities price		X	X
	Demographic imbalances	X		X
Social	Socio-economic inequality		X	X
	Ageing population	X		X
	Population growth in Asia and Africa	X		X
Technological	High dependency on oil	X	X	X
	Weapons of mass destruction	X	X	
Environmental	Deforestation	X		X
	Glacier depletion	X	X	X
	Rising sea level	X		X
	Global Pandemic	X	X	
	Volcanic induced winter	X	X	
	New Maunder Minimum	X		
Legal	Inefficient States	X	X	X
	Many pension funds systems are not sustainable	X	X	X

Source: Author

This analysis can reduce the list to risk factors that have all three criteria, to five risk factors, and these are:

- New geopolitical map inducing new conflicts
- High dependency on oil
- Glacier depletion
- Inefficient States
- Many pension funds systems are not sustainable

The next step is to make an analysis of each of these risk factors in order to better understand them and compare the relative capacity of nation states to deal with them.

New geopolitical map inducing new conflicts – According to the hegemonic cycles frame of analysis the USA is, and will continue to be, the hegemonic power during the entire period, but the secondary powers are shifting in their relations. After the fall of USSR in 1991, there has been a reshuffle in international relations. European Union (EU) has become a strong actor as well as the rise of new players like the BRIC's. Also the coming of the war against terrorism has forced the USA to intervene in many places of the world. These factors combined are redrawing the geopolitical map, forging new alliances as well as new conflicts. This factor is not a possibility in the future, it's already occurring, but so far the conflicts have been only minor without major inter-state wars.

However if a crisis really develop in the 2020's a clash between nations for resource dispute, political or religious divergences may occur in large scale, This may or may not involve use of large military forces, and weapons of mass destruction (WMD).

Almost all nations are exposed to this threat. There is very little difference between the nations in exposure to this risk, however, those with more technology and bigger economy can better react in such case. In the past crisis nations away from the center of conflict and with strong economies were less affected and could leverage from the situation. That was the case of UK in the Napoleonic wars, and US in the global wars. A particularly good example is Japan, in WWI it was away from the center of conflict and profited from the war, while in WWII it was a central part of the conflict and was ruined.

This brings the conclusion that although we cannot predict which conflicts will occur and why, it's possible to predict that those away from the center of conflict can be favored by this event. Those directly involved, even when winners are negatively affected.

The others risk factor will point to potential causes of conflict and thus where the center of the conflict may occur.

High dependency on oil – There is a high correlation between GDP per capita and energy consumption per capita, suggesting that to grow an economy is necessary to consume more energy. However, the energetic matrix of the bigger economies is mostly based in oil consumption. China and India have a large dependence in coal, and Brazil in hydroelectric power, while many others have developed nuclear plants. But these diversifications did not reduce the large dependence on oil.

To increase this problem a large proportion of the oil (and gas) resources come from one region of the world, that is, the Middle East, which is in turn the center point of geopolitical problems and conflicts since WWII. This is no coincidence of course. The economic growth since 1940's has been possible mostly due to the increase in oil output and its consumption.

The access to those reserves has been a key issue beginning in the North African campaign in WWII, and continuing with the creation of the state of Israel immediately after the war and its conflicts in 1948, 1956, 1967, 1973 and 1982. Also the gulf wars against Iraq occurred in 1991 and 2003. There has been roughly a war in each decade in the region, There's would come as no surprise if there was new conflicts there in the 2010's and 2020's. This is even more likely because oil is depleting.

Assuming that the Hubbert model of reservoir depletion is correct the oil production in the world is either very near its peak, or more likely already have passed its peak. Even new sources of oil do not promise enough relief based in the Hubbert Model.

That would imply that to keep growing the nations need to access new energy sources, or fight for the existing ones. The USA maintains a strong military presence in the Middle East and is aligned with Saudi Arabia, which is the main oil reserve in the world.

New technologies are being developed but they are still too expensive and the technologies are not economically viable to substitute oil as the main source of energy. Nuclear Fusion is the only real long term alternative that can substitute oil as an energy source, but not as a source for lubricants and plastics. However, nuclear fusion is not economically viable yet and forecasts point that it will not be before 2050.
This probably means that economic growth will be limited by oil energy sources until 2050. Alternative energies other than fusion will likely allow the access to energy at a high cost which will drive inflation and so create a constraint to economical growth.

Glacier depletion – Glaciers are retreating all around the world since early 1850's. Data before that is unavailable in most areas so we cannot be sure how long this trend

has been going on. Some evidence points out that this has been the norm since the last glaciation, or at least since the little ice age, a small cooling period that ran between 16th and 19th centuries, which is coincident with the last Maunder minimum of the solar activity.

What causes this retreat is global warming, but what is causing this is controversial. It may be normal climatic cycles in earth due to orbital mechanics, and solar cycles, or greenhouse gases, or both.

The result however has very little controversy. Glaciers all over the world are shrinking, and many of these glaciers supply water to big rivers like, Ganges, Yangtze, Mekong, Danube, Rhine, Amazon and Missouri. Not all water in those rivers comes from the glaciers, but a significant reduction in their volumes can cause serious shortage of water availability for drinking and farming. This would cause shortages in food supply and thus lead to inflation of prices.

The least affected continent would be Africa which rivers don't count on glacier supply. South America would be affected in the Amazon and Orinoco rivers, but less in Paraná basin. The most affected continent will be Asia, since the Tibetan Plateau supplies water for three major water sources in China, India and Southeast Asia. The potential for problems there is very high since the Mekong, Ganges and Yangtze together are responsible for the water of nearly a billion people.

There has never been a war for glaciers, but since the Tibet is in a frontier region, there may be a first time. Tibet itself is considered by China to be part of its territory, but it was annexed in 1949 when it was an independent state. A war between India and China could erupt over the right to divert water into some rivers. This may seem unlikely now, but can become a necessity if the glaciers become a key source of water. In the other hand, the glaciers may become so depleted that they become irrelevant.

The only connection that can be assured is that a reduction in water supply will lead to inflation in food, and them inflation in general.

Inefficient States – The modern national state has been evolving since 15th century through many advances, but in the last century the complexity of the society has presented a special challenge in terms of costs and governance. Also many transnational issues cannot be properly solved by individual nation states.

Making a proper review of the process that brought inefficiency to the nation states and listing their cause would constitute an article into itself. For purposes of this article we will limit ourselves to admitting that the nation state has become too big and complex and that diseconomies of scale have reduced its efficiency.

In terms of size, although small nations can be more efficient they cannot face competition from larger nations in terms of economic and military power. Therefore, greater nations have been the trend in the last centuries leading to unification of many states in to bigger ones and expansion of states into larger entities.

In terms of complexity, the public policies have been forced to deal with more complex services in health, education and public security leading the state, viewed as a service provider, to have its cost increased, and thus with an increased taxation. As in any organization that grows, its internal governance has become more complex. This has lead to further diseconomies of scale.

Together these two factors alone can explain reasonably how the states have become increasingly inefficient in the last centuries and particularly in the last century.

All states are vulnerable to this risk, and those which are bigger tend to be more complex and then inefficient, however, relatively small states have less bargain power in terms of economic and military power. This risk tends to be continuing in all states and not reversible. Gigantism will probably continue to be the trend in future centuries, but small efficient nations will also coexist with bigger and bigger nations. In the relatively short term view of this study this risk factor may be neutral in regard to differences between nations, as it will be present to all actors.

Many pension funds systems are not sustainable – Most pension funds systems around the world are based in solidarity between generations. In this system the active workforce pays a portion of their incomes to maintain the pension funds of the retired people. Aged dependency ratio (ADR) is calculated dividing the aged population (65 year of age or more) by the active workforce population (15-64 years of age). If the aged dependency ratio is low the system is viable.

The problem is that fertility ratio is reducing, and life expectancy is growing. That means that the aged dependency ratio is rising as the numerator is increasing and the denominator of the fraction is decreasing.

This problem can be solved in three ways: rising retirement age, increasing tax burden to active workforce, or debasing currencies to pay retirements.

Al three solutions are available to all nation States but they will cause a momentary imbalance in economy. Since rising the retirement age and increasing the tax are very unpopular policies they will probably not be taken by any government before it's too late. The most likely solution will be printing more currency so that the pensions can be paid by a debased coin. The net result will be another inflationary force in the 2020's.

However some nations have already moved to a new system of pension funding where each individual contributes to his own fund. This isolates the risks for an individual to rely on other groups to sustain him at elderly age. This is a form of private fund and various forms of this type can be found. Among the larger nations of the world only the USA and Canada have systems like this.

Looking at all five main risks now we can draw some conclusions.

Three of the main risks (energy, water and pension funds) will carry inflationary trends, which will in turn cause reduced economic growth, which will lead to unemployment.

Nations states will probably have trouble dealing with internal problems since the States are already with diseconomies of scale. This will most likely lead to point external agents as the causes of trouble and try to coalesce internal support against a common problem source.

In this scenario larger nations will tend to face smaller nations as a problem source since they cannot resist militarily and economically. This is safer than facing another large nation with which conflict result is dubious. However in the web of interests and with some resources like water and oil sources being of common need conflicts between large nations may result.

The main hotspots for conflict are the Middle East and the Tibetan Plateau. Other secondary hotspot for oil may be the Caribbean Basin, Nigeria, Angola and South East Asia. It's very unlikely that other water sources will become hotspots like the Andes, Alps and Urals.

NATION STATES AS THE ACTORS

We will now concentrate in identifying the main actors in this unfolding scenario. We concluded that Nations states and particularly large nation states are the main actors and we are going to use the criteria of GDP in purchasing power parity (PPP) for selection.

Table 5 shows the 24 nation states that represent 80% (Pareto) of world economy. The data is taken from CIA world factbook.

The criterion for selecting 24 nations and not another number was the Pareto number of 80%, which is of course arbitrary. Other possible cuts would be countries that represent at least 1% of the world economy, or 3% or even 5%, or the top 10, or top 15. Any of these criterions would be equally arbitrary, so we chose the traditional Pareto method.

However, comparing nations merely by GDP is not capable of categorizing nations properly so we introduce the population data in order to divide GDP into two components, GDP per capita and population. Since population is a number that varies very much across the states it can be better analyzed using its logarithm. Table 6 shows the resulting data for comparison.

Plotting the GDP per capita and the log of population in a 2D graphic we obtain figure 1. All the 24 nations are color coded, and the format of the plot indicates the continent. Squares are Asiatic nations, losangles are American nations, circles are European nations and triangles are oceanic nations.

The plot indicates a general tendency with three outliers. In general the bigger the GDP per capita the smaller the population, although the R^2 is low (Adj. R^2=0,33; p<0,01; F=10,8; without outliers), that points out to the hypothesis that bigger nations (in population) are less efficient (in GDP per capita).

However there are three outliers being China, India and USA. The hegemonic status of the USA can indicate that it can either achieve a higher performance by being the hegemonic power, or maintain its hegemonic status because it can maintain its higher performance, or both. The federative status of USA can be also an alternative explanation why such a big nation (in population) can maintain high performance.

India and China are a different situation. They should have smaller performances due their large populations but that doesn't happen.

Table 5 – The 24 bigger economies in the world in 2010.

	Nation	GDP (billions US$ PPP)	% total	∑ % total
	World	**70290**		
1	United States	14260	20,29%	20,29%
2	China	8789	12,50%	32,79%
3	Japan	4137	5,89%	38,68%
4	India	3560	5,06%	43,74%
5	Germany	2811	4,00%	47,74%
6	United Kingdom	2149	3,06%	50,80%
7	Russia	2116	3,01%	53,81%
8	France	2110	3,00%	56,81%
9	Brazil	2025	2,88%	59,69%

10	Italy	1760	2,50%	62,20%
11	Mexico	1482	2,11%	64,30%
12	Spain	1368	1,95%	66,25%
13	Korea, South	1356	1,93%	68,18%
14	Canada	1285	1,83%	70,01%
15	Indonesia	969	1,38%	71,39%
16	Iran	876	1,25%	72,63%
17	Turkey	863	1,23%	73,86%
18	Australia	824	1,17%	75,03%
19	Taiwan	718	1,02%	76,05%
20	Poland	690	0,98%	77,04%
21	Netherlands	655	0,93%	77,97%
22	Saudi Arabia	586	0,83%	78,80%
23	Argentina	558	0,79%	79,59%
24	Thailand	539	0,77%	80,36%

Source: CIA World Factbook, 2010

Since we identified outliers in two groups its possible to identify the other nations in two groups also divided mainly by GDP per capita. The group with high GDP per capita does include Japan, Germany, France, UK, Italy, Spain, South Korea, Taiwan, Canada, Australia and Netherlands. The group with low GDP per capita includes Indonesia, Brazil, Russia, Mexico, Turkey, Iran, Thailand, Argentina, Poland and Saudi Arabia. This division can be confirmed by an ANOVA ($F=141,8$ e $p<0,01$).

This leaves us with four main groups that could be further subdivided if necessary. The table 7 shows our four groups.

One last correlation is needed to confirm the need of energy to achieve a higher GDP per capita. To do that it's necessary to obtain the electricity consumption per capita and try to correlate it with GDP per capita.

Table 6 shows the data for our selected nations in terms of electricity consumption and GDP both per capita. The linear regression of GDP as a function of Energy consumption is high (Adj. $R^2= 0,71$; $p<0,01$; $F=58$). A polynomial regression of the second degree is even higher (Adj. $R^2= 0,80$; $p<0,01$; $F=48$). In fact this is a much better predictor for GDP per capita than population or logarithm of population.

Table 6 – Comparative Population and GDP per capita

	Nation	Popula-tion (millions)	GDP/cap (US$ PPP/hab)	Log of Popula-tion	Electrici-ty (G Kwh)	Ener-gy/Cap (kwh/hab)
1	United States	310	45965	2,49	3873	12484
2	China	1330	6608	3,12	3438	2585
3	Japan	127	32625	2,10	926	7299
4	India	1173	3035	3,07	568	484
5	Germany	82	34163	1,92	547	6651
6	United Kingdom	61	35066	1,79	346	5643
7	Russia	139	15180	2,14	1023	7339
8	France	64	32939	1,81	447	6981
9	Brazil	201	10069	2,30	404	2010
10	Italy	58	30297	1,76	315	5423
11	Mexico	112	13177	2,05	182	1614
12	Spain	41	33737	1,61	276	6809
13	Korea, South	49	27881	1,69	385	7918
14	Canada	34	38063	1,53	536	15880
15	Indonesia	243	3989	2,39	119	491
16	Iran	67	13067	1,83	154	2294
17	Turkey	78	11096	1,89	198	2546
18	Australia	22	38311	1,33	222	10318
19	Taiwan	23	31171	1,36	230	9980
20	Poland	38	17942	1,59	129	3362
21	Netherlands	17	39021	1,22	124	7394
22	Saudi Arabia	29	20057	1,47	165	5653
23	Argentina	41	13497	1,62	99	2400
24	Thailand	66	8111	1,82	134	2024

Source: Adapted from CIA World factbook 2010

Figure 1 – Graphic of GDP per capita and Log of Population

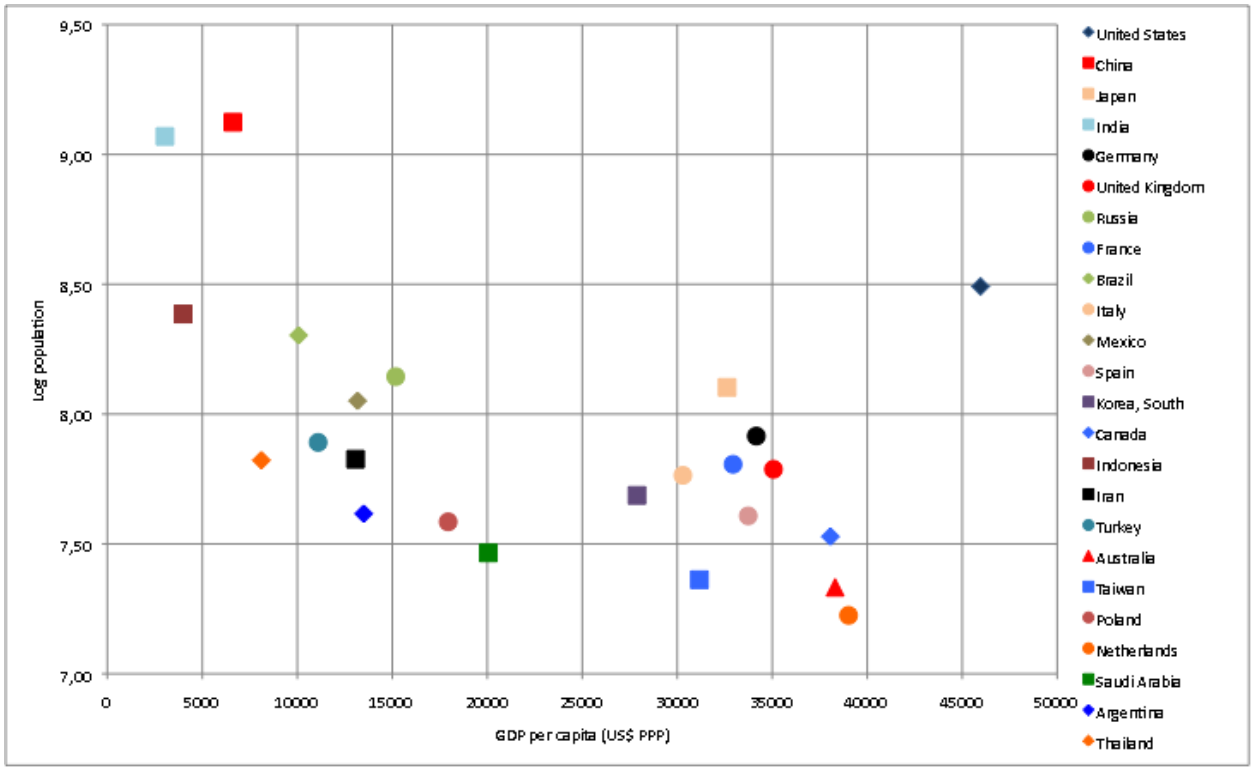


Table 7 – Four groups identified.

Group	Outlier high GDP per capita	Non-outlier high GDP per capita	Non-outlier low GDP per capita	Outlier low GDP per capita
Members	USA	Japan Germany France UK Italy Spain South Korea Taiwan Canada Australia Netherlands	Indonesia, Brazil Russia Mexico Turkey Iran Thailand Argentina Poland Saudi Arabia	China India

Source: Author

NATION STATES COMPARATIVE CAPACITIES

The next logical step is to compare the listed nations in terms of relative impact by each of the five identified risks and their relative capacities to respond to the risk.

Table 8 summarizes which nations are more affected by each of the five main risks identified. Each nation is marked in the risks they are more vulnerable and less able to cope with.

The criteria for analysis demand some explanation.

In the exposure to “new geopolitical map” every nation with high stakes in the Middle East, or with some neighbor was included. That includes nations in or adjacent to the Middle East and those with a high dependency on oil in their energy matrix. China and India despite having an energy matrix based mostly on coal have interest in enhancing their oil usage and also conflict between themselves and some neighbors. Russia and Indonesia were also included due to their extensive frontiers. South Korea was included not only because of North Korea but because it’s located between three major powers (Russia, China and Japan) and so its location is a hotspot.

The “high dependency on oil” risk was based in the need of oil for growth. In fact all non-exporters of oil and gas were included since all nations have needs for oil. That excluded only Saudi Arabia, Iran and Russia. Indonesia and Brazil were also excluded due to possible reservoirs to be developed that can reduce their exposure to this risk. France with 77% of its energy matrix being nuclear fission was also excluded. One could argue that China and India do not use oil as their energy base, but that is also the limiting factor in their growth.

Table 8 – Relative exposure to risks

	New geo-political map	High dependency on oil	Glacier depletion	Inefficient States	Pension funds system
USA	X	X			
China	X	X	X	X	X
Japan	X	X			X
India	X	X	X	X	X
Germany	X	X	X		X
UK	X	X			X
Russia	X			X	X
France	X		X		X
Brazil	X			X	X
Italy		X	X		X
Mexico		X		X	X
Spain	X	X			X
South Korea	X	X			X
Canada		X			
Indonesia	X			X	X
Iran	X		X	X	X
Turkey	X	X	X	X	X
Australia		X			X
Taiwan		X			X
Poland		X		X	X
Netherlands		X	X		X
Saudi Arabia	X			X	X
Argentina		X		X	X
Thailand		X	X	X	X

The “glacier depletion” factor was based on the amount of water usage depending on glacier in respect for the country. In that case Far East nations depending on Tibetan plateau water and European nations depending on the alpine water were included.

Turkey and Iran depend on water from their own glaciers also located in the Caucasus. USA, Russia and Brazil don't rely very much on their glacier water. Island nations like Japan, UK and Australia don't have significant glacier water, except perhaps in Scotland.

In the "inefficient State" topic all could be included, but to find some differentiation we used the GDP per capita as of 2010 as a criteria. Those with high GDP per capita were excluded from this risk.

The item "pension fund system" included all, except USA and Canada. Many nations don't even have a working pension fund system, and that will create a problem for the ageing population that will become a burden in the future.

We can now try to make an analysis of this data. Table 9 below show to how many risk factor each nation is exposed. Although it can be argued that the factors don't have the same weight this is a simple analysis viable with data gathered.

The mode is exposure to three factors. China, India and Turkey appear as particularly vulnerable while Canada is particularly safe.

However the factor count is not so reliable, since there is a lot of interaction on the disputed between nations and to understand that we will move to the theory that is built to explain interactions.

Table 9 – Number of factors nation is exposed to

Exposure to	5 factors	4 factors	3 factors	2 factors	1 factor
Nations	China India Turkey	Germany Thailand	Japan UK Russia France Brazil Italy Mexico Spain South Korea Indonesia Iran Poland Netherlands Saudi Arabia Argentina	USA Australia Taiwan	Canada

GAME THEORY AND CRISIS

Game theory has been used to model interactions since its introduction in the 1940's. Ordeshook (1986) points to its use in modeling military interactions as well as commercial ones. Tilly (1992) points out that trade and war are the two most important forms of interactions between nations.

To model commerce the best simple game theory model is the prisoner's dilemma in which cooperation between the nations can be mutually beneficial, but both have an advantage in making commercial barriers and thus not cooperating. So there is a balance between looking for mutual benefit or individual benefit.

In terms of military interaction the best simple model is the chicken game in which one nation will try to impose its superiority and thus reach Nash equilibrium in its favor.
During the early part of the 5th Kondratieff commerce was intensified, as there were clear advantages of increasing cooperation between trade partners. This process is part of what is now known as globalization and forced nations to be more effective and cooperative. In game theory terms mutual confidence was leading to a repeated Pareto optimal. However, in the prisoner's dilemma the Pareto optimal is unstable and when the crisis sets in and confidence is reduced and both players begin to look for their dominant strategy of individual benefit. When both players set into their dominant strategy the Nash equilibrium occurs with reduced trade.

Figure 2 shows an adaptation of the prisoner's dilemma to the international trade in which two nations interact by choosing either liberal (cooperative) trade policies with the other or protectionist (non-cooperative) trade policies. Of course the game is depicted as a symmetrical situation, which in practice is rare. However if asymmetry in size exists it could be argued that the gains would be relative to each player's size and thus symmetry could be found again. When asymmetry in gains due to non-complimentary economies exists the situation would change.

The exhaustion sub-phase of the Kondratieff Cycle will probably see the change in behavior within the trade game show in Figure 2, as nations will become less and less cooperative. In fact when many nations play the game above, the situation is similar to the tragedy of the commons.

Figure 2 – The trade game – a prisoner's dilemma version

		Nation 2: Liberal (cooperative)	Nation 2: Protectionist (non-cooperative)
Nation 1	Liberal (cooperative)	3,3	0,4
Nation 1	Protectionist (non-cooperative)	4,0	1,1

When disputing military supremacy and limited resources the game changes to a version of the chicken game show in figure 3, the scarce resource game. Here two nations dispute an essential resource to both using military power and intimidation. This game has being played since the dawn of civilization and is tied to the primitive hunter-gatherer nature of man.

Figure 3 – The scarce resource game – a chicken game version

		Nation 2: Share & preserve (cooperative)	Nation 2: Take & deplete (non-cooperative)
Nation 1	Share & preserve (cooperative)	3,3	1,4
Nation 1	Take & deplete (non-cooperative)	4,1	0,0

In the game above a scarce resource can be split between the two nations. This resource can be an oilfield, a water supply source, a mineral ore or a forest. If both nations decide to cooperate they can both take an equal (or proportional) share of the resource for their own purposes, however both are tempted to extract more for his own benefit and that can either reduce the market price of the resource due to excess supply or simply start to deplete the source if it was renewable up to a certain point. If both decide to take more than their equal (or proportional) share they either, deplete the source, or oversupply the market to a point in which there is no profit in its trade.

Again confidence and trust are paramount to find cooperation but both have the tendency to explore more than their share. The difference from figure 2 is that here if they both explore above the limits they clearly will deplete the source. In this scenar-

io one will take over the source and avoid to the maximum the access of the other to that resource. This situation has occurred thousands of times in the last millennia and can be a model for USA's military presence in the Middle East for example.

In fact the search for environmental accords onto limits of the Earth's ecosystem can be modeled by such game, only now the nations are depleting the resource and no agreement could be reached. Some nations did signed treaties like the Kyoto protocol but the biggest economies did not since they are still viewing for supremacy. This is pretty much like two alpha males disputing a territory. The leviathan, the state as an animal, still organizes itself like the hunter-gatherer species that formed it, that is, in hierarchies.

Here too as the scarce resources begin to be more and more crucial the nation states will clash for them and for supremacy either military or diplomatic. The period 2020-2030 will probably see some clashes between nations for these resources. The Middle East oil is the obvious resource center but there are other centers of dispute as was pointed earlier.

WHAT CAN UNFOLD: A SCENARIO STUDY

We don't believe that story is pre-written as a destiny although we can identify patterns of behavior in both Kondratieff cycles and game theory. To get a better picture of all these interactions we can develop a scenario study on the conflicts that will unfold in the next two decades.

We assume that there are two major variables that can affect those conflicts, one is the main cause of the dispute, and the other is the scope of those conflicts.

As a cause we will simplify in a contrast between economic and political causes. An economic cause is one motivated by the dispute for scarce economic resources or access to client markets. A political cause is one motivated by religious or political differences as well as possible search of an external enemy as a gathering instrument in a politically unstable situation internally.

In the scope dimension it can be either a restricted (limited) conflict restraining itself regionally, mostly in economic sanctions, and even limited military operations like for example the crisis of the 1970's was constrained mostly in the Middle East, South East Asia and the Falklands conflict in the early 1980's. On the other hand, it can be unrestricted (unlimited) like World War I or the Napoleonic wars with the war going global and affecting most nations and using high technology weapons and creating alliances in which both sides end the war exhausted and only the late comers or non-participants gain some advantage.

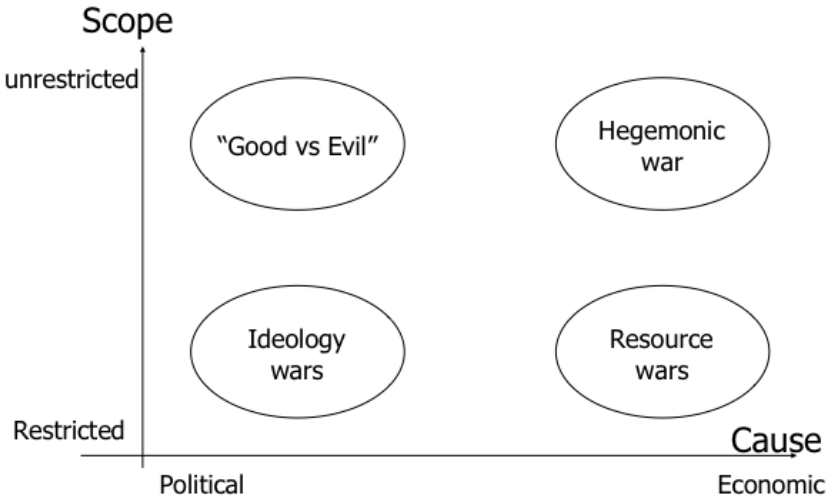
Figure 4 shows the combinations of those possibilities.

The four scenarios deserve a brief description.

The first scenario is the “Ideology wars” in which the primary cause of the conflict is political but the conflicts are limited. This may represent a set of smaller conflicts that do not evolve into a bigger war. China dispute with Taiwan is a good example of such possibility as well as Indo-Pakistan conflicts. The Caucasus is also a potential source of conflict for Turkey, Iran and Russia. Internal strife in many nations is possible and looking outside for trouble within an inflationary and political unstable situation. Somehow these disputes have a more political or religious nature and are limited. The crisis sub-phase on the second cycle is an analogue to that in the 1860’s.

The second scenario is the “Resource wars” in which the primary cause is economic dispute and access to limited resources but still limited to regional conflict and not evolving into a world conflict. This scenario could start as a limited war in the Middle East and border conflict between China and India in the Tibetan plateau and Kashmir. Other conflict could occur for the oil producing regions of the world like Caribbean, Nigeria, Angola and Indonesia. The crisis sub-phase of the fourth cycle is an analogue to that in the 1970’s.

Figure 4 – Four scenarios for 2010-2030



The third scenario is the “Good vs Evil”. Here the scenario name is an allegory since there is no “good” or “evil” in international relations, but only interests. However in propaganda both sides of a conflict try to depict themselves and the “good” side and the other as the “evil” side. In this scenario the main cause for conflict is political with ideologies dominating the propaganda, however in this scenario the war does spread and becomes worldwide or at least very wide. A possible conflict between India, China and Russia for the control of Eurasia is a distinct possibility here as well as conflict in East Europe between former soviet bloc nations as they try to reestablish their rel-

ative positions, such a war could include Russia and trigger NATO dissolution. The historical analogue is the crisis sub-phase of the first cycle in the 1800's and 1810's when Napoleonic wars climaxed in the ideology wars of the French revolution against the monarchies.

The last scenario is the "hegemonic war" in which the economic reasons lead to a global scale conflict. In this scenario a local war does escalate to a global war. It can happen due to a Middle East conflict, or for water sources. Possibilities are an India and China war, or a China and Russia war, or simply an internal war in Saudi Arabia leading to a global scarcity in oil producing several conflicts at once. The historical analogue for this scenario is the World War I in the 1910's that began as a result of the "great game" or neo-colonization and degenerated into a global conflict. Systems of alliances are made to stabilize the international relations but when they go wrong, they do so terribly as history shows us.

In none of the scenarios we pictured a direct defiance to the hegemonic power, as this is unlikely at the point on history. In fact the next crisis sub-phase will probably not lead to a hegemonic transition as pointed by tables 2 and 3. The most likely outcome as can be seen from a 2010 perspective is the "resource wars" scenario.

CONCLUSIONS

History is not clockwork, but we can look at it and find trends, cycles, games and cause-effect relations.

From those we can derive that the 2010-2030 period will be troublesome, as another end of a Kondratieff cycle approaches. In the past those periods were marked by games of competition leading to conflicts of various forms.

Today's nations will face challenges that have destroyed other nations in the past like the Austro-Hungarian Empire, or formed others like the German unification. Periods like these make international relations a struggle for life and death of the states.

We analyzed the 24 bigger nations of the world in face of five main risks identified for the period selected. India, China and Turkey appeared as the more vulnerable to the perceived risks.

Finally we used game theory to understand how the interactions occur in times of trouble, and assembled a scenario study using two variables (scope and cause).

The most likely scenario is described as "resource wars" similar to what unfolded in the 1970's.

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