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TERRORISM, TESTOSTERONE, AND PROSPERITY
– A Game Theory Perspective –

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CHAPTER I: TERRORISM, TESTOSTERONE, AND PROSPERITY
– A Game Theory Perspective –

Just over a decade ago, the political philosopher Francis Fukuyama told us that history as we have known it since the Enlightenment came to a resounding end in 1990 with the collapse of the Berlin wall, and with the resounding triumph of market-based capitalism based upon liberal democracy. During the past century, the world supposedly learned of the superiority of free market economics over its putative rivals, namely fascism, communism, and Fabian socialism.

But as we have pointed out before, Fukuyama's position is highly problematic. For the true antagonist of capitalism never was communism, but rather economic anarchy and thugocracy (rule by thugs). Regrettably, these forms of governance continue to flourish: excluding China, whose status is problematic, less than one-fifth of the world's population enjoys the fruits of the lesson which history is supposed to have taught us.

The attacks of last September 11 on New York bring this point home in a new way, and have single-handedly altered the global balance of power in ways that have not yet registered with most observers. In Part 1 of this brief essay, we explain how and why this transformation has occurred. In Part 2, we discuss the concept of power and offer a framework in terms of which investors can better assess the probabilities of who will prevail, and why. In doing so, we have drawn on that branch of game theory best suited to power analysis, a branch developed by John Nash (of "A Beautiful Mind" fame), John Harsanyi, and Reinhard Selten – the triad of 1994 Nobel laureates rewarded for their work in game theory.

Analogy to the Advent of OPEC in 1973: Why should investment managers care about "power" and how to measure it? The answer is that after 9/11, the prospects of terrorist threats will materially impact the performance both of markets and of the economy. The situation is analogous to what happened with the advent of OPEC in 1973. Having little mattered for decades, oil prices suddenly became *the* key variable in driving the business cycle, inflation, and the bond market. Indeed, the present writer was invited to give several seminars late in the 1970s on the difficult issue of "cartel dynamics". Previously, investment managers could have cared less about this subject.

This work led to our prediction that the cartel would collapse in the 1985–1987 period, and it did in the winter of 1986 when oil prices dropped from $27 to under $10, and bonds experienced one of their greatest rallies in history. Only game theory made such an analysis possible, and an analogous situation holds true today: if you want to understand the likelihood of who will prevail with what probability in today's terrorist confrontations, a game theoretic perspective is essential.

1. Roots of Terrorism

> *We find today fewer wars between nations than in the past, but more wars within them. Such internal conflicts, often driven by ethnic and religious differences, took five million lives in the last decade, most of them completely innocent victims. These conflicts present us with a stark challenge.*
>
> –President William J. Clinton, 6 September, 2000

One of the most arresting long-run predictions of the theory of economic growth is the 'Convergence Hypothesis'. This stipulates that, regardless of the initial distribution of resources around the world, the standards of living in virtually all nations will converge towards some global mean. Note how well this prediction fits the facts within the 29 nations comprising the OECD group. It is easy to assume that with its myriad advantages during the past century, Americans ought to live much better than the citizens of their competitor economies. But they do not.

Failure of 'Convergence': But once we go outside this group, the convergence hypothesis falls flat. Shockingly, whereas some 700 million people in the world now enjoy mean incomes of $28,000, some three billion people survive on less than $800 per year. By the year 2000, these people should and would have had incomes at least ten times as great had their economies been rationally managed in the previous century. Worse, an increasing share of these people now *realize* their relative plight. They learn about what they do not have by watching Western soap operas on TV. Moreover, they will increasingly possess both the incentive and the means to redress their grievances in a manner deleterious to the West.

Why does the Convergence Hypothesis fail so spectacularly? Most economists agree that the reason lies in the widespread absence of those "market augmenting" institutions of civil society (e.g., legally binding contracts) that permit market economies to take root in the first place. But if this is true, then surely economists should have done a better job in learning how and why such institutions get established in the first place. Yet with the exception of a few non-mainstream economists such as the late Mancur Olson, the economics profession has sidestepped these questions[1].

Terrorism in the Islamic World: According to the most recent Freedom House survey, 121 out of a total of 192 countries (63%) are electoral democracies of sorts, and thus "free" in a qualified sense. This proportion has been rising everywhere except in the Muslim world. There, only 11 countries (23%) of the 47 nations that are predominantly Muslim have democratic governments.

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[1] Indeed, when pressed on these issues, economists issue platitudes about the virtues of 'transparency', 'non-cronyism', 'accountability', 'cooperation', 'democracy', and so on. What they should be clarifying are the precise reasons why there is *so little* transparency and cooperation, and what can realistically be done to improve matters by rerigging the incentive structure of the underlying bargaining game. To view this from Olson's perspective, rampant economic inefficiency in scores of nations leaves lots of "money on the table" in the sense that most citizens could be better off were reforms made, and side-payments paid. But if this is so, then economists should surely have been investigating three root questions for any given nation: **(i)** Exactly why does so much money end up on the table, and in whose interest is this? **(ii)** How can various sticks and carrots be utilized to render the system more efficient? and **(iii)** Which players both inside the country and outside can best implement required changes?

The new survey states:

> "Since the early 1970s, when the third major historical wave of democratization began, the Islamic world, and in particular its Arab core, has seen little evidence of improvements in political openness, respect for human rights, and transparency…. In countries where there is an Islamic majority, there is just one free country, Mali, while 18 are rated partly free, and 28 are not free."

When this dismal reality is joined with the fact that real per capita economic growth is typically *negative* in the absence of freedom, the result is that in much of the Islamic world, prospects for a better tomorrow are dim if non-existent. Next, add in the demographic fact that 50% of the population in the Muslim world is under 22 years of age. Finally, throw in religious fundamentalism, the opium for the poor for centuries. The result:

TERRRORISM = ECONOMIC DESPAIR + FANATICISM + TESTOSTERONE

When the present writer was young in the 1960s, he often went to Lebanon. Here, despite the potential of ethnic conflict between Jews, Arabs, Christians, Muslim fundamentalists, Russians, and Americans, *everyone got on.* Why? Because the rule of law and a functioning economy were well established. Not surprisingly, therefore, annual real growth of 4% – 6% was the norm. After the mid-1970s, however, lawlessness set in, growth became negative, and the rest is history. Terrorism ended up taking root where it should: first in Lebanon, and then elsewhere throughout the Muslim world, with the exception of nations with reasonably good (if not democratic) government and thus decent growth.

Challenge for Western Governments: The foregoing analysis has important implications for the foreign policies of the industrial powers. Because of the above link between repressive governance and economic stagnation, and the link between stagnation and terrorism, the Western powers must utilize every possible "carrot and stick" to alter the incentive structures of developing nations. Specifically, they must render it in the *self-interest* of these nations to adopt those market-augmenting reforms required for economic growth. Aid packages and loans from the World Bank and the IMF must be stringently "conditioned" upon such reforms to a degree never witnessed during the twentieth century.

2. Balance of Power Analysis

As long as terrorist activity was either 'latent' or else confined to acts of aggression overseas, it did not materially impact US markets or economic activity. With the 9/11 attacks, everything changed. For starters, over 500,000 people already lost their jobs in airlines, hotels, and tourism; some say this number could reach 1,000,000 by summer. And this is only one dimension of the damage wrought.

Given such new realities, and the likelihood that technological progress will enhance the ability of terrorist cells to attack us more often and more effectively, it behooves investors to investigate how the balance of power and the prospects for "success" have been changed by recent developments.

Concept of Relative Power: Defining 'relative power' has proven to be exceptionally difficult. This was first achieved in the context of voting systems by the game theorists Lloyd Shapley and Martin Shubik in 1954. Their 'power index' defined the power of player **i** in terms of the probability that he will end up a 'pivotal player' able to make the *swing vote* in, say, a majority rule voting context. For any pair of players **i,j** the ratio of these probabilities provides a measure of **i**'s power relative to **j**'s.

Voting games are, of course, a special case of more general bargaining games, and a power index in this broader context was first proposed by John Harsanyi in 1962.[2] It was based upon his complex model of the **n**-person bargaining game, and defines **i**'s relative power as the *probability that* **i** *will prevail* in achieving what he wants. In what follows, the present author will draw upon this logic to propose a simplified version of Harsanyi's analysis. After first presenting the basic logic, we then apply it to the case of the US against Islamic terrorism.

The first thing to note is the so-called "symmetry axiom" of game theory: If two players are *strategically identical* (same resources, preferences, and risk aversion), then they will have the *same probability* of prevailing, and their power will thus be equal. Given this starting point, it is clear that the relative power of two people who are not identical is a function of the ways in which they *differ* strategically. There are three ways in which players can differ:

• **Difference in Intensity of Desire:** The more intensely player **i** wants what he wants (compared to the intensity of **j**), then the more likely he is to prevail. Surprisingly, this condition can be restated as follows: the *less risk averse* **i** is than **j**, then the *more likely* he is to prevail. This is because a person's degree of risk aversion and his "relative intensity of desire or neediness" are one and the same thing. Intuitively, consider the example of two people standing on the Berlin wall in 1975. Both profess to care a lot about securing freedom by escaping from East Germany. One then jumps off the wall, risking being killed in his pursuit of freedom. The other is unwilling to take such a risk. The inference: The latter cares less than the former about securing freedom.

• **Difference in 'Coalitional Muscle':** In analyzing the power of any player, it is necessary to take into account his bargaining relationships with every other individual individually, and also severally. Here's what this means. *First,* there are the pairwise bargaining equilibria that must hold between all n•(n-1) pairs of players. Any player **i** will thus have to achieve pairwise equilibrium with the other **(n-1)** players. *Second,* if there are **n** players in total, then there are **$(2^n - 2)$** possible coalitions that can form. When any such coalition **S** forms, it will oppose the "complementary" coalition **S*** of the players *not* in it. A given player's net payoff from multilateral bargaining in such a set-up will be a function of **(i)** his bilateral bargaining strength with each of the **(n-1)** individuals he makes a deal with, and **(ii)** his bargaining strength *within* each of the coalitions **S** of which he is a member. His strength within any coalition **S** is measured by the relative contribution he makes to **S**.[3]

[2] Harsanyi, J.C., "Measurement of Social Power in **n**-Person Reciprocal Power Situations", *Behavioral Science,* 7, 1962.

By summing up these measures of strength (contribution) across coalitions containing **i**, and by then doing the same for every other player, we end up with a set of **n** coalitional payoff numbers, one for each player. The ratio of these for any pair **i,j** yields the *relative coalitional power* of player **i** compared to **j**.

• **Difference in Threat Power:** Here we draw upon the remarkable theory of "optimal threats" developed by John F. Nash in his 1953 paper on bargaining. The logic is subtle, but very important to understand. First we give an intuitive version of Nash's logic. Then we give a more formal version. Nash proposed a model whereby each of two players begins the bargaining process by announcing his optimal threat strategies – strategies that will be played if bargaining breaks down and no compromise is reached. The player with the stronger threat strategy will, of course, have a strategic advantage over the other.

But how do the players determine their "optimal" threats? Nash proposed that in picking his threat, each player wants to do exactly the same thing: maximize the damage he can do to his antagonist *net* of the cost to himself of doing so. By formalizing this simple idea, we will now show how this amounts to solving a generalized zero-sum game of a special kind. The argument, incidentally, is pure genius. [Uninterested readers should skip the next four paragraphs.]

Consider a game between two coalitions, in which coalition **S** opposes its complement **S***. Then via Nash's logic, it will solve the following problem:

(1) $$\mathbf{MAX_X\ [V^{S^*}(x,y) - V^S(x,y)]}$$

where **X** is the set of threat strategies of **S,** and **Y** is the threat set of **S***; and where $\mathbf{V^{S^*}(x,y)}$ is the payoff value (cost) to **S*** when **S** selects strategy **x ε X** and S* selects strategy **y ε Y;** and where $\mathbf{V^S(x,y)}$ is the cost incurred by **S** itself in screwing **S***.

By symmetry, the members of **S*** solve a mirror image problem: They select that strategy **y ε Y** which maximizes the difference between the damage they can do to **S** minus the cost to themselves **S*** in doing so. That is, they solve:

(2) $$\mathbf{MAX_Y\ [V^S(x,y) - V^{S^*}(x,y)]}$$

Now, via the algebra of inequalities, this second maximization problem faced by **S*** is formally equivalent to the problem of minimizing exactly what **S** is trying to maximize: **S*** wants to pick **y ε Y** so as to *minimize* the bracketed term appearing in **(1)**. Because of this equivalence, we can rewrite the optimal threat game as follows:

(3) $$\mathbf{MIN_Y\ [\ MAX_X\ [V^{S^*}(x,y) - V^S(x,y)]\ ]}$$

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[3] More specifically, let **V(S)** be the "value" or "worth" of any coalition **S** given that it utilizes its best strategy against the opposing complementary coaltion **S***. It is assumed that player **i** is a member of **S**. Now compute the value **V(S – {i})** of the same coalition *without* player **i**. Then the entity **[V(S) – V(S – {i})]** gives the *contribution* (in utility terms) of **i** to coalition **S**.

Happily, we know (from the Kakutani-Nash "fixed point" theorem of topology) that all MIN-MAX problems such as **(3)** have a unique pair of optimal strategies **<x*,y*>**. Moreover, it can be shown that these optimal strategies are the only ones that are *mutually credible* – thus solving the deep problem of 'credibility' in bargaining theory.[4]

> As a result of this analysis, we see that the net threat power of **S** relative to **S*** can be assessed as *the relative <u>net</u> damage one coalition (player) can do to the other.* [To compute this, just plug the optimal strategies into **(3)** and then compare the MAX with the MIN values assumed by the optimand.][5]

Definition of Net Power: Drawing on the above analysis, we see that there are three dimensions of relative power. Moreover, they are relatively independent of one another: intensity of desire can change independently of threat power, and coalitional power can itself move independently of the others, etc. We thus can approximate the Harsanyi power index measure as a linear weighted form:

(4) $$p_i = a_1 I_i + a_2 C_i + a_3 T_i \qquad i = 1,....,n$$

where **p** is **i**'s power, with p_i/p_j his power *relative* to **j**'s; **I** is intensity of preference (relative risk tolerance), **C** is coalitional muscle, and **T** is threat power. The independent variables and the importance weights $\{a_i\}$ are both non-negative, and can be scaled such that $0 < p_i < 1$ for all players.

3. Application to Today's Crisis: The US versus al-Qaeda

The post-9/11 regime we have entered can be thought of most simply as a two- coalition game with players "al-Qaeda" and "the US coalition". Here is our analysis as to where each player sits along the three dimensions of power:

1. Intensity of Desire, and Risk Orientation: Al-Qaeda has the advantage of support by fanaticals who care single-mindedly about their goals of liberating the Muslim world from corrupting Western influences. Their strong intensity of desire for what they believe in – fanatically – is mirrored by their aggressiveness and repeated willingness to take risks. By contrast, the US is a couch potato society. Wars are fought antiseptically so that body bags are rarely seen. No one is drafted. We do not hate the terrorists; rather they are viewed as dangerous renegades who must be brought to heel by the US Special Forces, along with mop-up squads from developing nations increasingly utilized by our military command.

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[4] In fact, **x*** and **y*** may not be unique, but all solutions (fixed points) will be payoff-equivalent; their component strategies are thus interchangeable, and we thus have uniqueness **MOD u*(•)** where **u*** is the utility payoff vector generated by the (equivalent) equilibrium points.

[5] Nash in fact never gave a satisfactory algebraic demonstration of the above argument; his was geometric. The only place that a fully satisfactory analysis appears is in pages 167-180 of John C. Harsanyi's *Rational Behavior and Bargaining in Games and Social Situations,* Cambridge University Press, 1977.

To be sure, the US is more willing to take risks and to "rise to the occasion" today than it used to be, spurred on by the sheer affront of the 9/11 attack, and the vigor and competence of the Bush-Rumsfeld effort. *Nonetheless, the US is significantly less powerful than al-Qaeda in terms of this one dimension, by perhaps a 1:3 ratio.*

2. Coalitional Muscle: Here the US is in the driver's seat: it started off with much greater coalitional muscle, and has ended up with even more, to date. To begin with, the US can bestow valuable benefits upon the Pakistans of the world, and has. Second, it can impose significant costs of myriad kinds upon those who do not "cooperate" with its moral crusade to "rid the world of terrorism". In other words, it has many carrots and sticks available to induce cooperation from many parties, and it has used these effectively.

Al-Qaeda, on the other hand, is a global outlaw, and while there are rogue states receptive of its mission, the cost to them of harboring the terrorists is high and rising. To boot, they have no money, whereas the US has infinite wealth. *All in all, the US is more powerful than al-Qaeda along the coalitional strength dimension, by perhaps a 20:1 ratio.*

3. Threat Power: Here the US is increasingly at a disadvantage in confronting terrorist enemies. The Nash threat analysis makes very clear why this is so. Consider the each of the two terms inside the maximand of **(3)**, first from the standpoint of al-Qaeda, and second from that of the US.

• **From the al-Qaeda Viewpoint:** Throughout most of history, 1,000 armed and angry fanatics could always cause damage, but not much of it. Rarely could 5,000–10,000 opponents not quell them. *But technology has changed everything*. Today, the machinations of 15 – 25 well trained and financed people can do vast damage to the greatest powers on the earth. Indeed, what is rarely stated about 9/11 is how lucky New York was that only 3,000 people died. The toll could evidently have been 30,000. Before long, portable nuclear weapons will apparently make it possible to kill *millions* in the future. The correlative economic damage would be almost unthinkable. "Open" societies like the US can stammer their indignation, and institute meaningless security measures, but they *are* open, they are going to remain open, and they will become more and more vulnerable.

Now consider the subtrahend (the second term inside the brackets). Its value is very low, perhaps even 0, for rogue groups like al-Qaeda: Its members attach little disutility to dying for their cause. Dozens of doe-eyed virgins reputedly await martyrs as they enter the Muslim afterlife. To sum up, the damage they can do to the US is exploding, whereas the cost to themselves from doing so is negligible. Disaster!

• **From the US Viewpoint:** The exact reverse of the above analysis holds true for the US. *First*, its ability to damage groups like al-Qaeda is embarassingly modest. Yes, it can rid a country of a rogue government (the Taliban). But it seems altogether incapable of penetrating the all-important al-Qaeda cells which operate in at least 10 nations, and has been unable to date to lay its hands on any of the principals. *Second,* as for the Nash subtrahend, the US cares a great deal about any loss of life or economic distress resulting from an attack like that of 9/11. Worse, its antagonists know this. *All in all, the US probably is significantly less powerful along the threat power dimension, by perhaps a 1:5 ratio.*

– Net Relative Power of US versus al-Qaeda –

To sum up, consider the net power equation **(4)** above. If appropriate weights are given to the three dimensions of power[6], then the foregoing analysis suggests that the US has a power ratio of **3:1** versus the terrorists, or in equivalent decimal form, $\mathbf{p_{US} = .75, p_{AQ} = .25}$. This is a rather surprising conclusion, since one would assume that the US is "infinitely more powerful" than any rogue aggressor. But because of the extreme threat power asymmetry – favoring the terrorists – this is not the case. Note that history is dotted with examples where extremist minorities either improbably prevailed against established power, or else successfully wreaked havoc for decades. We have attempted to explain *why* this is so from first principles.

4. Increased US *Global* Power, Along All Three Dimensions

The foregoing discussion is entirely static in nature. But in fact, the activities of the US and its antagonists during the past few months have already changed the calculus of global power, perhaps rendering the US more powerful than it ever has been except for the 1945–1950 period when it was hegemonous as regards both wealth and atomic bomb power.

There are three ways in which US power relative to rest-of-the-world power has increased. The game theoretical measures introduced above make crystal clear what has happened.

Intensity of Preference / Risk Tolerance Power: As suggested above, the resolve and competence of the Bush-Rumsfeld effort have made clear that the US has put the "Vietnam syndrome" behind, and will stand up for its interests. The erratic stop-and-start foreign policy of the Clinton administration did not send the strong signals that have recently been sent. Additionally, the success of US military strategy – its remarkable "smart" technology in particular – has stiffened US resolve still further.

Coalitional Power: At the start of the current confrontation, the Bush administration surprised many by its ability to stitch together an unlikely coalition not only of the usual suspects, but of such nations as Russia and Pakistan as well. [And all this from a supposedly unsophisticated and unintelligent president denigrated by the intelligensia for "rarely traveling overseas".] The coalitional muscle of the US has increased still further because of the technological show of strength of the Afghan war. Specifically, with the US technology lead growing rapidly, and with its resolve stiffened, political leaders of other countries wondering what side to back will have less difficulty in choosing.

Threat Power: The relative threat power of the US has increased significantly, as can once again be seen by analyzing the two terms inside the brackets of the Nash maximand in **(1)**. *First*, the ability of the US to inflict damage on any adversary has increased because of the new technologies which work on any terrain and in any weather and at any time of day. Moreover, even greater technological prowess lies just ahead. *Second*, the cost to the US of military engagement has fallen, since 500 laser-equipped fighters can now do the work of 5,000 or even 50,000 of yesteryear's fighters; and they can do so with a massively reduced proportional loss of life.

[6] For technical reasons, coalitional power should receive about 50% more weight than the other two dimensions, themselves weighted equally. All this is, of course, a mere approximation.

There is another way in which recent events increased the admittedly small threat power that the US has relative to al-Qaeda. Its demolition of the Taliban government signaled all those who would harbor terrorists that the *price* they will pay for doing so will be high. This in turn raises the costs to the terrorists themselves of pursuing their strategies. Where will they train, much less hide?

The developments discussed in this brief chapter have an impact transcending today's headlines. Rumor has it in the intelligence community that turmoil has broken out in the defense establishments of Russia, China, Pakistan, and France. Russian generals who predicted a "quagmire" and US defeat have been bureaucratically discredited, and in some cases are being sent out to pasture. The Chinese military has witnessed a routing of their principal strategic assumptions: Their close ally Pakistan is no longer the ally it was; the Russo-US alliance in central Asia has displaced their own role there; and their battle plan for Taiwan has been compromised by the new US ability to conduct an effective war without hundreds of thousands of troops.

Pakistan has become Humpty-Dumpty land, where every assumption of the military has been turned upside down. Finally, the French military has apparently advised the nation's political relationship to improve ties with the US lest it confront strategic obsolescence You *know* things have changed when this occurs.[7]

Conclusion

In confronting its new nemesis, the US has much less "net" power than one would think, even though its power quotient has increased during the past four months. While it can *retaliate* very effectively – with great coalitional strength – against any geographical region that hosts its antagonists, it can do little if anything to *defend* itself against strikes like that of 9/11. Both sides know this. Moreover, even when the US does retaliate, it has shown no ability to lay hands on the culprits directly responsible. Little is going to change this equation, and further terrorist strikes almost certainly *will* occur over time.

The greatest challenge to the West lies not in military preparedness, but rather in aggressively transforming the *incentive structure* in the Muslim world so as to make rapid economic growth a more attractive option to all parties involved.

[7] The global analysis sketched in the past two paragraphs have benefited from an e-mail faxed to the author. Regrettably, the original source of the insights was missing, and cannot be acknowledged.

