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War and Peace: The Fundamental Role of Incentives in Game Theory and Economics Analysis

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Discurso de ingreso en la Real Academia de Ciencias Económicas y Financieras
como académico correspondiente para Israel,
leído el 10 de Noviembre de 2011

EXCMO. SR. DR. D. ROBERT J. AUMANN

Y contestación del académico de número

EXCMO. SR. DR. D. JAIME GIL ALUJA

Barcelona, Noviembre 2011

Sumario

Discurso de ingreso en la Real Academia de Ciencias Económicas y Financieras leído el 10 de Noviembre de 2011 por la académico correspondiente para Israel

EXCMO. SR. DR. D. ROBERT J. AUMANN

Discurso de contestación por el académico de número
EXCMO. SR. DR. D. JAIME GIL ALUJA

EXCMO. SR. DR. D. ROBERT J. AUMANN

WAR AND PEACE*

ROBERT J. AUMANN

"Wars and other conflicts are among the main sources of human misery." Thus begins the *Advanced Information* announcement of the 2005 Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel, awarded for Game Theory Analysis of Conflict and Cooperation. So it is appropriate to devote this lecture to one of the most pressing and profound issues that confront humanity: that of War and Peace.

I would like to suggest that we should perhaps change direction in our efforts to bring about world peace. Up to now all the effort has been put into resolving specific conflicts: India–Pakistan, North–South Ireland, various African wars, Balkan wars, Russia–Chechnya, Israel–Arab, etc., etc. I'd like to suggest that we should shift emphasis and study war in general.

Let me make a comparison. There are two approaches to cancer. One is clinical. You have, say, breast cancer. What should you do? Surgery? Radiation? Chemotherapy? Which chemotherapy? How much radiation? Do you cut out the lymph nodes? The answers are based on clinical tests, simply on what works best. You treat each case on its own, using your best information. And your aim is to cure the disease, or to ameliorate it, in the specific patient before you.

And, there is another approach. You don't do surgery, you don't do radiation, you don't do chemotherapy, you don't look at statistics, you don't look at the patient at all. You just try to understand what happens in a cancerous cell. Does it have anything to do with the DNA? What happens? What is the process like? *Don't* try to cure it. Just try to *understand* it. You work with mice, not people. You try to make them sick, not cure them.

Louis Pasteur was a physician. It was important to him to treat people, to cure them. But Robert Koch was not a physician, he didn't try to cure people.

He just wanted to know how infectious disease works. And eventually, his work became tremendously important in treating and curing disease.

War has been with us ever since the dawn of civilization. Nothing has been more constant in history than war. It's a phenomenon, it's not a series of isolated events. The efforts to resolve specific conflicts are certainly laudable, and sometimes they really bear fruit. But there's also another way of going about it – studying war as a general phenomenon, studying its general, defining characteristics, what the common denominators are, what the differences are. Historically, sociologically, psychologically, and – yes – *rationally*. Why does *homo economicus* – rational man – go to war?

What do I mean by "rationality"? It is this:
*A person's behavior is **rational** if it is in **his** best interests, given **his** information.*

With this definition, can war be rational? Unfortunately, the answer is yes; it can be. In one of the greatest speeches of all time – his second inaugural – Abraham Lincoln said: "Both parties deprecated war; but one would make war rather than let the nation sur vive; and the other would accept war rather than let it perish. And the war came."

It is a big mistake to say that war is irrational. We take all the ills of the world – wars, strikes, racial discrimination – and dismiss them by calling them irrational. They are not necessarily irrational. Though it hurts, they may be rational. If war is rational, once we understand that it is, we can at least somehow address the problem. If we simply dismiss it as irrational, we can't address the problem.

Many years ago, I was present at a meeting of students at Yale University. Jim Tobin, who later was awarded the Prize in Economic Sciences in Memory of Alfred Nobel, was also there. The discussion was freewheeling, and one question that came up was: Can one sum up economics in one word? Tobin's answer was "yes"; the word is *incentives*. Economics is all about incentives.

So, what I'd like to do is an economic analysis of war. Now this does *not* mean what it sounds like. I'm not talking about how to finance a war, or how to

rebuild after a war, or anything like that. I'm talking about the *incentives* that lead to war, and about building incentives that prevent war.

Let me give an example. Economics teaches us that things are not always as they appear. For example, suppose you want to raise revenue from taxes. To do that, obviously you should raise the tax rates, right? No, wrong. You might want to *lower* the tax rates. To give people an incentive to work, or to reduce avoidance and evasion of taxes, or to heat up the economy, or whatever. That's just one example; there are thousands like it. An economy is a game: the incentives of the players interact in complex ways, and lead to surprising, often counter-intuitive results. But as it turns out, the economy really works that way.

So now, let's get back to war, and how *homo economicus* – rational man – fits into the picture. An example, in the spirit of the previous item, is this. You want to prevent war. To do that, obviously you should disarm, lower the level of armaments. Right? No, wrong. You might want to do the exact opposite. In the long years of the cold war between the US and the Soviet Union, what prevented "hot" war was that bombers carrying nuclear weapons were in the air 24 hours a day, 365 days a year. Disarming would have led to war.

The bottom line is – again – that we should start studying war, from all viewpoints, for its own sake. Try to understand what makes it happen. Pure, basic science. *That* may lead, eventually, to peace. The piecemeal, case-based approach has not worked too well up to now.

Now I would like to get to some of my own basic contributions, some of those that were cited by the Prize Committee. Specifically, let's discuss repeated games, and how they relate to war, and to other conflicts, like strikes, and indeed to all interactive situations.

Repeated games model long-term interaction. The theory of repeated games is able to account for phenomena such as altruism, cooperation, trust, loyalty, revenge, threats (self-destructive or other wise) – phenomena that may at first seem irrational – in terms of the "selfish" utility-maximizing paradigm of game theory and neoclassical economics.

That it "accounts" for such phenomena does not mean that people deliberately choose to take revenge, or to act generously, out of consciously self-ser ving, rational motives. Rather, over the millennia, people have evolved norms of behavior that are by and large successful, indeed optimal. Such evolution may actually be biological, genetic. Or, it may be "memetic"; this word derives from the word "meme," a term coined by the biologist Richard Dawkins to parallel the term "gene," but to express social, rather than biological, heredity and evolution.

One of the great discoveries of game theory came in the early seventies, when the biologists John Maynard Smith and George Price realized that strategic equilibrium in games and population equilibrium in the living world are defined by the same equations. Evolution – be it genetic or memetic – leads to strategic equilibrium. So what we are saying is that in *repeated* games, strategic equilibrium expresses phenomena such as altruism, cooperation, trust, loyalty, revenge, threats, and so on. Let us see how that works out.

What do I mean by "strategic equilibrium"? Very roughly, the players in a game are said to be in *strategic equilibrium* (or simply *equilibrium*) when their play is *mutually optimal*: when the actions and plans of each player are rational in the given strategic environment – i.e., when each knows the actions and plans of the others.

For formulating and developing the concept of strategic equilibrium, John Nash was awarded the 1994 Prize in Economics Sciences in Memory of Alfred Nobel, on the fiftieth anniversary of the publication of John von Neumann and Oskar Morgenstern's *Theory of Games and Economic Behavior*. Sharing that Prize were John Harsanyi, for formulating and developing the concept of *Bayesian* equilibrium, i.e., strategic equilibrium in games of incomplete information; and Reinhard Selten, for formulating and developing the concept of *perfect* equilibrium, a refinement of Nash's concept, on which we will say more below. Along with the concepts of *correlated* equilibrium (Aumann 1974, 1987), and *strong* equilibrium (Aumann 1959), both of which were cited in the 2005 Prize announcement, the above three fundamental concepts constitute the theoretical cornerstones of noncooperative game theory.

Subsequent to the 1994 prize, two Prizes in Economic Sciences in Memory of Alfred Nobel were awarded for *applications* of these fundamental concepts. The first was in 1996, when William Vickrey was awarded the Prize posthumously for his work on auctions. (Vickrey died between the time of the Prize announcement and that of the ceremony.) The design of auctions and of bidding strategies are among the prime practical applications of game theory; a good – though somewhat dated – sur vey is Wilson 1992.

The second came this year – 2005. Professor Schelling will, of course, speak and write for himself. As for your humble ser vant, he received the prize for applying the fundamental equilibrium concepts mentioned above to *repeated* games. That is, suppose you are playing the same game G, with the same players, year after year. One can look at this situation as a single big game – the socalled *supergame* of G, denoted $G\infty$ – whose rules are, "play G every year." The idea is to apply the above equilibrium concepts to the supergame $G\infty$, rather than to the one-shot game G, and to see what one gets.

The theory of repeated games that emerges from this process is extremely rich and deep (good – though somewhat dated – sur veys are Sorin 1992, Zamir 1992, and Forges 1992). In the few minutes that are available to me, I can barely scratch its surface. Let me nevertheless try. I will briefly discuss just one aspect: the *cooperative*. Very roughly, the conclusion is that

Repetition Enables Cooperation.

Let us flesh this out a little. We use the term *cooperative* to describe any possible outcome of a game, as long as no player can *guarantee* a better outcome for himself. It is important to emphasize that in general, a cooperative outcome is *not* in equilibrium; it's the result of an agreement. For example, in the well-known "prisoner's dilemma" game, the outcome in which neither prisoner confesses is a cooperative outcome; it is in neither player's best interests, though it is better for both than the unique equilibrium.

An even simpler example is the following game H: There are two players, Rowena and Colin. Rowena must decide whether both she and Colin will receive

the same amount – namely 10 – or whether she will receive ten times more, and Colin will receive ten times less. Simultaneously, Colin must decide whether or not to take a punitive action, which will harm both Rowena and himself; if he does so, the division is cancelled, and instead, each player gets nothing. The game matrix is

	Acquiesce	**P**unish
Divide **E**venly	10 10	0 0
Divide **G**reedily	1 100	0 0

The outcome (**E,A**), yielding 10 to each player, is a cooperative outcome, as no player can guarantee more for himself; but like in the prisoner's dilemma, it is not achievable in equilibrium.

Why are cooperative outcomes interesting, even though they are not achievable in equilibrium? The reason is that they are achievable by contract – by agreement – in those contexts in which *contracts are enforceable*. And there are many such contexts; for example, a national context, with a court system. The Talmud (Avot 3, 2) says,

הוי מתפלל בשלומה של מלכות, שאלמלא מוראה, איש את רעהו חיים בלעו.

"Pray for the welfare of the government, for without its authority, man would swallow man alive." If contracts are enforceable, Rowena and Colin can achieve the cooperative outcome (**E,A**) by agreement; if not, (**E,A**) is for practical purposes unachievable.

The cooperative theory of games that has grown from these considerations predates the work of Nash by about a decade (von Neumann and Morgenstern 1944). It is very rich and fruitful, and in my opinion, has yielded *the* central insights of game theory. However, we will not discuss these insights here; they are for another Prize in Economic Sciences in Memory of Alfred Nobel, in the future.

What I do wish to discuss here is the relation of cooperative game theory to repeated games. The fundamental insight is that repetition is like an enforcement mechanism, which enables the emergence of cooperative outcomes *in equilibrium* – when everybody is acting in his own best interests.

Intuitively, this is well-known and understood. People are much more cooperative in a long-term relationship. They know that there is a tomorrow, that inappropriate behavior will be punished in the future. A businessman who cheats his customers may make a short-term profit, but he will not stay in business long.

Let's illustrate this with the game *H*. If the game is played just once, then Rowena is clearly better off by dividing **G**reedily, and Colin by **A**cquiescing. (Indeed, these strategies are *dominant*.) Colin will not like this very much – he is getting nothing – but there is not much that he can do about it. Technically, the *only* equilibrium is (**G,A**).

But in the supergame H^{∞}, there *is* something that Colin can do. He can *threaten* to **P**unish Rowena for ever after wards if she ever divides **G**reedily. So it will not be worthwhile for her to divide greedily. Indeed, in H^{∞} this is actually an equilibrium in the sense of Nash. Rowena's strategy is "play **E** for ever"; Colin's strategy is "play **A** as long as Rowena plays **E**; if she ever plays **G**, play **P** for ever after wards."

Let's be quite clear about this. What is maintaining the equilibrium in these games is the *threat of punishment*. If you like, call it "MAD" – mutually assured destruction, the motto of the cold war.

One caveat is necessary to make this work. The discount rate must not be too high. Even if it is anything over 10% – if $1 in a year is worth less than 90 cents today – then cooperation is impossible, because it's still worthwhile for Rowena to be greedy. The reason is that even if Colin punishes her – and himself! – for ever after wards, then when evaluated today, the entire eternal punishment is worth less than $90, which is all that Rowena gains today by dividing greedily rather than evenly.

I don't mean just the monetary discount rate, what you get in the bank. I mean the personal, subjective discount rate. For repetition to engender cooperation, the

players must not be too eager for immediate results. The present, the now, must not be too important. If you want peace now, you may well never get peace. But if you have time – if you can wait – that changes the whole picture; *then* you may get peace now. It's one of those paradoxical, upside-down insights of game theory, and indeed of much of science. Just a week or two ago, I learned that global warming may cause a cooling of Europe, because it may cause a change in the direction of the Gulf Stream. Warming may bring about cooling. Wanting peace now may cause you never to get it – not now, and not in the future. But if you can wait, maybe you will get it now. The reason is as above: The strategies that achieve cooperation in an equilibrium of the supergame involve punishments in subsequent stages if cooperation is not forthcoming in the current stage. If the discount rates are too high, then the players are more interested in the present than in the future, and a one-time coup now may more than make up for losses in the sequel. This vitiates the threat to punish in future stages.

To summarize: In the supergame $H\infty$ of the game H, the cooperative outcome (**E,A**) is achievable in equilibrium. This is a special case of a much more general principle, known as the *Folk Theorem*, which says that *any* cooperative outcome of *any* game G is achievable as a strategic equilibrium outcome of its supergame $G\infty$ – even if that outcome is not an equilibrium outcome of G. Conversely, every strategic equilibrium outcome of $G\infty$ is a cooperative outcome of G. In brief, for any game G, we have

THE FOLK THEOREM: **The cooperative outcomes of G coincide with the equilibrium outcomes of its supergame $G\infty$.**

Differently put, repetition acts as an enforcement mechanism: It makes cooperation achievable when it is not achievable in the one-shot game. Of course, the above caveat continues to apply: In order for this to work, the discount rates of all agents must be low; they must not be too interested in the present as compared with the future.

There is another point to be made, and it again relates back to the 1994 Prize. John Nash got the Prize for his development of equilibrium. Reinhard Selten got the Prize for his development of *perfect* equilibrium. Perfect equilibrium means, roughly, that the threat of punishment is *credible;* that *if* you have to go to a

punishment, then after you punish, you are still in equilibrium – you do not have an incentive to deviate.

That certainly is *not* the case for the equilibrium we have described in the supergame $H\infty$ of the game H. If Rowena plays **G** in spite of Colin's threat, then it is *not* in Colin's best interest to punish forever. That raises the question: In the repeated game, can (**E,A**) be maintained not only in strategic equilibrium, but also in *perfect* equilibrium?

The answer is yes. In 1976, Lloyd Shapley – whom I consider to be the greatest game theorist of all time – and I proved what is known as the *Perfect Folk Theorem*; a similar result was established by Ariel Rubinstein, independently and simultaneously. Both results were published only much later (Aumann and Shapley 1994, Rubinstein 1994). The Perfect Folk Theorem says that in the supergame $G\infty$ of any game G, any cooperative outcome of G is achievable as a *perfect* equilibrium outcome of $G\infty$ – again, even if that outcome is not an equilibrium outcome of G. The converse of course also holds. In brief, for any game G, we have

THE PERFECT FOLK THEOREM: **The cooperative outcomes of G coincide with the perfect equilibrium outcomes of its supergame $G\infty$.**

So again, repetition acts as an enforcement mechanism: It makes cooperation achievable when it is not achievable in the one-shot game, even when one replaces strategic equilibrium as the criterion for achievability by the more stringent requirement of *perfect* equilibrium. Again, the caveat about discount rates applies: In order for this to work, the discount rates of all agents must be low; they must not be too interested in the present as compared with the future.

The proof of the Perfect Folk Theorem is quite interesting, and I will illustrate it very sketchily in the game H, for the cooperative outcome (**E,A**). In the first instance, the equilibrium directs playing (**E,A**) all the time. If Rowena deviates by dividing **G**reedily, then Colin punishes her – plays **P**. He does not, however, do this forever, but only until Rowena's deviation becomes unprofitable. This in itself is still not enough, though; there must be something that motivates

Colin to carry out the punishment. And here comes the central idea of the proof: If Colin does not punish Rowena, then Rowena must punish Colin – by playing **G** – for not punishing Rowena. Moreover, the process continues – any player who does not carry out a prescribed punishment is punished by the other player for not doing so.

Much of society is held together by this kind of reasoning. If you are stopped by a policeman for speeding, you do not offer him a bribe, because you are afraid that he will turn you in for offering a bribe. But why should he not accept the bribe? Because he is afraid that you will turn him in for accepting it. But why would you turn him in? Because if you don't, he might turn you in for not turning him in. And so on.

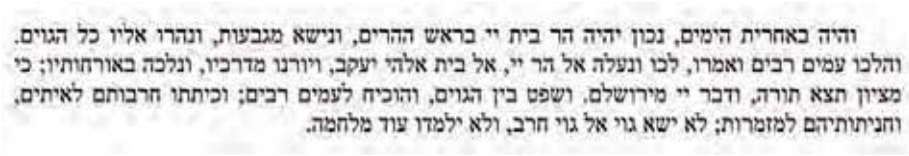
This brings us to our last item. Cooperative game theory consists not only of delineating all the possible cooperative outcomes, but also of choosing among them. There are various ways of doing this, but perhaps best known is the notion of *core*, developed by Lloyd Shapley in the early fifties of the last century. An outcome x of a game is said to be in its "core" if no set S of players can *improve* upon it – i.e., assure to each player in S an outcome that is better for him than what he gets at x. Inter alia, the concept of core plays a central role in applications of game theory to economics; specifically, the core outcomes of an economy with many individually insignificant agents are the same as the competitive (a.k.a. Walrasian) outcomes – those defined by a system of prices for which the supply of each good matches its demand (see, e.g., Debreu and Scarf 1963, Aumann 1964). Another prominent application of the core is to *matching* markets (see, e.g., Gale and Shapley 1962, Roth and Sotomayor 1990). The core also has many other applications (for sur veys, see Anderson 1992, Gabszewicz and Shitovitz 1992, Kannai 1992, Kurz 1994, and Young 1994).

Here again, there is a strong connection with equilibrium in repeated games. When the players in a game are in (strategic) equilibrium, it is not worthwhile for any one of them to deviate to a different strategy. A *strong* equilibrium is defined similarly, except that there it is not worthwhile for any *set* of players to deviate – at least one of the deviating players will not gain from the deviation. We then have the following

THEOREM (AUMANN 1959): **The core outcomes of G coincide with the strong equilibrium outcomes of its supergame $G\infty$.**

In his 1950 thesis, where he developed the notion of strategic equilibrium for which he got the Prize in Economic Sciences in Memory of Alfred Nobel in 1994, John Nash also proposed what has come to be called the *Nash Program* – expressing the notions of cooperative game theory in terms of some appropriately defined noncooperative game; building a bridge between cooperative and noncooperative game theory. The three theorems presented above show that repetition constitutes precisely such a bridge – it is a realization of the Nash Program.

We end with a passage from the prophet Isaiah (2, 2–4):


והיה באחרית הימים, נכון יהיה הר בית יי בראש ההרים, ונישא מגבעות, ונהרו אליו כל הגוים.
והלכו עמים רבים ואמרו, לכו ונעלה אל הר יי, אל בית אלהי יעקב, ויורנו מדרכיו, ונלכה באורחותיו; כי
מציון תצא תורה, ודבר יי מירושלם. ושפט בין הגוים, והוכיח לעמים רבים; וכיתתו חרבותם לאיתים,
וחניתותיהם למזמרות; לא ישא גוי אל גוי חרב, ולא ילמדו עוד מלחמה.

"And it shall come to pass ... that ... many people shall go and say, ... let us go up to the mountain of the Lord, ... and He will teach us of His ways, and we will walk in His paths. … And He shall judge among the nations, and shall rebuke many people; and they shall beat their swords into ploughshares, and their spears into pruning hooks; nation shall not lift up sword against nation, neither shall they learn war any more."

Isaiah is saying that the nations can beat their swords into ploughshares when there is a central government – a Lord, recognized by all. In the absence of that, one *can* perhaps have peace – no nation lifting up its sword against another. But the swords must continue to be there – they cannot be beaten into ploughshares – and the nations must continue to *learn* war, in order *not* to fight!

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Discurso de contestación por el Académico de Número

EXCMO. SR. DR. D. JAIME GIL ALUJA

EXCMO. SR. DR. D. JAIME GIL ALUJA

Excelentísimos e Ilustrísimos Señores Académicos,
Señoras y Señores,

"La guerra está en el origen de la miseria humana". Así podríamos resumir las primeras palabras de nuestro nuevo académico, el ilustrísimo doctor Robert Aumann, al iniciar su discurso de aceptación del Premio en Ciencias Económicas instituido en memoria de Alfred Nobel en Estocolmo.

Y el profesor, a quien esta Real Corporación se honra en acoger hoy, tiene buenas razones para haber elegido esta idea, porque con una guerra y un genocidio comenzó también su propia vida.

Robert Aumann nació en 1930 en Frankfurt, Alemania, pero su familia tuvo que huir de la barbarie nazi en 1938, cuando él apenas había cumplido los 8 años. Los Aumann emigraron a Estados Unidos dos semanas antes de la Noche de los Cristales Rotos.

Y allí en Nueva York comenzó una nueva vida y una brillantísima trayectoria académica que despegó con su graduación en Matemáticas por el City College en 1950 y con su doctorado en el Massachussets Institute of Technology, el prestigioso MIT.

La tesis del joven Aumann, *Asphericity of Alternating Linkages,* revolucionó la comprensión del concepto de "núcleo", desarrollado anteriormente por Lloid Shapley como forma válida para la elección entre todos los posibles resultados cooperativos. En este ámbito se considera que "un resultado de un juego se encuentra en su **núcleo** si ningún conjunto de jugadores puede mejorarlo".

Aumann ya había deslumbrado con sus investigaciones en dicho campo a los círculos más avanzados, lo que le abriría la puerta para entrar en los grupos matemáticos más selectos.

En 1956, el joven profesor se incorpora al prestigioso claustro de la Universidad Hebrea de Jerusalén, aunque mantiene contactos y docencia con los mejores centros de la universidad americana. Simultaneamente, el doctor Aumann

continua avanzando en sus investigaciones que, poco a poco, van consolidando su prestigio como estudioso de la teoría de juegos.

La idea de que "los juegos repetidos sirven para modelizar las interacciones a largo plazo", constituye una interesante contribución a un mejor conocimiento de las situaciones en las que los jugadores se enfrentan una y otra vez. Con ello, lo que cambia no es sólo el estudio del cálculo racional de incentivos sino también la propia adopción de las decisiones.

Sostiene el profesor Aumann que la evolución, tanto genética como memética, es decir la herencia genética y la herencia social, lleva al "equilibrio estratégico", es decir a la situación en que el juego es **óptimo mutuamente** para los jugadores. Es precisamente la formulación y desarrollo del concepto de **equilibrio estratégico** lo que le valió a John Nash el Premio en Ciencias Económicas instituido en memoria de Alfred Nobel.

En su proceso investigador, el profesor Aumann define los conceptos de "equilibrio correlacionado" y de "equilibrio fuerte" y, lo que es más importante, los aplica a los **juegos repetitivos**. Esta repetición revoluciona el conocimiento en el ámbito de los juegos no cooperativos. Imagina un superjuego G ∞, es decir la repetición del juego G año tras año en vez de un juego G que se realiza una única vez y aplica los conceptos de equilibrio al superjuego G ∞ en lugar de hacerlo en el juego G. Surge, entonces, la "teoría de los juegos repetitivos". Aumann recibe el premio por aplicar a juegos repetitivos los conceptos fundamentales de equilibrio antes mencionados.

Las investigaciones de Aumann le llevan entonces a la conclusión: **la repetición hace posible la cooperación**, apareciendo la cooperación cuando un jugador no consigue un mejor resultado por sí mismo.

Pero el profesor Aumann no sólo ha destacado por el estudio de la cooperación en la teoría de juegos sino que él mismo ha destacado por su capacidad de cooperar con otros investigadores como Lloyd Shapley con quien demostró el "Teorema Popular Perfecto", en el que se pone de manifiesto, una vez más, que la repetición actúa como un mecanicismo de reforzamiento. Su enunciado es el

siguiente: “los resultados cooperativos de G coinciden con los resultados en clave de **equilibrio perfecto** de su superjuego G ∞”.

Aumann ha sabido utilizar la Teoría de Juegos con flexibilidad y versatilidad, no sólo en los campos habituales sino que también ha encontrado terrenos de experimentación insospechados como es el caso de los estudios talmúdicos.

En efecto, Aumann y Maschler aplicaron la Teoría de Juegos al análisis de los milenarios dilemas talmúdicos como el misterio del “problema de la división”, un antiquísimo dilema en el que la lógica talmúdica trata de resolver el problema de dividir la herencia de un marido. El profesor Aumann dedicó el artículo que recoge este trabajo a su hijo Shlomo, que cayó en el frente de batalla durante la guerra del Líbano en 1982 sirviendo en el ejército israelí.

Permítanme, ahora, una breve incursión en algunos aspectos, que consideramos genuinos del pensamiento aumanniano, de su discurso de aceptación del Premio Nobel. Para empezar, Aumann rechaza cierto pacifismo irreflexivo que se niega a tratar de entender la Guerra al incluirla de entrada y sin concederle un análisis detenido en el saco de los sucesos irracionales que acaban con vidas humanas.

Quien tacha a la guerra de irracional -argumenta el profesor- se priva también de la posibilidad de entenderla y, por tanto, de evitarla.

El hecho de intentar racionalizar las causas de la guerra -añadimos nosotros- no significa que las justifiquemos ni que le concedamos una cobertura moral sino sólo que reconozcamos que los conflictos humanos y el uso de la violencia tiene unas causas y que se hallan sometidos a determinadas leyes.

A partir de ese rechazo del rechazo irreflexivo, el doctor Aumann utiliza la lógica y la teoría de los juegos para argumentar desde el más puro raciocinio el adagio latino *“si vis pacem, para bellum”*.

Si situamos los cálculos bélicos en el marco teórico de la teoría de los juegos repetidos, veríamos que el “ahora” pierde sentido estratégico respecto al

mañana, lo que nos lleva a la tan repetida frase de Aumann en el sentido de que "para que esto funcione, el tipo de descuento de todos los agentes debe ser bajo; no deben estar demasiado interesados en el presente si se compara con el futuro". Cualquier decisión estratégica debe poner, pues, la táctica al servicio del objetivo a largo plazo.

En ese sentido, argumenta el profesor Aumann, cierto ingenuo pacifismo puede causar la guerra aun buscando la paz inmediata y, en cambio, la carrera armamentística y la amenaza de la mutua destrucción asegurada puede conseguir la paz, aunque parezca paradójico a quien no conoce la teoría de juegos.

Y es ese aspecto, el de cómo la actuación inmediata de un jugador que sólo calcule las consecuencias de su acción a corto plazo puede obtener resultados indeseables a largo, el que interesa ahora destacar por su enorme utilidad en la concepción y aplicación de políticas económicas.

Del mismo modo que la búsqueda inmediata de la paz puede conducir al inicio súbito de la guerra, puesto que el enemigo interpretaría tu deseo de paz como debilidad que querría aprovechar, determinadas políticas monetarias pueden provocar efectos indeseables e incluso opuestos al deseado.

Si el gobernante pretende, por ejemplo, la estabilidad presupuestaria inmediatamente puede que no la consiga simplemente con recortes masivos de servicios sociales y con aumentos de impuestos, aunque ese parezca el camino más corto para conseguir el objetivo, ya que los jugadores inhibirán su actividad para evitar el riesgo de pérdidas en un escenario depresivo y lo que conseguirá el gobernante en realidad es una reducción de expectativas que limitará la inversión y por tanto cercenará el crecimiento a medio plazo impidiendo cualquier recuperación.

De ese modo, el presente, el puro "ahora", no debe ser demasiado importante para quien diseña políticas económicas, del mismo modo que no debe serlo tampoco para quien busca la paz.

Si se desea la paz inmediata puede que nunca se consiga, pero si no se tiene prisa, si se es capaz de ver más allá de lo inmediato, paradójicamente es posible que se consiga la paz ahora.

Del mismo modo, obtener ahorro inmediato en un presupuesto ahora puede dañar la posibilidad de cubrir el presupuesto del año próximo, puesto que los jugadores habrán reducido su actividad, expectativas y riesgo de tal modo que la caída en la recesión será inevitable y hará imposible cualquier recuperación próxima.

Se trataría, pues, de conseguir la reducción presupuestaria sin dañar el crecimiento a medio y largo plazo y nos tememos que para conseguir ese equilibrio óptimo no es suficiente con el vulgar tijeretazo ni con el aumento de impuestos sin más. Y ello es así por cuanto, con demasiada frecuencia las estrategias que consiguen resultados a corto plazo provocan castigos en el medio y largo plazo.

Como apunta con sabiduría Aumann, esto es bien sabido incluso intuitivamente. Las relaciones de largo plazo, las de toda la vida, son, en realidad, estrategias de juego repetido.

De ahí que sea más difícil el engaño en una transacción cotidiana -comprar el pan en la panadería de siempre- que en una transacción única -adquirir una alfombra durante un viaje turístico-. El panadero tendrá muchos menos incentivos para engañarte en el precio si sabe que volverás cada día a repetir la compra. La estrategia más productiva para él a corto plazo: venderte pan duro; lo será menos en el largo: puesto que puedes dejar de ir a comprar a su panadería y, así, lo que gane al engañarte un día, lo perderá con creces en el futuro al dejar de percibir el margen que le dejan tus compras.

Los jugadores en la actividad cotidiana, en la economía y en los conflictos armados deben elegir sus estrategias pensando no sólo en su inmediato provecho sino en los resultados a largo plazo y, a menudo, las estrategias en apariencia más eficaces no son las más eficientes.

El doctor Aumann, en fin, no sólo ha dotado de expresión matemática a la sabiduría humana y al sentido común sino que ha ido un paso más allá, como sentenció la Academia Sueca al concederle el Nobel de Economía del 2005 junto a Thomas Schelling: “ha ampliado nuestra comprensión del conflicto y la cooperación”.

Bienvenido Dr. Aumann a esta Real Corporación que hoy le acoge en su seno con la mejor de las alegrías y con la mayor de las esperanzas. Con su incorporación, la Real Academia de Ciencias Económicas y Financieras de España cuenta con una personalidad de alto prestigio intelectual y de gran valor humano. Juntos sabremos colocar compuertas a los efectos nocivos de la globalización y juntos seremos capaces de edificar el monumento a la justicia social y al bienestar tan deseado por todos los pueblos.

Muchas gracias.