**Game Theory and the First World War.** A review for JEL of

- Roger Ransom, *Gambling on War: Confidence, Fear, and the Tragedy of the First World War* (2018); and


WW1 still demands deeper understanding, is a vital test case for probing game theory’s explanatory power, and limitations of its basic assumptions.

Wolford: Rational-choice analysis can humanize our image of historical actors, as we look for the goals & beliefs motivating them.

Game theory requires us to look at a conflict from the perspectives of all sides, and it does not require any one be blamed for conflict (*PD game*).

In war, people fight even though they could all be better off not fighting, and this paradox can be modeled by games with Pareto-inefficient Nash equilibria.

But we may need to allow some exceptions to both the *rationality* and *consistency* assumptions of standard game-theoretic analysis to understand World War I.

Modeling the onset of war with moral hazard and informational incentive constraints.

Models of war-onset & models of war-duration: differing in *focal eqm selection*?

Fixing the War of Attrition model by admitting *public random events* (battles).

Enigmas of 1914. Was the outbreak of war in August 1914 an act of irrationality?

International belief consistency as the first casualty of war.

Schelling’s focal coordination and Janis’s groupthink.

Peace-making: the final failure of the First World War.
**Modeling the onset of war**

Minimal requirements for a game model to explain war: *War is an equilibrium*, but *some other feasible outcome is Pareto-superior*. *(Students take note!)*

The Prisoners' Dilemma game is a basic example. Even if other equilibria are better (Stag Hunt, Repeated PD), a bad equilibrium shows how people can be in a conflict that all want to avoid but no one will.

Fearon's (1995) *Rationalist Explanations for War-Onset* unifies previous theories, and he sets a higher bar: no equilibria without costly conflict.

"*It seems farfetched to think that small numbers of states would have trouble reaching the efficient solution here, if coordination were really the only problem.*"

Finding all equilibria is often hard, but we can analyze incentive constraints to bound the equilibrium set, even when negotiation procedures are not fully specified.

Theories of preventative war & pre-emptive war can be derived from *moral hazard incentive constraints* (minimum-payoff participation constraints).

**Preventative war:** dominant nation won't accept less than it can get by war now, rising nation can't promise to accept less than what it could get from future war.

**Pre-emptive war:** neither side can promise to accept less than what it could get from launching war, which may be increased by first-strike advantages.

When these constraints eliminate all feasible allocations, war must happen.

War can also be caused by *informational incentive constraints* where one nation claims that it prefers war to a modest share, but others think it's probably a bluff.
From war-onset modeling to war-duration modeling
Theories about causes of war have suggested corresponding theories about how wars can end, as the end would require the resolution of at least some of the causes. But the theories that best fit war-onset in 1914 are hard to fit with WW1's duration.
Germany warned Russia not to mobilize against Austria in July 1914, which Russians saw as a bluff, until Germany invaded Belgium. This costly signal eliminated doubts about truth of Germany's warning but the war was just getting started then. After the invasion, asymmetric information increased.
Trench warfare (Ludendorff 1917) contradicted assumptions of pre-emptive war. Germany was the dominant power in 1914, but feared Russian military reforms could make it dominant by 1917, unless Russia diminished now by preventative war. But Russia's collapse in the 1917 Revolution did not end the war.
In war, even as old incentive problems are resolved, the mobilization of vast military forces can create new moral-hazard problems that constrain negotiations.
The argument for ignoring Pareto-inefficient equilibria is less convincing for models of war duration, when we assume that the war has already started.
Peace = international relations with an accepted framework for arbitrating disputes. In a struggle for global leadership, it would be absurd to assume that both sides could agree on a focal arbitrator to designate a Pareto-superior equilibrium.
If the great powers of Europe had accepted Woodrow Wilson's offer to broker a peace, his "peace without victory" would have given the US supreme global leadership.
Fixing the War of Attrition model by admitting public random events (battles)
Why didn’t Wolford emphasize the simple War of Attrition model?
Two nations 1 & 2 are contending for shares of peacetime benefits flows worth 1.
Nation j demands \( w_j \), is offered \( v_j = 1 - w_j \) by the other nation -j.
Until an offer is accepted, each j pays conflict cost \( c_j \).  \( 1 > w_j > v_j > 0 > -c_j \)  \( \forall j \in \{1,2\} \).
Expected future flows of benefits & costs are discounted at rate \( r > 0 \).
If \( q_j \) is the probability density of -j accepting j’s offer in near future, then nation j is
willing to concede now (not wait short \( dt \)) only if \( (c_j + v_j)dt \geq (w_j/r - v_j/r)q_jdt \),
that is, \( q_j \leq \lambda_j \) where \( \lambda_j = (c_j + v_j)r / (w_j - v_j) \) is the critical success rate for j.
Conflict eqm: each nation j’s concession time is an independent exponential random variable, mean \( \mu_j = 1/\lambda_j \).  \( EU_j = v_j/r \), expected conflict costs cancel win-gains.
Bizarre implication: higher \( c_j \) => higher \( \lambda_j \) => lower \( \mu_j \) => j more likely to win!
Other equilibria: immediate concession expected from -j (always), j never concedes.
The conflict eqm is Pareto-inferior to randomizing equally over 1 or 2 conceding.
This assumed uncertainty only from other’s decisions.  But battles are random too!
Let \( q_j \) denote the probability density of decisive victory for j (\( => -j \) conceding focal).
Fighting until a decisive victory is equilibrium if each \( q_j \geq \lambda_j \).
Then can get higher \( c_j \) => higher \( \lambda_j \) => (switch to eqm of j conceding if now \( \lambda_j > q_j \)).
Why don’t nations moderate their demands to end conflict sooner?
Model: Each j has small \( \delta_j \) rate of becoming exhausted type that must concede soon.
An unanticipated concession could be taken as indicating an exhausted type.
Enigmatic events of 1914.
France & Russia were allies against Germany, which allied with Austria; positions of Britain and Italy were less clear.
Germany had the strongest military forces in Europe but feared Russia could become stronger by 1917, after its major military rearmament program.
So many Germans were considering the advantages of a preventative war, but it would require Austrian support (recently questionable).
28 June: Austria's heir killed by a Serbian faction (hoping to embarrass their PM). Germany urged a major punitive response, to establish Austrian dominance over Serbia (Russia's ally), to diminish Russian power in the Balkans.
After Austria's ultimatum to Serbia, Russia announced mobilization against Austria, to deter more than a limited punitive action (to preserve SQ balance of power). Germany warned Russia that mobilization could force Germany into pre-emptive war, and then Russia ordered a general mobilization of its forces.
[Next: Germany should have ordered a defensive mobilization of its forces, and then Austria would have occupied Belgrade in a strictly limited punitive action...]
Then Germany declared war on Russia and invaded Belgium to attack France!
(Aug 1: Moltke told the Kaiser they had only one military mobilization plan.) Europeans became severely divided about the (in)justice of this surprising invasion.
People in Britain were shocked and agreed to join the war against Germany.
But in Germany, even Socialists were persuaded to support their country's war efforts.
... 4+ years of horrific war in Europe, and an armistice that lasted only to 1939.
Was the outbreak of war an act of rationality?
Game-theoretic analysis is based on general assumptions of *individual rationality* and *collective consistency* (common prior beliefs about the game, types, & strategies). A broader analytical framework could admit exceptions to rationality in limited cases.

Groupthink? Groups with shared interests may reason better than individuals apart. Discussing ideas with others can help people to think more clearly (as in academia). By this standard, we may expect rational inference among European diplomats, who benefitted from broad discussions in a decentralized network.

But military plans are formulated in secret by small tightly-controlled teams. In 1914, Germany's military chief of staff was *Helmuth von Moltke* (the younger). His uncle with same name had won the Franco-Prussian War in 1870 by superior planning and management of military operations on a vast scale, using railroads. For the younger Moltke, the *Schlieffen Plan* optimally maximized the probability of achieving a reputation even greater than his uncle. (Risk-seeking preferences!)

Successful organizations should be able to channel actions of individuals with different goals, but Germany's political leaders only learned on 1 Aug 1914 that Moltke had just one prepared plan for mobilization: the Schlieffen Plan of invading Belgium. Military planners now accept that civilian leaders should expect them to prepare several alternative plans for any anticipatable crisis; but in 1914, complex plans for huge armies supplied by railroad were still a relatively new innovation.

*(Did the disaster of 1914 protect us from a greater disaster in the nuclear age?)*

Observers may err in rationalizing a mistake, attributing it to an expansionist type...
Game-theoretic consistency as the first casualty of war
A peaceful international equilibrium may require punitive responses against those who disturb the peace, distinguishing unjustified provocations from justified responses. Pre-1914, such judgments were made by diplomatic consensus of the Great Powers (with norms of "compensation" to preserve the balance of power against shocks). Germany's invasion of Belgium shattered this consensus and created inconsistent beliefs about how the old equilibrium applied in this unexpected subgame.

German leaders justified their invasion as a necessary response to intolerable threats posed by Russia's mobilization and French alliance (Moltke's error not admitted). In Russia, France & Britain, Germany's invasion was seen as unjustifiable aggression and evidence of the German government's dangerously expansionist type.

In each nation, people generally accepted their leaders' expressed interpretation and believed that any moral European should agree that their side's actions were just, so that their adversaries' violent opposition was evidence of a malicious nature. Different beliefs about the war's origin could change people's effective preferences, as more Germans might demand a permanent weakening of France & Russia so that their malicious threats could never again cause such terrible conflict. So the war's outbreak induced basic inconsistency of beliefs about strategies and types.

But this inconsistency across nations was derived from the factor that makes consistency a good assumption in most applications: the normal imperative for everyone to accept focal judgments of generally accepted leaders in their society.
Common implications of Schelling’s focal-point effect & Janis’s groupthink

Schelling (1960) observed that games with multiple equilibria are pervasive, and any society needs *coordination from norms & leaders* to avoid inefficient equilibria. This focal coordination depends on everyone's willingness to accept the authoritative judgments of their focal leaders.

So in any successful society, we should expect to find strong social norms against questioning the *universal validity* of such judgments.

The power of leaders in any society can be derived from their role in determining the focal equilibrium that people will play in games with multiple equilibria.

The war's impact on social perceptions exemplifies Irving Janis's *groupthink*: belief in our group's fundamental morality and ability to prevail in conflict; view of our rivals as too evil to negotiate with & too stupid to counter our moves; group norms to deter & punish any questioning of these shared beliefs.

Such beliefs can help induce group members to accept risks of fighting for the group and to resist the influence of rival groups' leaders.

In a war-of-attrition game: "The equilibrium where the other side is always expected to concede should be focal when everyone understands the morality of our position."

When two groups are contending for supreme power in their region, to accept the focal relevance of judgments from the other group would be a substantial concession.

For groups with distinct leadership to coordinate positively in inter-group relations, they need some *mutually accepted principles of justice* to settle disputes.
Peace-making: the final failure of the First World War

To probe the foundations of social order, Schelling began by considering how limited war can be sustained, by expectations that a violation of beneficial limits by either side could change the focal equilibrium so that both ignore these limits thereafter.

Peace is not just an armistice where weapons cease firing. In peace, nations should have a mutually accepted framework for resolving disputes and coordinating consistent strategic expectations in transactions between them. In war, we deny the justice of our opponents' positions; in peace, we must join them in a shared system of justice.

To go from war to peace, the essential consensus could be achieved either by negotiations among the leaders of the two sides, or by the winning side replacing the leadership of the losing side (by forceful occupation of losers' communities).

After the war ended in 1918, Germany was unconquered but its representatives were excluded from the 1919 peace negotiations to define Europe's new order. (Many nations had joined the Entente's alliance to get an influential seat at the winners' table, but intra-alliance negotiations took too long, leaving no time for Germany.) The resulting treaty, with the War-Guilt Clause and Reparations, perpetuated Germans' inability to accept the Allies concept of a just order in Europe, which poisoned politics in Germany and set Europe on the path to a second world war.

These notes: <http://home.uchicago.edu/~rmyerson/research/ww1_notes.pdf>
Full paper: <http://home.uchicago.edu/~rmyerson/research/ww1_review.pdf>