1. Introduction

"When it comes to avenging harm done to our people we *never* forget."
Madam Secretary, Season 4, Episode 16

2. Game and results

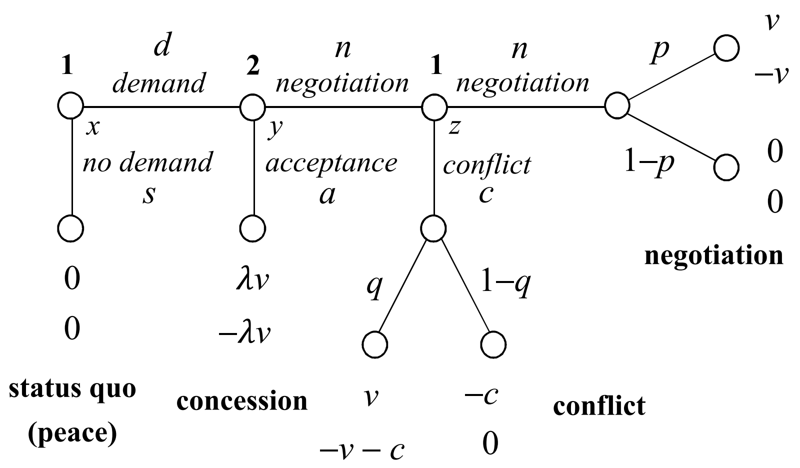

Fig. 1. The game (with $0 < \lambda \leq 1$)

Proposition 1. Assuming generic payoffs, the only subgame perfect equilibrium (SPE) of the game of Fig. 1 is:

(i) (d, n, n) if $q < \frac{pv+c}{v+c}$ and $p < \lambda$ (negotiation);
(ii) (d, n, c) if $\frac{c}{v+c} < q < \frac{\lambda v}{v+c}$, $p < \lambda - \frac{c}{v}$ and $\lambda > \frac{c}{v} < 1$ (conflict);
(iii) (d, a, n) if $q < \frac{pv+c}{v+c}$ and $p > \lambda$ (concession); and
(iv) (d, a, c) if $q > max\{\frac{pv+c}{v+c}, \frac{\lambda v}{v+c}\}$ (concession).

Proof. Case 1: n chosen at node z. At z, n is better than c if and only if (iff) $pv > qv - c(1 - q)$; that is, iff $q < \frac{pv+c}{v+c}$. Case 1a: n chosen at y. Given n at z, n is better than a at y iff $p < \lambda$. Given n at z and n at y, d is the only best reply at x. Therefore, (d, n, n) is a SPE when $q < \frac{pv+c}{v+c}$ and $p < \lambda$. This SPE represents the outcome *negotiation*; see Fig. 2. Case 1b: a chosen at y. Given n at z, a is better than n at y iff $p > \lambda$. Given n at z and a at y, d is the only best reply at x. Hence, when $q < \frac{pv+c}{v+c}$ and $p > \lambda$, (d, a, n) is a SPE, corresponds to the outcome *concession* and is represented in Fig. 2 by the region labelled concession_1.

Case 2: c chosen at node z. At z, c is better than n iff $q > \frac{pv+c}{v+c}$. Case 2a: n chosen at y. Given c at z, n is better than a at y iff $-q(v + c) > -\lambda v$; that is, iff $q < \frac{\lambda v}{v+c}$. Case 2a1: d chosen at x. Given c at z and n at y, d is better than s at x iff $qv - (1 - q)\,c > 0$; that is, iff $q > \frac{c}{v+c}$. This condition is implied by the previous requirement $q > \frac{pv+c}{v+c}$. Besides, the consistency of $\frac{pv+c}{v+c} < q < \frac{\lambda v}{v+c}$ requires $p < \lambda - \frac{c}{v}$ (and, consequently, $\lambda > \frac{c}{v} < 1$). In sum, ($d$, n, c) is a SPE when $\frac{c}{v+c} < q < \frac{\lambda v}{v+c}$, $p < \lambda - \frac{c}{v}$ and $\lambda > \frac{c}{v} < 1$. This SPE represents the outcome *conflict*; see the corresponding region in Fig. 2. Note then that conflict is not a SPE outcome when $\lambda > \frac{c}{v}$ (player 2 concedes a sufficiently high part of the demand) or $c > v$ (conflict is too costly in comparison with player 1's demand). Case 2a2: s chosen at x. This requires $q < \frac{c}{v+c}$, which contradicts the condition $q > \frac{pv+c}{v+c}$ making c the best replay at z. Consequently, (s, n, c) is never a SPE. Case 2b: a chosen at y. Given c at z, a is better than n at y iff $q > \frac{\lambda v}{v+c}$, in which case d is the only best reply at x. As a result, (d, a, c) is a SPE when $q > max\{\frac{pv+c}{v+c}, \frac{\lambda v}{v+c}\}$. This SPE, also leading to the outcome *concession*, is represented in Fig. 2 by the regions labelled concession$_2$. The concession$_2$ region absorbs the conflict region when $\lambda > \frac{c}{v}$ or $c > v$.■

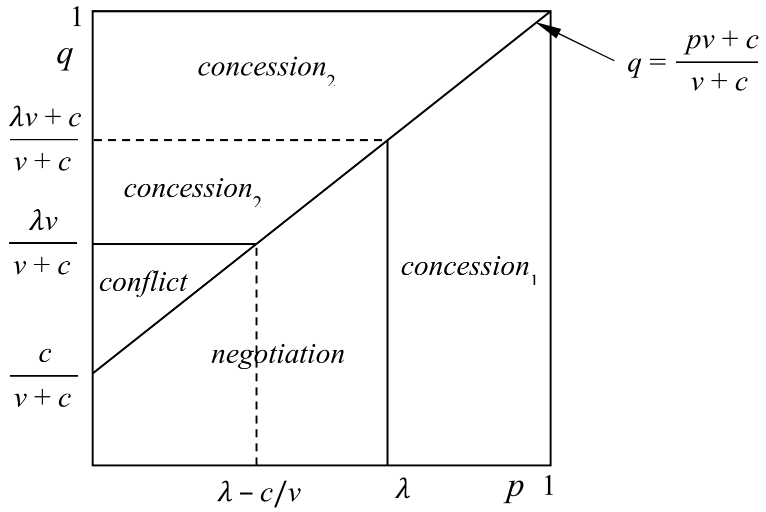

Fig. 2. SPE outcomes when $\lambda > c/v < 1$

3. Discussion

Proposition 1 embodies at least three interesting features of the game of Fig. 1. Firstly, the status quo (interpretable as peace) cannot arise in a subgame perfect equilibrium. The only play candidate to lead to the status quo outcome is (*s*, *n*, *c*), but this cannot be sustained as an equilibrium because player 1's decisions at the two nodes involve inconsistent conditions on q ($q < \frac{c}{v+c}$ at node *x* and $q > \frac{pv+c}{v+c}$ at *z*). In a sense, this game situation tends to reinforce the position of player 1: most parameter combinations create outcomes (negotiation and concession) that increase, at least in expected terms, player 1's initial payoff. Since player 2 is not given the option to engage in conflict with player 1, it could be interpreted that player 2 (a lesser power) is weaker than player 1 (a big power).

Secondly, if player 2 is given a third choice (conflict) that leads to the same payoffs as conflict initiated by player 1, then the status quo can be a subgame perfect equilibrium outcome (it suffices that q is sufficiently low). Paradoxically, in the context of the game of Fig. 1, peace would require that a peaceful neighbour be willing to break peace.

And thirdly, the equilibrium results are also paradoxical in that an increase in the willingness of player 2's to comply with 1's demand (that is, a rise in λ) creates *more* cases in which conflict emerges: the conflict region in Fig. 2 enlarges as λ grows. The area of the conflict region in Fig. 2 is $C = \frac{(\lambda-\alpha)^2}{2(1+\alpha)}$, where $\alpha = c/v$. Thus, a larger λ (the part of player 1's demand that player 2 is willing to satisfy outright) increases the proportion of cases in which conflict arises. If all probability pairs (p, q) are equally likely, then the areas of the regions in Fig. 2 associated with outcomes of the game in Fig. 1 can be interpreted as probabilities of occurrence of the corresponding outcomes. In this case, as expected, the probability that conflict occurs lowers with a rise in α (as $\frac{dC}{d\alpha} < 0$ if $\lambda > c/v$) but, counterintuitively, conflict is more probable when λ rises ($\frac{dC}{d\lambda} > 0$). As a consequence, the less of player 1's demand is player 2 willing to concede, the smaller the incentive for player 1 to enter into conflict with player 2 (and that despite player 2 being a friendly neighbour, in the sense that the game situation does not give player 2 the possibility of initiating a conflict). A plausible initial guess would run in the opposite direction: the more reluctant an agent to cede to another agent's demand, the more likely the latter to resort to conflict.

The third observation suggests that peaceful actors confronting potentially aggressive actors with a strategy of appeasement (by substantially satisfying the demands by the unfriendly actors) contribute to cause what they try to avert: war.