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Inducing good behavior

van der Veen, A.

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D. How to Derive the Equilibrium Predictions of IBE and QRE with Loss Aversion in the Context of the Canonical Inspection Game

In this appendix, we explain the procedure to derive the equilibrium predictions of IBE and QRE with loss aversion in the context of the canonical inspection game. Selten and Chmura (2008) provide a more general discussion for IBE and Brunner, Camerer, and Goeree (2011) for QRE.

In IBE, players judge the payoffs according to how they relate to their security level. A player's security level s is determined by the player's pure maximin payoff, the maximum of the minimum payoffs corresponding to the player's actions. The left panel of Figure D.1 presents the canonical inspection game, in which the inspector can secure a payoff of 12 and the worker a payoff of 25. The payoff matrix is then transformed to account for loss aversion in the following way. From each payoff exceeding a player's security level half the difference between the payoff and the security level is subtracted (the other payoffs remain unchanged). Or, each payoff x is replaced by $x - \max\{\frac{1}{2}(x - s), 0\}$. As a consequence, losses compared to the reference point weigh twice the amount that gains weigh. The middle panel of Figure D.1 presents the Transformed inspection game. From the Transformed game, the Impulse matrix is derived with the following procedure. Each set of two payoffs of a player corresponding to the same action of the other player is transformed such that the highest payoff becomes 0 and the lowest becomes the difference between the highest and the lowest. The resulting numbers represent the impulses to choose the other action given the action chosen by the other player. The impulse matrix is presented in the right panel of Figure D.1.

In the IBE, a player's expected impulse from one action to the other equals the expected impulse from the other action to the one action. Let p represent the probability that the employer chooses I, and q the probability that the worker chooses L, then p and q follow from the solution of the *impulse balance equations*:

$$\begin{aligned} 4p(1-q) &= 12(1-p)q \\ 7.5(1-p)(1-q) &= 5pq \end{aligned}$$

Figure D.1.: Canonical Inspection Game, Transformed Game and Impulse Matrix

Canonical Game

	H	L
I	52, 25	12, 20
N	60, 25	0, 40

Transformed Game

	H	L
I	32, 25	12, 20
N	36, 25	0, 32.5

Impulse Matrix

	H	L
I	4, 0	0, 5
N	0, 7.5	12, 0

In QRE, players maximize expected utility taking the actual response function of the other player into account, but make mistakes. Let $\mathbb{E}_{player}\,[a]$ represent a player's expected utility from choosing action a, then:

$$
\begin{aligned}
p &= \frac{e^{\lambda \mathbb{E}_{employer}[I]}}{e^{\lambda \mathbb{E}_{employer}[I]} + e^{\lambda \mathbb{E}_{employer}[N]}} \\
q &= \frac{e^{\lambda \mathbb{E}_{worker}[L]}}{e^{\lambda \mathbb{E}_{worker}[L]} + e^{\lambda \mathbb{E}_{worker}[H]}}
\end{aligned}
$$

where λ represents the player's rationality parameter that is estimated from the data. For QRE with loss aversion, the payoffs of the Transformed inspection game are used. In this case, p and q follow from the solution of:

$$
\begin{aligned}
p &= \frac{e^{\lambda[32(1-q)+12q]}}{e^{\lambda[32(1-q)+12q]} + e^{\lambda[36(1-q)]}} \\
q &= \frac{e^{\lambda[25]}}{e^{\lambda[25]} + e^{\lambda[20p+32.5(1-p)]}}
\end{aligned}
$$

The QRE prediction for the game without loss aversion is similarly found using the ordinary payoffs listed in the left panel of Figure D.1.