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**Working Paper**

## Rational Cooperation In One-Shot Simultaneous Pd-Situations

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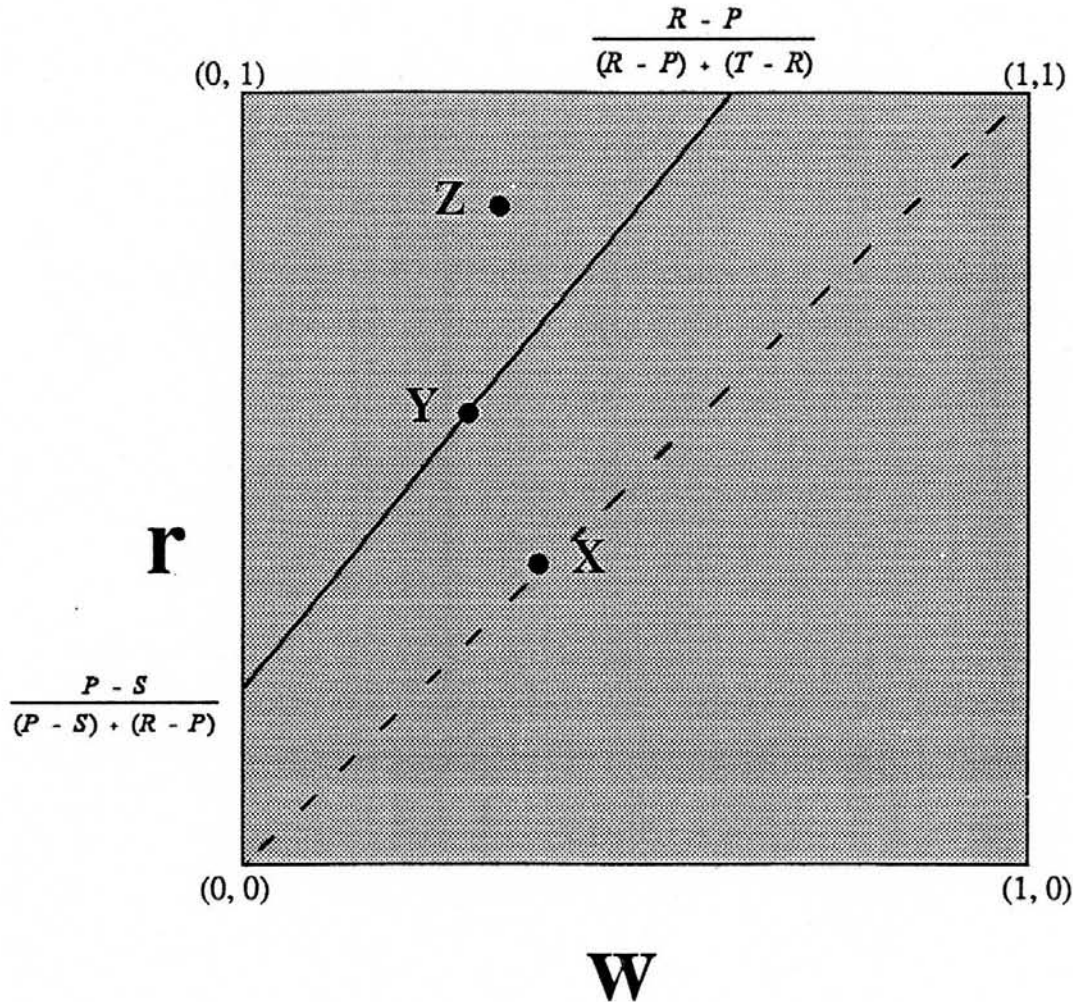
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# FIGURE 1



1. The 45° dashed line represents the limit of zero forecasting ability, corresponding to  $0 \leq r = w \leq 1$ ; such as point  $X$ . Such a point means that players cannot forecast each other's actual choice to cooperate or defect better than pure chance.
2. The straight line above the 45° dashed-line is a **cooperation line**; with formulas for its intercepts shown where the line intersects the top and left sides of the unit probability box. Inequality (1) is satisfied by points  $Y$  and  $Z$ , which lie on or above the cooperation line.
3. The intercept formulas imply that as  $T - R$  and  $P - S$  shrink relative to  $R - P$ , the cooperation line will shift arbitrarily close the 45° dashed-line; but never touch the dashed-line if the ordinal PD-payoff ranking ( $T > R > P > S$ ) is preserved.

### Joint Probability and Expected Payoff Calculations

For  $(r, w) = (.5, .5)$  and  $(T, R, P, S) = (10, 8, 6, 4)$

STRATEGY PAIR	$p(C_A, C_E)$	$p(D_A, C_E)$	$p(C_A, D_E)$	$p(D_A, D_E)$	$U_A$	$U_E$
$(DD_A, DD_E)$	0	0	0	1	6	6
$(CD_A, DD_E)$	0	0	0.5	0.5	5	8
$(DD_A, CD_E)$	0	0.5	0	0.5	8	5
$(CD_A, CD_E)$	0.25	0.25	0.25	0.25	7	7

TABLE 1

### STRATEGY MATRIX IMPLIED FROM TABLE 1

		$CD_E$	$DD_E$
$CD_A$		7	8
	$CD_A$	7	5
$DD_A$		5	6
	$DD_A$	8	6

## Joint Probability and Expected Payoff Calculations

For  $(r, w) = (.9, .3)$  and  $(T, R, P, S) = (10, 8, 6, 4)$

STRATEGY PAIR	$p(C_A, C_E)$	$p(D_A, C_E)$	$p(C_A, D_E)$	$p(D_A, D_E)$	$U_A$	$U_E$
(DD <sub>A</sub> , DD <sub>E</sub> )	0	0	0	1	6	6
(CD <sub>A</sub> , DD <sub>E</sub> )	0	0	0.3	0.7	5.4	7.2
(DD <sub>A</sub> , CD <sub>E</sub> )	0	0.3	0	0.7	7.2	5.4
(CD <sub>A</sub> , CD <sub>E</sub> )	0.675	0.075	0.075	0.175	7.5	7.5

TABLE 2

### STRATEGY MATRIX IMPLIED FROM TABLE 2

		CD <sub>E</sub>	DD <sub>E</sub>
CD <sub>A</sub>	7.5	7.2	
DD <sub>A</sub>	7.5	5.4	
	5.4	6	
	7.2	6	

## Joint Probability and Expected Payoff Calculations

For  $(r, w) = (.53, .50)$  and  $(T, R, P, S) = (25.2, 25, 5, 4.8)$

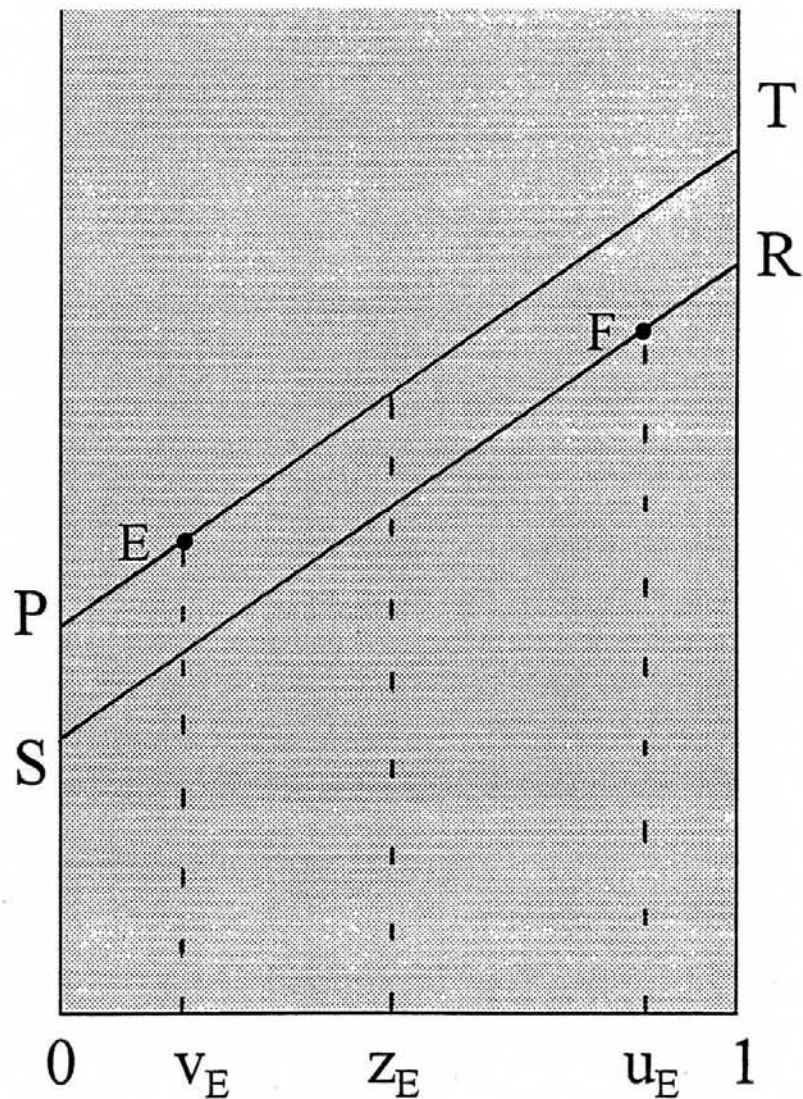
STRATEGY PAIR	$p(C_A, C_E)$	$p(D_A, C_E)$	$p(C_A, D_E)$	$p(D_A, D_E)$	$U_A$	$U_E$
(DD <sub>A</sub> , DD <sub>E</sub> )	0	0	0	1	5	5
(CD <sub>A</sub> , DD <sub>E</sub> )	0	0	0.5	0.5	4.9	15.1
(DD <sub>A</sub> , CD <sub>E</sub> )	0	0.5	0	0.5	15.1	4.9
(CD <sub>A</sub> , CD <sub>E</sub> )	0.273	0.242	0.242	0.242	15.3	15.3

TABLE 3

### STRATEGY MATRIX IMPLIED FROM TABLE 3

		CD <sub>E</sub>	DD <sub>E</sub>
CD <sub>A</sub>	15.3	15.1	
DD <sub>A</sub>	4.9	5	

# FIGURE 2



$$z_E = p(C_E)$$

$$u_E = p(C_E|C_A)$$

$$v_E = p(C_E|D_A)$$

1. The upper and lower lines represent Adam's expected payoff from defecting and cooperating respectively; depending on whether Eve's unconditional or conditional probabilities of cooperating,  $z_E$  or  $(u_E, v_E)$ , are used to calculate his expected payoffs.
2. Using a single  $z_E$  probability implies vertical expected payoff comparisons. Otherwise, horizontally displaced comparisons result from using  $u_E$  and  $v_E$ ; as illustrated by points E and F.

# TABLE 4

	$p(C_A^f)$	$p(C_E^f)$
$(CD_A, CD_E)$	$\frac{r_A w_E + w_A(1 - w_E)}{1 - (r_A - w_A)(r_E - w_E)}$	$\frac{r_E w_A + w_E(1 - w_A)}{1 - (r_A - w_A)(r_E - w_E)}$
$(DD_A, CD_E)$	$r_A w_E + w_A(1 - w_E)$	$w_E$
$(CD_A, DD_E)$	$w_A$	$r_E w_A + w_E(1 - w_A)$
$(DD_A, DD_E)$	$w_A$	$w_E$

# TABLE 5

**Unconditional Forecast Probabilities**

For  $(r, w) = (.9, .3)$

$p(C_A^f)$        $p(C_E^f)$

$(CD_A, CD_E)$	0.75	0.75
$(DD_A, CD_E)$	0.48	0.3
$(CD_A, DD_E)$	0.3	0.48
$(DD_A, DD_E)$	0.3	0.3

**Unconditional Forecast Probabilities**

For  $(r, w) = (.51, .50)$

$p(C_A^f)$        $p(C_E^f)$

	0.50505	0.50505
	0.505	0.5
	0.5	0.505
	0.5	0.5