# Moral Hazard, Targeting and Contract Duration in Agri-Environmental Policy





Professor Rob Fraser
School of Economics

University of Kent

# Outline

1. Background
2. The Model
3. Numerical Analysis
4. Conclusion

The model of Fraser (2004) uses a two-period decision context to capture the ‘early’ and ‘late’ aspects of contract duration for a risk averse farmer. In this context the farmer considers the present value of expected utility from four alternatives:

i. complying in both periods
ii. complying in the first period, but not the second
iii. complying in the second period, but not the first
iv. not complying in both periods

The farmer’s income ( $I_i$ ) in each period of complying is given by:

$$I_i = B + x - y \qquad (1)$$

where:

| | | |
|---|---|---|
| $I_i$ | = | income in period $i$ ($i$ =1,2) |
| $B$ | = | income independent of participation |
| $x$ | = | payment for participating |
| $y$ | = | cost of complying |
| $x$ | > | $y$ |

Note that if the farmer chooses not to comply, and is not caught, then:

$$I_i = B + x \qquad (2)$$

However, if the farmer chooses not to comply, and is caught, then a penalty is incurred.

Specifically, a farmer caught cheating in period 1 is penalised not just by the recovery of the payment for participation in that period (ie $x$), but also by the withdrawal of future benefits through exclusion from participation in period 2.

In addition, a farmer caught cheating in period 2 is penalised not just by the recovery of the payment for participation in that period (ie $x$), but also by the recovery, with interest, of the payment for participation in period 1 (ie $x(1 + r)$; where $r$ = the rate of interest).

Inserting this penalty system into the model of Fraser (2004) means that the present value of the expected utility ($E(U)$) from the four alternative farmer behaviours is given by:

$$U(I_{TIT2}) = U(B + x - y) + U(B + x - y)/(1 + r) \quad (3)$$

$$EU(I_{TIC2}) = U(B + x - y) + (pU(B + x) + (1 - p)U(B - x(1 + r)))/(1 + r) \quad (4)$$

$$EU(I_{CIT2}) = pU(B + x) + (1 - p)U(B) + (pU(B + x - y) +$$

$$(1 - p)U(B))/(1 + r) \quad (5)$$

$$EU(I_{CIC2}) = pU(B + x) + (1 - p)U(B) + (p(pU(B + x) + (1 - p)U(B - x(1 + r)))$$

$$+ (1 - p)U(B))/(1 + r) \quad (6)$$

An examination of equations (3) and (6) reveals that the key policy parameters in determining the relative size of utility from always complying with expected utility from always not complying are:

i. $p$ – the probability of not being monitored

ii. $(x - y)$ – the relative size of benefits and costs of complying

For example, if $p = 0$, then with $x > y$:

$$U(I_{TIT2}) = U(B + x - y) + U(B + x - y)/(1 + r)$$

$$> U(B) + U(B)/(1 + r) = EU\,(I_{CIC2})$$

More generally, if $p$ is relatively low and $(x - y)$ is relatively high, then it is expected that:

$$U(I_{TIT2}) > EU(I_{CIC2}) \qquad (8)$$

and so the farmer would comply in both periods. While if $p$ is relatively high and $(x - y)$ is relatively low, then it is expected that:

$$U(I_{TIT2}) < EU(I_{CIC2}) \qquad (9)$$

and so the farmer would not comply in both periods.

$$E(I_{TIC2}) = B + x - y + p(B + x)/(1 + r) + (1 - p)(B - x(1 + r))/(1 + r) \quad (10)$$

while:

$$E(I_{CIT2}) = p(B + x) + (1 - p)B + p(B + x - y)/(1 + r) + (1 - p)B/(1 + r) \quad (11)$$

Moreover, equations (10) and (11) can be rearranged and simplified to give:

$$E(I_{TIC2}) = B + B/(1 + r) + px(1 + 1/(1 + r)) - y \quad (12)$$

$$E(I_{CIT2}) = B + B/(1 + r) + px(1 + 1/(1 + r)) - py/(1 + r) \quad (13)$$

It follows from a comparison of equations (12) and (13) that:

$$E(I_{CIT2}) > E(I_{TIC2})$$

$$Var(I_{TIC2}) = p(x + x/(1 + r) - px(1 + 1/(1 + r)))^2 + (1 - p)(- px(1 + 1/(1 + r)))^2 \quad (15)$$

while:

$$Var(I_{CIT2}) = p(x + x/(1 + r) - \mathrm{y}/(1 + \mathrm{r}) - px(1 + 1/(1 + r)) + \mathrm{py}/(1 + \mathrm{r}))^2$$

$$+ 1 - \mathrm{p})(- \mathrm{px}(1 + 1/(1 + \mathrm{r})) + \mathrm{py}/(1 + \mathrm{r}))^2 \quad (16)$$

Moreover, equations (15) and (16) can be rearranged and simplified to give:

$$Var(I_{TIC2}) = p(1 - p)(x(1 + 1/(1 + r)))^2 \quad (17)$$

$$Var(I_{CIT2}) = p(1 - p)(x(1 + 1/(1 + r)) - y/(1 + r))^2 \quad (18)$$

It follows from a comparison of equations (17) and (18) that:

$$Var(I_{CIT2}) < Var(I_{TIC2}) \quad (19)$$

and so it is unambiguously the case that the variance of the present value of income from cheating early is less than that of cheating late.

In what follows the utility function is specified to take the constant relative risk aversion form[5]:

$$U(I) = \left(\frac{I^{1-R}}{1-R}\right) \qquad (20)$$

Where:

$R$ = constant coefficient of relative risk aversion

= $-U''(I).I/U'(I)$

In addition, the following parameter values are chosen for a Base Case:

$$B = 12; \quad x = 10; \quad y = 7; \quad R = 0.2, 0.6$$

$$r = 0; \quad p = 0.75$$

# Table 1
# Results of the Numerical Analysis[a]

| **Panel 1** ($p$ = 0.75) | $U(I_{TIT2})$ | $E(U(I_{TIC2}))$ | $E(U(I_{CIT2}))$ | $E(U(I_{CIC2}))$ |
|---|---|---|---|---|
| $R = 0.2$ | 21.82 | 22.57 | 23.86 | 23.97 |
| $R = 0.6$ | 14.77 | 14.67 | 15.37 | 14.28 |
| **Panel 2** ($p$ = 0.5) | | | | |
| $R = 0.2$ | 21.82 | 19.40 | 21.99 | 19.87 |
| $R = 0.6$ | 14.77 | 13.34 | 14.75 | 12.01 |
| **Panel 3** ($R$ = 0.2) | | | | |
| $p = 0.5$ | 21.82 | 19.40 | 21.99 | 19.87 |
| $P_1 = 0.4$; $p_2 = 0.6$ | 21.82 | 20.67 | 21.24 | 19.69 |

*Note a:* $B = 12$; $x = 10$; $y = 7$; $r = 0$

# Moral Hazard, Targeting and Contract Duration in Agri-Environmental Policy





Professor Rob Fraser
School of Economics

University of Kent