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APPENDIX

Derived
$$\int_0^X \frac{dx}{(1-X)(1-rX)} = \frac{1}{(1-r)} \ln \frac{(1-rX)}{(1-X)}$$

Assume
$$\frac{1}{(1-X)(1-rX)} = \frac{A}{(1-X)} + \frac{B}{(1-rX)}$$

$$A(1-rX) = B(1-X) = \frac{A}{(1-X)} + \frac{B}{(1-rX)}$$

when $X = 1$
$$A = \frac{1}{(1-r)}$$

$$B = \frac{1}{(1-\frac{1}{r})}$$

$$\int_0^X \frac{dX}{(1-X)(1-rX)} = \int_0^X \frac{1}{(1-r)} \frac{dX}{1-X} = \int_0^X \frac{r}{(r-1)} \frac{1}{(1-rX)} dX$$

$$= -\frac{1}{(1-r)} \ln(1-X) - \frac{1}{r} \frac{r}{(r-1)} \ln(1-rX)$$

$$= -\frac{1}{(1-r)} \ln(1-X) + \frac{1}{(1-r)} \ln(1-rX)$$

$$= \frac{1}{(1-r)} \ln \left[\frac{(1-rX)}{(1-X)} \right]$$

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