

Roll the DICE Again: Economic Models of Global Warming

Appendix B

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Appendix B. Equations of DICE-99

$$(B.1) \quad W = \sum_t U[c(t),L(t)]R(t)$$

$$(B.2) \quad R(t) = \prod_{v=0}^t [1 + \rho(v)]^{-10}$$

$$\rho(t) = \rho(0)\exp(-g^{\rho}t)$$

$$(B.3) \quad U[c(t),L(t)] = L(t) \{\log[c(t)]\}$$

$$(B.4) \quad g^{\text{pop}}(t) = g^{\text{pop}}(0)\exp(-\delta^{\text{pop}}t)$$

$$L(t) = L(0) \exp\left(\int_0^t g^{\text{pop}}(t) dt\right)$$

$$(B.5) \quad Q(t) = \Omega(t)(1-b_1(t)\mu(t)^{b_2}) A(t) K(t)^{\gamma} L(t)^{1-\gamma}$$

$$(B.6) \quad g^A(t) = g^A(0)\exp(-\delta^A t)$$

$$A(t) = A(0) \exp\left(\int_0^t g^A(t) dt\right)$$

$$(B.7) \quad \Omega(t) = 1/[1+D(t)]$$

$$(B.8) \quad D(t) = \theta_1 T(t) + \theta_2 T(t)^2$$

$$(B.9) \quad g^b(t) = g^b(0) \exp(-\delta^b t)$$

$$b_1(t) = b_1(t-1)/(1+g^b(t))$$

$$b_1(0) = b_1^*$$

$$(B.10) \quad E(t) = (1-\mu(t))\sigma(t)A(t) K(t)^{\gamma} L(t)^{1-\gamma}$$

$$(B.11) \quad g^{\sigma}(t) = g^{\sigma}(0)\exp(-\delta^{\sigma}_1 t - \delta^{\sigma}_2 t^2)$$

$$\sigma(t) = \sigma(t-1)/(1+g^\sigma(t))$$

$$\sigma(0) = \sigma^*$$

$$(B.12) \quad Q(t) + \tau(t)[\Pi(t) - E(t)] = C(t) + I(t)$$

$$(B.13) \quad \Pi(t) = E(t)$$

$$(B.14) \quad c(t) = C(t)/L(t)$$

$$(B.15) \quad K(t) = K(t-1)(1-\delta_K)^{10} + 10 \times I(t-1)$$

$$K(0) = K^*$$

$$(B.16) \quad LU(t) = LU(0)(1-\delta_L)^t$$

$$ET(t) = E(t) + LU(t)$$

$$(B.17a) \quad M_{AT}(t) = 10 \times ET(t) + \phi_{11} M_{AT}(t-1) - \phi_{12} M_{AT}(t-1) + \phi_{21} M_{UP}(t-1)$$

$$M_{AT}(0) = M_{AT}^*$$

$$(B.17b) \quad M_{UP}(t) = \phi_{22} M_{UP}(t-1) + \phi_{12} M_{AT}(t-1) - \phi_{21} M_{UP}(t-1) + \phi_{32} M_{LO}(t-1) - \phi_{23} M_{UP}(t-1)$$

$$M_{UP}(0) = M_{UP}^*$$

$$(B.17c) \quad M_{LO}(t) = \phi_{33} M_{LO}(t-1) - \phi_{32} M_{LO}(t-1) + \phi_{23} M_{UP}(t-1)$$

$$M_{LO}(0) = M_{LO}^*$$

$$(B.18) \quad F(t) = \eta \{ \log[M_{AT}(t)/M_{AT}^{PI}] / \log(2) \} + O(t)$$

$$O(t) = \begin{cases} -0.1965 + 0.13465t & t < 11 \\ 1.15 & t > 10 \end{cases}$$

$$(B.19) \quad T(t) = T(t-1) + \sigma_1 \{ F(t) - \lambda T(t-1) - \sigma_2 [T(t-1) - T_{LO}(t-1)] \}$$

$$T(0) = T^*$$

$$(B.20) \quad T_{LO}(t) = T_{LO}(t-1) + \sigma_3[T(t-1) - T_{LO}(t-1)]$$

$$T_{LO} = T_{LO}^*$$