The Equity Adjusted Social Cost of Carbon

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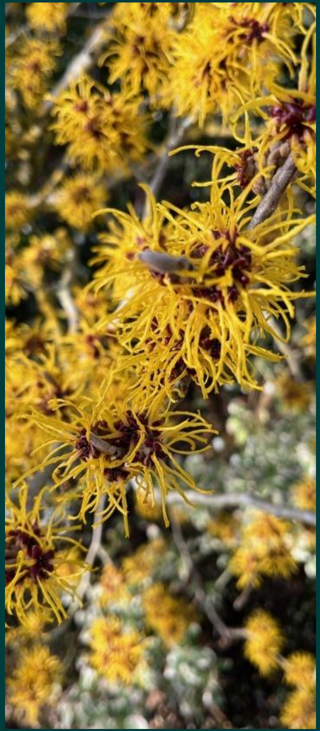

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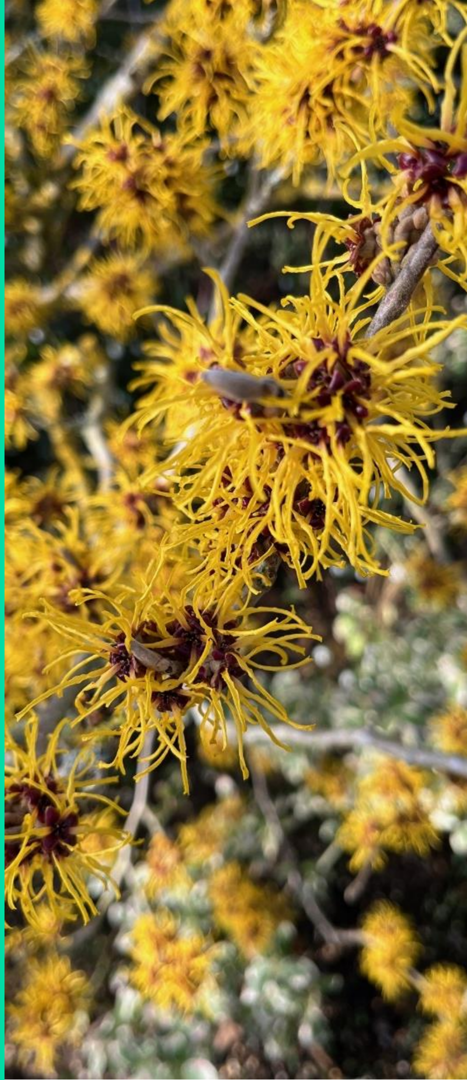
A Simple Integrated Assessment Model

Measurement and Metrics

Theory of Risk, Insurance and Innovation Values



Climate and Climate Damages

- Temperature (T) deviations are linear in cumulative emissions (E)
- Damages Linear in Temperature (T)
- Social Cost of Carbon

$$T_t = \xi_0 + \xi_1 E_t \text{ with } E_t = \int_0^t e_s ds.$$

$$D_t = (\chi_0 + \chi_1 T_t) N c_t{}^{mean}.$$

$$SCC_0 = \chi_1 \zeta_1 N c_0^{mean} \int_0^\infty e^{-R_t t} dt,$$

$$SCC_0 = \frac{\chi_1 \xi_1 N c_0{}^{mean}}{R_t}.$$

$$R_t \equiv r_t - g_t$$

Welfare and Discount Rate

- Welfare Function with intra-generational distribution

$$W_0 = \int_0^{\infty} e^{-\delta t} V\left(U^{-1}\left(\int_\theta U\left(c_t(\theta)\right) dF(\theta)\right)\right) dt = \int_0^{\infty} e^{-\delta t} V(c_t^{EDE}) dt$$

- Discount rate

$$r_t = \begin{cases} \delta + \omega g_t - (\omega+1)\eta h & \text{if } i(c_t(\theta)) = k(c_0(\theta)) = 1, \\ \delta + \omega g_t - \omega \eta h & \text{if } i(c_t(\theta)) = \frac{c_t^{EDE}}{c_t(\theta)} \& k(c_0(\theta)) = \frac{c_0^{EDE}}{c_0(\theta)}, \\ \delta + \omega g_t - (\omega+1)\eta h - \eta \frac{1}{t}\left[\kappa \sigma_0^2 - \iota \underbrace{(\sigma_0^2 + 2ht)}_{\sigma_t^2}\right] & \text{if } k_0 \propto c_0(\theta)^{\kappa} \text{ and } i_t \propto c_t(\theta)^{\iota}. \end{cases} \quad (12)$$

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- Standard Approach

$$SCC_0 = \left(\frac{\chi_1 \xi_1}{\delta + (\omega - 1)g_t}\right) N c_0{}^{mean}.$$

- Equity Adjusted Approach

$$SCC_0 = \begin{cases} \frac{\chi_1 \xi_1}{\delta+(\omega-1)g_t-(\omega+1)\eta h} N c_0{}^{mean} & if\ k(c_t(\theta)) = i(c_t(\theta)) = 1, \forall\theta, \\ \frac{\chi_1 \xi_1}{\delta+(\omega-1)g_t-\omega\eta h} N c_0{}^{mean} & if\ i(c_t(\theta)) = k(c_t(\theta)) = \frac{c_t^{EDE}}{c_t(\theta)}, \\ \frac{\chi_1 \xi_1}{\delta+(\omega-1)g_t-(\omega+1)\eta h+2\eta\iota h} N c_0{}^{mean} e^{\eta(\kappa-\iota)\sigma_0^2} & if\ k_t \propto c_t(\theta)^{\kappa} and\ i_t \propto c_t(\theta)^{\iota}. \end{cases}$$

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- Standard Approach

$$SCC_0 = \left(\frac{\chi_1 \xi_1}{\delta + (\omega - 1) g_t} \right) N {c_0}^{mean}.$$

- Equity Adjusted Approach

$$SCC_0 = \frac{\chi_1 \xi_1}{\delta + (\omega - 1) g_t - (\omega + 1)\eta h + 2\eta\iota h} N {c_0}^{mean} e^{\eta(\kappa - \iota)\sigma_0^2}$$

Equity Adjusted Social Cost of Carbon

Scenario	Diverging Incomes: SSP4 ($h = 0.0048$)	Inequality Neutral ($h = 0$)	Converging Incomes: SSP2 ($h = -0.0063$)	Converging Incomes: SSP5 ($h = -0.0093$)
Deterministic	126.2	66.7	41.2	34.9
Stochastic (Calibrated)	147.6	109.4	**81.7**	72.9
Stochastic ($\kappa = \iota = 0$)	201.3	83.1	47.0	38.9
Stochastic (elast. of subs.: $\omega = 2/3$)	115.6	108.6	100.3	96.8
Stochastic (ineq. aversion: $\eta = 1.5$)	205.0	125.6	83.3	71.7
Stochastic (ineq. aversion: $\eta = 0.5$)	109.5	95.4	81.6	76.3
Stochastic (risk aversion: $\gamma = 3.5$)	127.6	98.0	75.2	67.7
Stochastic (time preference: $\delta = 0.5\%/\text{year}$)	475.8	224.1	132.3	110.7
Stochastic (TCRE: $\xi_1 = 2.5°\text{C/TtC}$)	205.0	151.9	113.5	101.3
Stochastic (damages: χ_1=0.069)	295.1	218.9	163.5	145.9

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