Appendix C.

System-Dynamics Model of Institutional Stability in Noocracy**

C.1. Purpose and Scope of the Model

This appendix presents the technical specification and modelling results referenced in Chapter IV (§ IV.X), used to evaluate the **structural stability** of Noocracy in comparison with the hybrid scenario (S_0). The model is designed to demonstrate the *internal coherence* of the core noocratic constructs ¬ the **Census of Reason (CR)**, **IEKV**, the **Cognitive-Ethical Contour (CEC)**, and **Zero Bias** ¬ within a dynamic environment spanning **2025–2050**.

The simulation is implemented in a discrete-time framework with a yearly step, $\Delta t=1$ year using the Euler method. Implementation was done in **Python 3.11** with **NumPy**, **pandas**, and **matplotlib**. The complete code is available in the repository *Noocracy Open Model v1.0* (see link in the digital edition of the book).

C.2. Model Structure

Core Variables

Symbol	Meaning	Range
R	Resource capacity (fraction of remaining natural capital)	0–1
P	Population (normalised; 1 ≈ 10 billion people)	> 0
K	Cognitive coherence (education + rationality)	0–1
T	Trust and institutional legitimacy	0–1
A	IEKV adoption (energy-cognitive currency)	0–1
C	Integrated conflict risk	0–1
H	Proxy-HDI (Human Development Index)	0–1

These variables represent the minimal state-vector needed to capture institutional, cognitive, and resource dynamics under Noocracy.

C.3. Key Equations (Condensed Form)

$$\frac{dR}{dt} = \rho(1 - R) \; - \; \alpha Y(1 - \varepsilon_A A),$$

$$\frac{dK}{dt} = \eta(1 - K) \; - \; \delta(0.4 - T),$$

$$\frac{dA}{dt} = r_A(A^* - A)(1 - A) + 0.5\, r_A K T(1 - A),$$

$$\frac{dC}{dt} = \beta_0 + \beta_1(1 - R) - \beta_2 T - \beta_3 A,$$

$$\frac{dT}{dt} = \lambda(0.6H + 0.4F - T) - \mu T,$$

$$\frac{dH}{dt} = w_{\text{inc}} Y + w_{\text{edu}} K + w_{\text{env}}(1 - EI),$$

where:

- F= 0.5 (A + K)F ¬ *fairness perception index* (perceived fairness).
- Y ¬ *income proxy*.
- EI ¬ *environmental impact*.

Parameter values for scenarios **S₀** and **S₁** are provided in Table IV.X.1 in Chapter IV.

C.4. Code Fragment (Illustrative Implementation)

```
for t in range(1, n):
    gdp = P[t-1]*(0.5 + 0.5*K[t-1])*(0.5 + 0.5*T[t-1])
    cons = alpha*gdp*(1 - eff_A*A[t-1])

    R[t] = np.clip(R[t-1] + (rho*(1-R[t-1]) - cons)*dt, 0, 1)

    K[t] = np.clip(K[t-1] + (eta*(1-K[t-1]) - delta*(0.4 - T[t-1]))*dt, 0, 1)

    A[t] = np.clip(A[t-1] + (
        rA*(A_star - A[t-1])*(1 - A[t-1]) +
        0.5*rA*K[t-1]*T[t-1]*(1 - A[t-1])
    )*dt, 0, 1)

    # further blocks: trust (T), conflict (C), HDI (H)
```

The full code listing and accompanying CSV file are provided in the supplemental materials: **noocracy_sd_model_2025_2050.csv**

C.5. Modelling Results

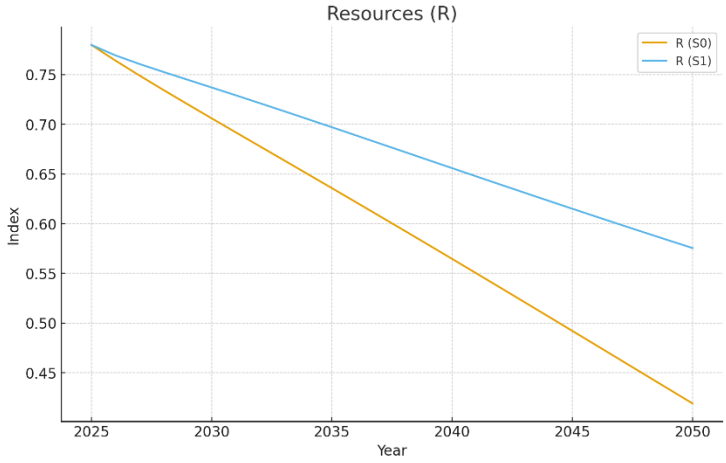

Figure C1. Resources (R)

Illustrates gradual depletion under **S₀** and stabilisation under **S₁** (≈ +20% by 2050).

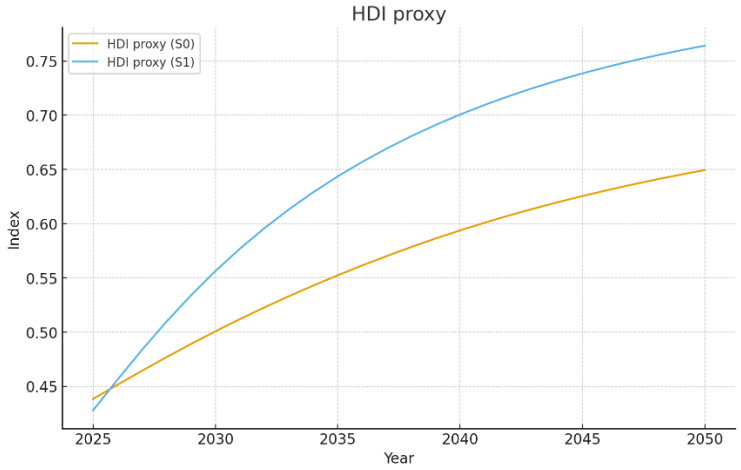

Figure C2. Human Development Index (H)

Scenario $\mathbf{S_1}$ achieves $H \approx 0.85$ versus ≈ 0.68 in $\mathbf{S_0}$, driven by increases in K and T.

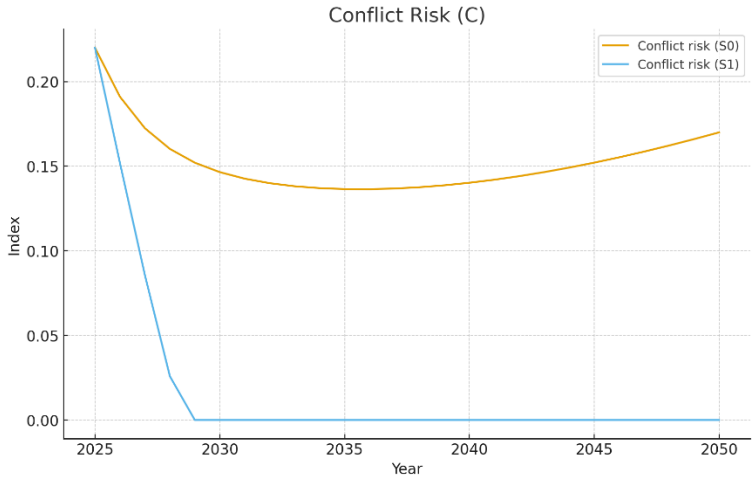

Figure C3. Conflict Risk (C)

Under $\mathbf{S_1}$, C declines by nearly half, reflecting deterrence via IEKV-linked interdependence (A) and trust (T).

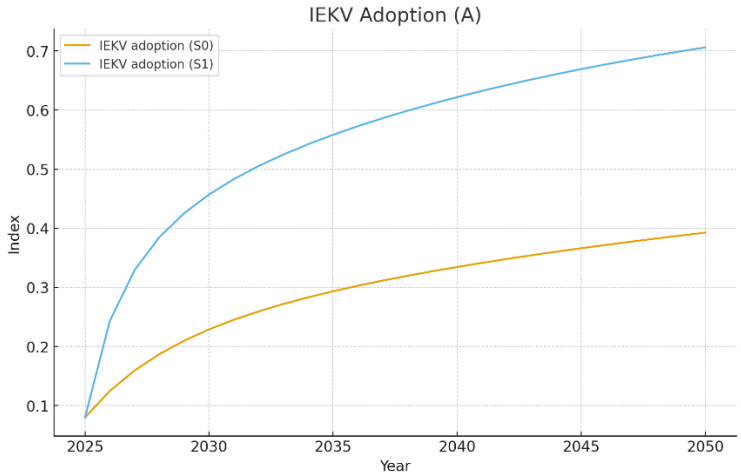

Figure C4. IEKV Adoption (A)

S-curve diffusion: in **S₁**, $A \to 0.9$ by 2045, whereas in **S₀** it remains below 0.4.

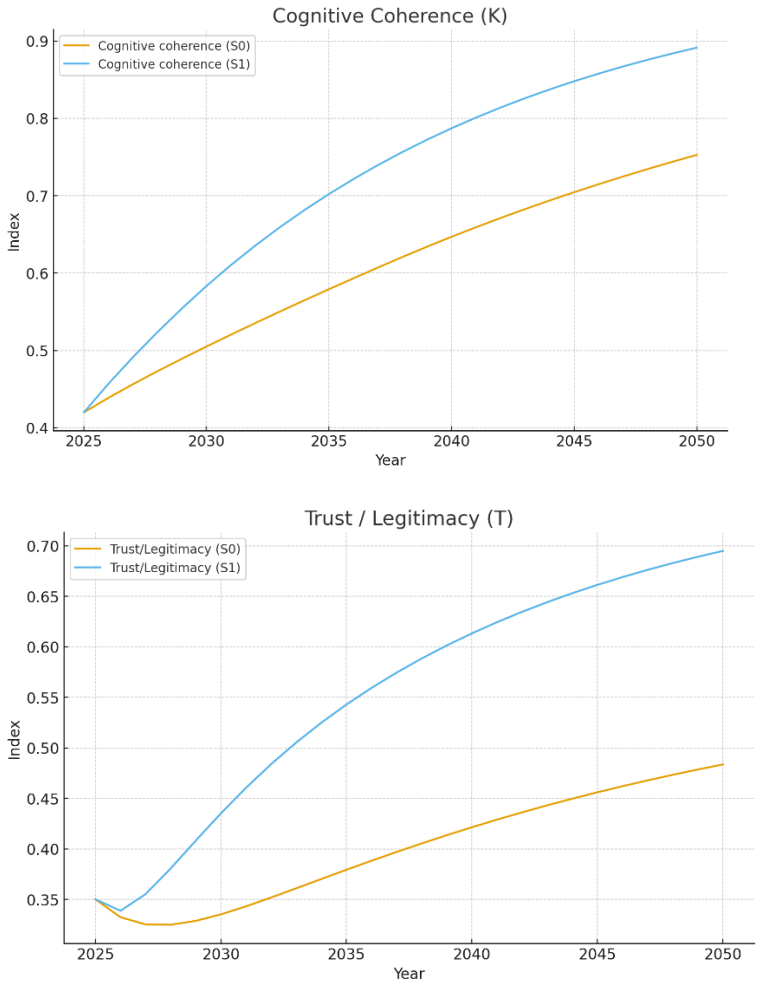

Figure C5. Cognitive Coherence (K) and Trust (T)

Positive feedback between *K* and *T* in **S₁** produces a "cognitive plateau" where both exceed 0.7.

C.6. Interpretation of Results

The model demonstrates that introducing cognitive-ethical mechanisms generates a **self-reinforcing cycle**:

higher rationality → higher trust → reduced conflict → stronger resource stability → higher HDI

This quantitative pattern supports the internal coherence of the noocratic hypothesis (see Chapter VI §1).

In essence, the S₁ trajectory exhibits a stable institutional attractor rooted in cognitive coherence, resource optimisation, and trust formation.

C.7. Limitations and Future Work

The model is **not** intended as an empirical forecasting tool; rather, it aims to show structural plausibility and formal coherence.
Planned extensions include:

- integrating an **agent-network architecture** for CEC–CAO (GJA);
- adding a **financial transition block** (C-SDR, noos-bonds);
- modelling the **coevolution of human and AI agents** under noocratic governance.