
Supplementary Materials

1. Model specification

Households

Households' utility increases monotonically with both consumption C and health status H . Consumption is decomposed into regular/generic goods spending C_m and tourism/recreational spending C_r^* , where C_r has an asterisk given its relationship with health disaster risk (to be defined later). Specifically, households maximize their expected lifetime utility

$$E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \ln C_t + \eta \frac{H_t^{1-\gamma}}{1-\gamma} \right\} \quad (1)$$

$$C_t = C_{r,t}^{\varphi} C_{m,t}^{1-\varphi}$$

where β is the subjective discount factor; η is the weight of health status in the utility function; γ is the inverse of the intertemporal elasticities of substitution for health status; and φ is the share of tourism goods in the consumption bundle, whereas a unit elasticity of substitution exists between the two types of goods in the bundle.

The occurrence of a health disaster (i.e., a society-wide epidemic) is captured in the following health accumulation equation:

$$H_{t+1} = [X_t + (1 - \delta)H_t]e^{x_t \ln(1-\Delta)} \quad (2)$$

where X_t is the health increment, and δ is the deterioration rate of health status.

Households' health investment is determined by combining health spending and leisure hours in the following manner:

$$X_t = (I_t)^\kappa (1 - N_t)^{1-\kappa} \quad (3)$$

where I_t denotes health expenditure and $1 - N_t$ denotes leisure hours, defined as normalized total hours less hours spent working. κ and $1 - \kappa$ represent the elasticity of health investment relative to health spending and leisure, respectively. Two states of nature exist in the model, namely normal circumstances and times of health disaster. x_t is an indicator variable capturing the occurrence of a health disaster. Specifically, $x_t = 1$ with probability ω_t , in which case society is hit by an economy-wide pestilence causing a large share Δ of health to be eliminated; otherwise, $x_t = 0$ denotes a normal societal period. The loss of health would affect welfare directly, as health appears in the utility function, and indirectly by affecting the consumption of tourism and generic goods.

The relationship between health disaster risk and tourism consumption is captured by the following reduced-form equation:

$$C_{r,t}^* = C_{r,t} e^{x_t \ln H_t^\chi} \quad (1')$$

where χ measures the elasticity of tourism consumption with respect to health status, and the property of x_t remains. Working hours consist of time devoted to producing regular goods $N_{m,t}$ and recreational goods $N_{r,t}$ as follows:

$$N_t = N_{r,t} + N_{m,t} \quad (4)$$

Finally, households face the following intertemporal budget constraint:

$$P_{r,t}C_{r,t} + P_{m,t}C_{m,t} + P_{m,t}I_t + B_{t+1} = W_t N_{r,t} + W_t N_{m,t} + R_{d,t}B_t - T_t \quad (5)$$

where B_t is a generalized one-period bond that provides a saving opportunity for households, and $R_{d,t}$ is the interest rate. W_t is the real wage; $P_{r,t}$ and $P_{m,t}$ are the relative prices of recreational goods and regular goods, respectively; and T_t is the net transfer from the government. A household will maximize lifetime utility (Eq. [1]) subject to health accumulation (Eq. [2]), health investment function (Eq. [3]), working time constraint (Eq. [4]), and intertemporal budget constraint (Eq. [5]).

Producers

On the supply side, two sectors are specified in the model economy: the tourism goods sector and generic goods sector. Sectoral production functions are given by

$$Y_{r,t} = A_{r,t}(N_{r,t}H_t)^{\alpha_r} \quad (6)$$

$$Y_{m,t} = A_{m,t}(N_{m,t}H_t)^{\alpha_m} \quad (7)$$

where Eqs. (6) and (7) represent recreational goods production and regular goods production, respectively. $Y_{r,t}$ and $Y_{m,t}$ are the two sectoral goods. α_r and α_m are the elasticity of effective labor in the two sectoral production functions, where effective labor is denoted as the working time indexed by health status. Here, we implicitly assume that the physical capital is fixed and normalized to one. $A_{r,t}$ and $A_{m,t}$ denote sectoral productivity shocks. The two sectoral producers will minimize production costs subject to Eqs. (6) and (7).

Government and market clearing

The government balances its budget every period and institutes policies if needed, as we will examine later. The government budget is given by

$$G_t + R_{d,t}B_t = B_{t+1} + T_t \quad (8)$$

The market clearing conditions for the goods markets (i.e., recreational and regular) are given by

$$Y_{r,t} = C_{r,t} \quad (9)$$

$$Y_{m,t} = C_{m,t} + I_t + G_t \quad (10)$$

2. Derivation of equilibrium conditions

Households

$$\begin{aligned} \max E_t \sum_{j=0}^{\infty} \beta^j \left[\ln(C_{t+j}) + \eta \frac{(H_{t+j})^{1-\gamma}}{1-\gamma} \right] \\ C_t = C_{r,t}^*{}^\varphi C_{m,t}^{1-\varphi} \\ = \left(C_{r,t} e^{x_t \ln H_t^\chi} \right)^\varphi C_{m,t}^{1-\varphi} \\ = [\omega_t C_{r,t} H_t^\chi + (1 - \omega_t) C_{r,t}]^\varphi C_{m,t}^{1-\varphi} \end{aligned}$$

s.t.

$$H_{t+1} = [X_t + (1 - \delta)H_t] e^{x_t \ln(1-\Delta)} \quad (11)$$

$$= [X_t + (1 - \delta)H_t](1 - \omega_t \Delta)$$

$$X_t = (I_t)^\kappa (1 - N_t)^{1-\kappa} \quad (12)$$

$$P_{r,t} C_{r,t} + P_{m,t} C_{m,t} + P_{m,t} I_t + B_{t+1} = W_t N_{r,t} + W_t N_{m,t} + R_{B,t} B_t + T_t \quad (13)$$

First-order conditions (F.O.C):

$$C_{r,t}: \quad \varphi C_{r,t}^{*\varphi-1} [\omega_t H_t^\chi + (1 - \omega_t)] = \Lambda_t p_{r,t} \quad (14)$$

$$C_{m,t}: \quad (1 - \varphi) C_{m,t}^{-1} = \Lambda_t p_{m,t} \quad (15)$$

$$I_t: \quad \Theta_t \kappa \frac{X_t}{I_t} (1 - \omega_t \Delta) = \Lambda_t p_{m,t} \quad (16)$$

$$N_t: \quad \Theta_t (1 - \kappa) \frac{X_t}{1 - N_t} (1 - \omega_t \Delta) = \Lambda_t w_t \quad (17)$$

$$B_t: \quad \Lambda_t = \beta \Lambda_{t+1} R_{B,t+1} \quad (18)$$

$$H_t: \quad \Theta_t = \beta\varphi\chi \frac{C_{r,t+1}}{C_{r,t+1}^*} H_t^{\chi-1} \omega_{t+1} + \beta\eta H_t^{-\gamma} + \beta\Theta_{t+1}(1-\delta)(1-\omega_{t+1}\Delta) \quad (19)$$

Producers

$$\min_{N_{k,t}} w_t N_{k,t}, \quad k = r, m$$

s.t.

$$Y_{k,t} = A_{k,t}(N_{k,t}H_t)^{\alpha_k}$$

F.O.C

$$w_t = \alpha_k p_{k,t} A_{k,t} (N_{k,t})^{\alpha_k-1} (H_t)^{\alpha_k} \quad (20)$$

Government

$$G_t + R_{d,t}B_t = B_{t+1} + T_t \quad (21)$$

Market clearing

$$Y_{r,t} = C_{r,t} \quad (22)$$

$$Y_{m,t} = C_{m,t} + I_t + G_t \quad (23)$$

Steady state

$$R_B = \frac{1}{\beta} \quad (24)$$

$$\frac{X}{H} = \frac{1}{1-\omega\Delta} - (1-\delta) \quad (25)$$

$$\frac{\Theta}{\Lambda} = \frac{1}{1-\omega\Delta} \quad (26)$$

$$\frac{C}{H} = \left[\frac{1}{1-\omega\Delta} - \beta(1-\delta) \right] / (\beta\varphi\chi\omega + \beta\eta) \quad (27)$$

$$\frac{w}{X} = \frac{1-\kappa}{1-N} \quad (28)$$

$$\frac{P_m Y_m}{X} = \frac{N_m}{1-N} \frac{1-\kappa}{\alpha_m} \quad (29)$$

$$\frac{P_r Y_r}{X} = \frac{N_r}{1-N} \frac{1-\kappa}{\alpha_r} \quad (30)$$

Solution for simulation

We solve the model by using high-order perturbation methods for the system of equilibrium conditions. The solution forms a state-space representation as follows

$$\mathbf{y}_t = \mathbf{g}(\mathbf{x}_t, \sigma) \quad (31)$$

$$\mathbf{x}_{t+1} = \mathbf{h}(\mathbf{x}_t, \sigma) + \sigma\theta\epsilon_{t+1} \quad (32)$$

where \mathbf{y}_t is a vector of control variables, \mathbf{x}_t a vector of state variables, and ϵ_t a vector of i.i.d innovations. σ is an auxiliary perturbation parameter, and θ determines the variance-covariance matrix of innovations. Functions \mathbf{g} and \mathbf{h} are constructed by approximated Taylor series expansion with unique order. We then simulate the system according to the state-space representation. Since we are interested in the effect of the risk of health disaster, we thus simulate the impulse response functions of the system conditional on the particular shock.

3. Calibration

Table S Baseline calibration

Parameter	Description	Value
Disaster risk		
ω	Mean probability of disaster	0.016
Δ	Size of disaster	0.1
ρ	Persistence of disaster risk	0.6
Utility function		
β	Discount factor	0.99
φ	Share of recreational goods in consumption	0.1
η	Weight of health	0.8
γ	Risk aversion coefficient	3
Investment		
δ	Health deterioration rate	0.08
κ	Elasticity of health spending	0.27
Production		
α_r	Labor share in recreational goods production	0.8
α_m	Labor share in regular goods production	0.4
