

$$RD_{rd}(t+1, n) = RD_{rd}(t, n)(1 - \delta_{rd})^{\Delta t} + \Delta t \times a \times I_{rd}(t, n)^b \times RD_{rd}(t, n)^c \times SPILL_{rd}(t, n)^d$$

$$SPILL_{rd}(t, n) = \frac{RD_{rd}(t, n)}{\sum_{n \in OECD} RD_{rd}(t, n)} \times (\sum_{n \in OECD} RD_{rd}(t, n) - RD_{rd}(t, n))$$

$$\frac{SC_j(t, n)}{SC_j(0, n)} = \left(\frac{RD_j(t, n)}{RD_j(0, n)} \right)^{-lbr_factor} \left(\frac{wcum_j(t, n)}{wcum_j(0, n)} \right)^{-lbd_factor}$$

$$lbr_rate = 1 - 2^{-lbr_factor}$$

Solution:
 $\max U_n(c) \forall n$

R&D Optimal investment (% of GDP)

Spillovers

Mitigation costs
 Technology costs

Aggregated at the EU level

EU national level

Optimal R&D Investments EU Level Downscaling

$$tfp(t, n, j) = tfp_{LD}(t, n, j) \cdot tfp_{LRHC}(t, n, j) \cdot tfp_{SPILL}(t, n, j) \cdot tfp_{LAG}(t, n, j)$$

$$tfp_{factor}(t, n, j) = \left(\frac{\sum_j cumfactor_{t, n, j}}{\min_n \sum_j cumfactor_{0, n, j}} \right)^{\beta_{factor}}, \forall factor \in \{LFRC, SPILL\}$$

$$cumI_{rd, t, n, j} = (1 - \delta_{rd} I_{rd})^{\Delta t} \cdot cumI_{rd, t-1, n, j} + I_{rd, t-1, n, j} \cdot \left[\frac{(1 - \delta_{rd} I_{rd})^{\Delta t + 1} - 1}{(1 - \delta_{rd}) - 1} \right]$$

$$cumSPILL_{t, n, j} = \sum_n \frac{BTR_{0, n, j}}{\sum_n BTR_{0, n, j}} \cdot cumI_{rd, t, n, j}$$

$$\beta_{factor} = \gamma_{factor} \cdot \ln \left(\frac{HC_{t, n}}{\min_n HC_{0, n}} \right), \forall factor \in \{LFRC, SPILL\}$$

tfp is then used in a dual function in order to reduce the unit costs

Optimal R&D Financing
 - Public: Through carbon revenues
 - Private: Subsidies

RD_{rd} : Stock of Knowledge
 δ_{rd} : Discount rate
 I_{rd} : Investment in R&D
 j : Sector
 a, b, c, d : Coefficients of the knowledge function

$SPILL_{rd}$: The contribution of foreign knowledge through spillovers to the production of new domestic ideas depends on the interaction between two terms: the first describes the absorptive capacity whereas the second captures the distance from the technology frontier, which is represented by the stock of knowledge in OECD countries.

t : time
 n : Country/Rgion
 SC : Instalation Costs
 $wcum$: Cumulated installed capacity
 β : elasticity of $cumI_{rd}$ to tfp

U : Utility
 BTR : Bilateral imports
 lbr_rate : Learning Rate
 tfp : total factor productivity
 HC : Human capital index

LD : Learning-by-doing
 $LRHC$: Learning-by-research
 $SPILL$: Spillovers