

Macro economy and Material stock & flow

Kyoto University, Reina Kawase

1. Macro economy

Objective : Estimate GDP in 230 region form 1980-2100

Structure : Main variables are GDP, Labor force, Saving rate, Investment rate, TFP. GDP is formulated by Cobb-Douglas production function, $\alpha = 0.31$. Labor force = f (population, participation rate by age group, unemployment rate). Saving rate = f (share of 1564 population, growth rate of GDP per capita). Investment rate = f (Saving rate, net trade rate). TFP is explained by a following formula with average number of years of schooling [H], Governance Index (=Government Effectiveness) [G], and regional unique term [C]. This is a catch-up model based on the level of TFP in USA.

$$\log \frac{TFP_{r,t}}{TFP_{USA,t} - TFP_{r,t}} = \gamma 1 \cdot H_{r,t} + \gamma 2 \cdot G_{r,t} + C_{r,t}$$

Scenario(Input) : There are 2 scenarios; Scenario of Low Carbon Society (SLCS) and Scenario of STAGnation (SSTAG). Depending on scenarios, change rates of H, G, and C are different. Those of SLCS change with a high speed, and TFPs in regions in 2100 are different, but are converged toward the level of TFP in USA. On the other hand, those of SSTAG change with a slow speed, and even in 2100, the range of TFP is wide. As for an unemployment rate which affects labor force, SLCS assumes that it becomes 0% in 2075, but in SSTAG the rate is fix at the level of 2009 up to 2100.

Output : GDP

2. Material stock & flow

Objective : Estimate energy-intensive material demand to meet service demands derived from socio-economic activities. Target material is steel and cement.

Structure : Service demand is calculated from socio-economic variables, then goods stocks to supply the service demand is estimated. To meet a demand of goods stock, demands of goods are estimated and the material input to produce the goods means material demand. Service has 4 categories which include households, production by sectors, transportation, and infrastructure. Goods classification has 29 goods.

Input :

2005-2050: socio-economic index (GDP by sector, population, household), energy consumption (thermal, hydro), transport demand (output from transport model), technology parameters (share of structure type of dwelling, material input per floor area, efficiency of power generation, ratio to production capital to output, *etc.*), policy parameters (road length per car, floor area per dwelling, access rate to improved water and sanitation, *etc.*), *etc.*

1980-2005: parameters listed in 2005-2050, goods stocks (dwellings, floor area per dwelling, possession of transport equipment, *etc.*), material input per goods production *etc.*

Output : service demand, goods demand, material demand, and material stock