Computable General Equilibrium Models:
Final demand

Wolfgang Britz, Institute for Agricultural Policy,
University Bonn

Simulation Models for Policy Analysis

Summer Term 2020

Aims for today

- Refresh your memory about the LES and CD demand function
- Learn how production final demand is depicted in CGEs
- Look at code

Final demand

- Typically agents (also named institutions):
  - Private household(s)
  - Government(s)
  - Savings (= Investments)
- Expenditure on commodities by these institutions can be found in SAM
- As with production:
  - Prices set to unity
  - Expenditure in benchmark defines quantity index (= physical demand)

LES

- Linear expenditure system

```
*
* --- household demand, LES
*
  e_xah(r,c,"hou") ..

    v_xa(r,c,"hou") =E=
                        v_Gamma(r,c) + p_alphaa(R,c,"hou")/[v_px(r,c)*(1+p_oTax(r,c))]
                          * (v_yc(r) -SUM(c1, v_Gamma(r,c1)*v_px(R,c1)*(1+p_oTax(r,c1))    ));
```

Marginal budget share

Constant term,
so-called commitments

Non-committed income

Total household expenditure

LES

- Properties:
  - Linear Engel-curves
  - No inferior commodities (p_alphaa must be positive), i.e. Engel curves upward sloping
  - Marginal budget shares *v_alphaa* must add up to unity
  - Thus, N*2 – 1 degrees of freedom, of which N are needed to calibrate the system against the given quantities and prices in the benchmark

LES calibration

- We pre-define the marginal budget shares:

```
p_alphaa(R,"C_Agr","hou") = 0.1;
p_alphaa(R,"C_Ind","hou") = 0.4;
p_alphaa(R,"C_Ser","hou") = 0.5;
```

- No easy way to calculate commitment terms directly in that case .. we let the solver do the job
- Note: if commitment terms (= constant terms) are given, marginal budget shares can be easily calculated

LES calibration

- Closure swap: fix demand quantities and solve for commitments:

```
v_gamma.UP(R,c)      = inf;
v_gamma.l(R,c)       = 0;
*
* ---- Calibration model for CES share and shift parameters,
*      minimum commitment levels Gamma for LES demand system
*      and calculation of Utility

Model m_calLES /e_xah ,e_dummy/;
m_calLES.Solprint  = 1;
m_calLES.Limcol    = 0;
m_calLES.Limrow    = 0;
m_calLES.Holdfixed = 0;
m_calLES.optfile   = 1;

* ---- Fix variables to balanced SAM

v_yc.fx(r)          = V_yc.l(r);
v_xa.fx(r,c,"hou") = V_sam.l(r,c,"hou");

SOLVE m_calLES MINIMIZING v_dummy USING NLP;
IF ( m_calLES.numInfes > 0,
   Abort "CGE could not be calibrated, Stop";
);

* --- fix parameters to calibrated solution

v_Gamma.FX(R,c)      = v_Gamma.L(R,c);
```

Commitments are free variable

Model with LES equations only (and dummy objective)

Income and demand quantities fixed

CD demand

- Can be either understood as:
  - Simplification of LES demand system, i.e. without commitments
  - or as a special case of CES with a substitution elasticity of unity
- Only N parameters => just sufficient to calibrate against given prices and quantities
- Limited parameter space can also be seen from elasticities:
  - all income are elasticities are equal to +1
  - and all price elasticities equal to -1

CD demand

Fixed value share

```
*
* --- government demand is CD = fixed value shares
*
  e_xag(r,c,"gov") ..

    v_xa(r,c,"gov") * v_px(r,c)*(1+p_oTax(r,c)) =E= p_alphaa(r,c,"gov") * v_yg(r);
*
* --- investmend demand is CD = fixed value shares
*
  e_xas(r,c,"inv") ..

    v_xa(r,c,"inv") * v_px(r,c)*(1+p_oTax(r,c)) =E= p_alphaa(r,c,"inv") * v_ys(r);
```

Further on demand

- Extensions are possible by using CES-sub-nests, similar to nest CES on production side, for instance
  - Agri-food commodities (or all meats etc.) are in a CES-nest
  - Related CES price aggregator defines “average price for agri-food products”
  - Top-level demand system (LES,CD) defines the total expenditure for agri-food at given aggregate price

Further on demand

- Other functional forms used in CGE modeling:
  - CDE (Constant Difference in Elasticities): used in the GTAP standard model
  - AIDADS (An Implicite Additive Indirect Demand System): used e.g. in the long-term module G-RDEM (Britz and Roson 2019) of CGEBox