APPENDIX

MODEL DESCRIPTION

SETS

c  set of commodities
a  set of sectors
f  set of factors
h  set of households
insd set of institutions

PARAMETERS

alphaq(c)  Armington function shift parameter for commodity c
alphat(c)  CET function shift parameter for commodity c
alphava(a)  shift parameter for CES activity production function
betam(c, h)  marginal share of household consumption spending on commodity c
cwts(c)  weight of commodity c in the consumer price index
deltaq(c)  Armington function share parameter for commodity c
deltat(c)  CET function share parameter for commodity c
deltava(f, a)  share parameter for CES activity production function
gammam(c, h)  per capita subsistence consumption of marketed commodity c for household h
ica(c, a)  quantity of c as intermediate input per unit of aggregate intermediate
mpsbar(h)  marginal or average propensity to save
qbarinv(c)  base-year quantity of investment demand for commodity c
rhoq(c)  Armington function exponent for commodity c
rhot(c)  CET function exponent for commodity c
rhova(a)  CES activity production function exponent
shift(insd, f)  share of institution insd in the income of factor f
trnsfr(insd, insd)  inter institutional transfers
tinsbar(h)  direct tax rate for household h
tradelarm(c)  Armington elasticity for commodity
tradelet(c)  CET elasticity for commodity
alphava2(c)  shift parameter for CES function for rural and urban labour
deltava2(c)  share parameter for CES function for rural and urban labour
rhova2(c)  exponent of CES function for rural and urban labour
gammam(c, h)  per capita subsistence consumption of commodity c for household h
tst(c)  sales tax
texc(a)  excise duty
tstm(c)  stamp duty
toth(c)  other taxes
tser(c)  service tax
tsub(a)  subsidy rate
tm(c)  import tariff
te(c)  export tariff
inta(a)  intermediate aggregate coefficient of Leontief production function
iva(a)  aggregate value added coefficient of Leontief production function
mps0(h)  marginal (and average) propensity to save for household h
VARIABLES

CPI  consumer price index (fixed variable)
EG   government expenditure
EH (h) household consumption expenditure
EXR  exchange rate (domestic currency per unit of foreign currency)
GSAV government savings
IADJ investment adjustment factor
MPS (h) marginal (and average) propensity to save for household (fixed variable)
PDD (c) demand price of output produced and sold domestically
PDS (c) supply price of output produced and sold domestically
PISTA (a) price of intermediate aggregate
PE (c) export price
PM (c) import price
PWE (c) world price of exported commodity (fixed variable)
PWM (c) world price of imported commodity (fixed variable)
PQ (c) composite commodity price
PVA (a) value-added price
PX (c) producer price for commodity
QD (c) quantity sold domestically of domestic output
QE (c) export quantity
QF (f, a) quantity demanded of factor f from activity a
QVA (a) quantity of aggregate value added
QH (c, h) quantity consumed of commodity c by household h
QINT (c, a) quantity of commodity c used as intermediate input in activity a
QINTA (a) quantity of aggregate intermediate input for activity a
QINV (c) quantity of investment demand for commodity c
QM (c) import quantity
QQ (c) quantity of goods supplied domestically (composite supply)
QX (a) quantity of domestic output of commodity c
TABS total absorption
TINS (h) direct tax rate (fixed variable)
WF (f) economy-wide wage of factor f
WFDIST (f, a) wage distortion factor for factor f in activity a
YF (f) factor income
YG government income
YIF (insd, f) income of institution insd from factor f
YI (insd) income of institution insd
CORPSAV corporate saving
QFS (f) factor supply
PVTENTSARV private enterprise savings
PUBENTSARV public enterprise savings
FSAV foreign savings (fixed variable)
WALRAS variable introduced to equalize number of variables and equations
QFLAB (a) aggregate labour in activity a
WLAB (a) wage of aggregate labour in activity a
NREGTRNSFR transfers to poor rural households due to MGNREGA
NREGATAX additional tax rate to finance MGNREGA transfers
MODEL EQUATIONS

1. Import price

$$PM(c) = \left(1 + \text{indtax}(c, \text{tm}')\right) \cdot \text{EXR} \cdot \text{pwm}(c)$$

2. Export price

$$PE(c) = \left(1 - \text{indtax}(c, \text{te}')\right) \cdot \text{EXR} \cdot \text{pwe}(c)$$

3. Domestic price equilibrium

$$\text{PDD}(c) = \text{PDS}(c)$$

4. Consumption value (net of taxes)

$$\text{PQ}(c) \cdot \left(1 - \text{indtax}(c, \text{tsal}') \cdot \text{indtax}(c, \text{tstn}') \cdot \text{indtax}(c, \text{toth}') \cdot \text{indtax}(c, \text{tser}')\right) \cdot \text{QQ}(c) = \text{PDD}(c) \cdot \text{QDD}(c) + \text{PM}(c) \cdot \text{QM}(c)$$

5. Production value

$$\text{PX}(c) \cdot \text{QX}(c) = \text{PDS}(c) \cdot \text{QD}(c) + \text{PE}(c) \cdot \text{QE}(c)$$

6. Aggregate price of intermediate inputs for sector

$$\text{PINTA}(a) = \sum_c \text{PQ}(c) \cdot \text{Ica}(c,a)$$

7. Production value (net of taxes)

$$\text{PX}(a) \cdot \text{QX}(a) \cdot \left(1 - \text{indtax}(a, \text{texc}') + \text{indtax}(a, \text{tsub}') \cdot \text{nregatax}\right) = \text{PVA}(a) \cdot \text{QVA}(a) + \text{PINTA}(a) \cdot \text{QINTA}(a)$$

8. Consumer price index

$$\text{cpl} = \sum_c \text{cwts}(c) \cdot \text{PQ}(c)$$

9. Aggregate intermediate input quantity for sector

$$\text{QINTA}(a) = \text{inta}(a) \cdot \text{QX}(a)$$

10. Aggregate value added quantity for sector

$$\text{QVA}(a) = \text{iva}(a) \cdot \text{QX}(a)$$
11. Constant elasticity of substitution (CES) function for aggregate value added (capital and aggregate labour)

\[ QVA(a) = \alpha(a) \cdot \left( \delta^{\text{'CAP'},a} \right) \cdot QF('\text{CAP'},a)^{\rho_{\text{VA}}(a)} + \left( 1 - \delta^{\text{'CAP'},a} \right) \cdot QFLAB(a)^{\rho_{\text{VA}}(a)} \]

12. First order condition for aggregate value added

\[ QF('\text{CAP'},a) = QFLAB(a) \cdot \left( \left( \frac{WF('\text{CAP'}) \cdot WFDIST('\text{CAP'},a))}{1 - \delta^{\text{'CAP'},a}} \right) \right) \]

13. Euler’s equation for aggregate value added

\[ QVA(a) \cdot PVA(a) = QFLAB(a) \cdot WFLAB(a) + QF('\text{CAP'},a) \cdot WF('\text{CAP'}) \cdot WFDIST('\text{CAP'},a) \]

14. Constant elasticity of substitution (CES) function for aggregate labour (urban and rural labour)

\[ QLAB(a) = \alpha(a) \cdot \left( \delta^{\text{'RLAB'},a} \right) \cdot QF('\text{RLAB'},a)^{\rho_{\text{LAB}}(a)} + \left( 1 - \delta^{\text{'RLAB'},a} \right) \cdot QFLAB(a)^{\rho_{\text{LAB}}(a)} \]

15. First order condition for aggregate labour

\[ QF('\text{RLAB'},a) = QF('\text{ULAB'},a) \cdot \left( \left( \frac{WF('\text{ULAB'})}{1 - \delta^{\text{'ULAB'},a}} \right) \right) \]

16. Euler’s equation for aggregate labour

\[ QFLAB(a) \cdot WFLAB(a) = QF('\text{RLAB'},a) \cdot WF('\text{RLAB'}) + QF('\text{ULAB'},a) \cdot WF('\text{ULAB'}) \]

17. Intermediate input quantity for sector

\[ QINT(c,a) = \text{ica}(c,a) \cdot QINTA(a) \]

18. Armington function for imported and domestic goods

\[ Q(c) = \alphaq(c) \cdot \left( \delta^{\text{'Q'},c} \right) \cdot QM(c)^{\rho_{\text{Q}}(c)} + \left( 1 - \delta^{\text{'Q'},c} \right) \cdot QD(c)^{\rho_{\text{Q}}(c)} \]

19. First order condition for Armington function

\[ QM(c) = QD(c) \cdot (PM(c) / QM(c)) \cdot \left( \delta^{\text{'Q'},c} \right) \]

20. Constant elasticity of transformation (CET) function for exported and domestic goods

\[ QX(c) = \alpha(c) \cdot \left( \delta^{\text{'Q'},c} \right) \cdot QE(c)^{\rho_{\text{X}}(c)} + \left( 1 - \delta^{\text{'Q'},c} \right) \cdot QD(c)^{\rho_{\text{X}}(c)} \]
21. First order condition for CET function
\[ QE(c) = \frac{QD(c) \times (PE(c)/PDS(c) \times (1 - deltat(c)) / deltat(c))^{1/\text{frac{1}{m}}}}{1} \]

22. Demand supply equilibrium for non imported goods
\[ QQ(c) = QD(c) \]

23. Demand supply equilibrium for non exported goods
\[ QX(c) = QD(c) \]

24. Factor income (capital)
\[ YF('\text{CAP}') = \sum_a WF('\text{CAP}') \times WFDIST('\text{CAP}', A) \times QF('\text{CAP}', A) \]

25. Factor income (rural labour)
\[ YF('\text{RLAB}') = \sum_a \text{wf0}('\text{RLAB}') \times QF('\text{RLAB}', A) \]

26. Factor income (urban labour)
\[ YF('\text{ULAB}') = \sum_a WF('\text{ULAB}') \times QF('\text{ULAB}', A) \]

27. Institutional income from rural labour
\[ YIF(\text{insd}, '\text{RLAB}') = \text{shif(\text{insd}, '\text{RLAB}') \times YF('\text{RLAB}') - trnsfr('\text{ROW}', '\text{RLAB}') \times EXR} \]

28. Institutional income from urban labour
\[ YIF(\text{insd}, '\text{ULAB}') = \text{shif(\text{insd}, '\text{ULAB}') \times YF('\text{ULAB}') - trnsfr('\text{ROW}', '\text{ULAB}') \times EXR} \]

29. Institutional income from capital
\[ YIF(\text{insd}, '\text{CAP}') = \text{shif(\text{insd}, '\text{CAP}') \times YF('\text{CAP}') - trnsfr('\text{ROW}', '\text{CAP}') \times EXR - CORPSAV} \]

30. Rural household income
\[ YI(RH) = \sum_f YIF('\text{RH1}', f) + \text{trnsfr('\text{RH1}', \text{GOVT}) \times cpl + trnsfr('\text{RH1}', \text{ROW}) \times EXR + popshr \times nreg \times trnsfr} \]
31. Urban household income

\[ YI(UH) = \sum_i YIF('UH1',i) + \text{transfr('UH1',GOVT')*CPI} + \text{transfr('UH1',ROW')*EXR} \]

32. Household expenditure net of savings and direct taxes

\[ EH(h) = (1-MPS(h))*(1-TINS(h)-nregatax)*YI(h) \]

33. Linear expenditure system (LES)

\[ PQ(c)*QH(c,h) = PQ(c)*\text{gammam}(c,h) + \text{betam}(c,h)*(EH(h)-\sum_i PQ(c)*\text{gammam}(c,h)) \]

34. Investment demand quantity

\[ QINV(c) = qbarinv(c)*IADJ \]

35. Government income

\[ YG = \sum_h TINS(h)*YI(h) + nregatax*\sum_h YI(h) + \sum_a \text{indtax}(a,\text{te})*PX(a)*QX(a) + \sum_c \text{indtax}(c,\text{tm})*PWM0(c)*QM(c)*EXR + \sum_c \text{indtax}(c,\text{isal})*PQ(c)*QQ(c) + \sum_c \text{indtax}(c,\text{tstn})*PQ(c)*QQ(c) + \sum_c \text{indtax}(c,\text{toth})*PQ(c)*QQ(c) + \sum_c \text{indtax}(c,\text{tser})*PQ(c)*QQ(c) + \sum_c \text{indtax}(c,\text{te})*PWE0(c)*QE(c)*EXR - \sum_a \text{indtax}(a,\text{isub})*PX(a)*QX(a) + \text{YIF('GOVT','CAP')} + \text{transfr('GOVT','PVTENT')*cpi} + \text{transfr('GOVT','ROW')*EXR} \]

36. Government expenditure

\[ EG = \sum_c PQ(c)*QG0(c,\text{GOVT'}) + \sum_h \text{transfr}(h,\text{GOVT'})*cpi + \text{transfr('PVTENT','GOVT')*cpi} + NREGTRNSFR \]

37. Transfers financed through household taxes

\[ NREGTRNSFR = NREGATAK*\sum_h YI(h) \]

38. Aggregate rural labour supply

\[ QFS('RLAB') = \sum_a QF('RLAB',a) \]
39. Aggregate urban labour supply

\[ QFS('ULAB') = \sum_a QF('ULAB', a) \]

40. Aggregate capital supply

\[ QFS('CAP') = \sum_a QF('CAP', a) \]

41. Total commodity demand

\[ QQ(c) = \sum_a QINT(c, a) + \sum_h QH(c, h) + QG0(c, 'GOVT') + QINV(c) \]

42. Current account balance

\[
\sum_{c \in cem} pwe(c) \times QE(c) + \sum_{ins} trnsfr(ins', row') + fsv
\]

\[ = \sum_{c \in cem} pwn(c) \times QM(c) + \sum_f trnsfr('row', f) \]

43. Government savings

\[ GSAV = YG - EG \]

44. Direct tax rate for households

\[ TINS(h) = tinsbar(h) \]

45. Retained earnings of firms

\[ CORPSAV = YF('CAP') - trnsfr('ROW', 'CAP') \times EXR - \sum_{insd} YIF(insd, 'CAP') \]

46. Total absorption

\[ TABS = \sum_c \sum_h PQ(c) \times QH(c, h) + \sum_c PQ(c) \times QG0(c, 'GOVT') + \sum_c PQ(c) \times QINV(c) \]

47. Savings of private firms

\[ PVTENTSAV = YIF('PVTENT', 'CAP') + trnsfr('PVTENT', 'GOVT') \times cpi - trnsfr('GOVT', 'PVTENT') \times cpi \]
48. Savings of government firms

\[ \text{Pубпентsav} = \text{YIF('Pубпент','CAP')} \]

49. Savings-investment balance

\[ \text{SUM}(c, \text{PQ}(c)*\text{QINV}(c)) = \text{GSAV} + \sum_{h} \text{MPS}(h)*\text{YI}(h)*\left(1-\text{TINS}(h)-\text{nregatax}\right) + \text{CORPSAV} + \text{PVTENTSAV} + \text{PUBENTSAV} + \text{EXR*fsav} + \text{WALRAS} \]

50. Marginal propensity to save for households

\[ \text{MPS}(h) = \text{mps0}(h) \]