Appendix A: The 2003 Social Accounting Matrix

The Input- Output Table

	A.AGRI	A.MINE	A.MAN	A.TRADE	A.SERV	INF-A.AGRI	INF-A.MINE	INF-A.MAN	INF-A.TRADE	INF-A.SERV
C.AGRI	19	1	4757		13	22		1192		
C.MINE	27	1	3942		416	30		987		
C.MAN	825	44	7691	73	17860	947		1927		
C.TRADE										
C.SERV	779	285	6806	7381	18000	894		1705		
INF-C.AGRI										
INF-C.MINE										
INF.C.MAN										
INF-C.TRADE										
INF-C.SERV										

Note: features are in Billion MT

Source: *Author's own calculations based on Thurlow (2008)*

Appendix A

The Institutional Part of the Activity Columns

	A.AGRI	A.MINE	A.MAN	A.TRADE	A.SERV	INF-A.AGRI	INF-A.MINE	INF-A.MAN	INF-A.TRADE	INF-A.SERV
SK-LAB	193	6	1033	1271	7202	222		259		
SSK-LAB	402	9	1526	2036	9784	461		382		
USK-LAB	5874	58	4970	2868	10392	6744		1245		4885
CAP	1985	380	8144	7405	17264	2281		2041		
ENTR										
R-HHDS										
U-HHDS										
TRD										
TRE										
TRM										
GOVT										
YTAX										
VATB-RSA										
VATB-RoSADC										
VATB-ROW										
VATD										
REB	-61	-15	-1230		-1872					
STAX										
ATAX		-1			-189					
MTAX-RSA										
MTAX-RoSADC										
MTAX-ROW										
S-I										
RSA										
RoSADC										
ROW										
TOTALS	10043	768	37639	21034	78870	11601	0	9738	0	4885

Note: features are in Billion MT

Source: *Author's own calculations based on Thurlow (2008)*

The Make Matrix

	C.AGRI	C.MINE	C.MAN	C.TRADE	C.SERV	INF-C.AGRI	INF-C.MINE	INF-C.MAN	INF-C.TRADE	INF-C.SERV
A.AGRI	10043	0	0	0	0					
A.MINE	0	768	0	0	0					
A.MAN	0	0	37639	0	0					
A.TRADE	0	0	0	21034	0					
A.SERV	0	0	0	0	78870					
INF-A.AGRI										
INF-A.MINE										
INF.A.MAN										
INF-A.TRADE										
INF-A.SERV										

Note: features are in Billion MT

Source: *Author's own calculations based on Thurlow (2008)*

Appendix A

The Institutional Part of the Activity Rows

	SK-LSB	SSK-LAB	USK-LAB	CAP	ENTER	R-HHDS	U-HHDS	TRD	TRE	TRM	GOVT	YTAX	VATB-RSA	VATB-RoSADC	VATB-ROW
A.AGRI															
A.MINE															
A.MAN															
A.TRADE															
A.SERV															
INF-A.AGRI						11601									
INF-A.MINE						0									
INF.A.MAN						9738									
INF-A.TRADE						0									
INF-A.SERV						4885									

	VATD	REB	STAX	ATAX	MTAX-RSA	MTAX-RoSADC	MTAX-ROW	S-I	RSA	RoSADC	ROW	TOTALS
A.AGRI												10043
A.MINE												768
A.MAN												37639
A.TRADE												21034
A.SERV												78870
INF-A.AGRI												11601
INF-A.MINE												0
INF.A.MAN												9738
INF-A.TRADE												0
INF-A.SERV												4885

Note: features are in Billion MT

Source: *Author's own calculations based on Thurlow (2008)*

The Institutional Part of the Commodity Rows

	SK-LSB	SSK-LAB	USK-LAB	CAP	ENTER	R-HHDS	U-HHDS	TRD	TRE	TRM	GOVT	YTAX	VATB-RSA	VATB-RoSADC	VATB-ROW
C.AGRI						2114	6152								
C.MINE						154	77								
C.MAN						10180	22383								
C.TRADE								15783	1173	4078					
C.SERV						5172	19747				14745				
INF-C.AGRI															
INF-C.MINE															
INF-C.MAN															
INF-C.TRADE															
INF-C.SERV															

	VATD	REB	STAX	ATAX	MTAX-RSA	MTAX-RoSADC	MTAX-ROW	S-I	RSA	RoSADC	ROW	TOTALS
C.AGRI								66	706	270	2777	**18089**
C.MINE								476	32	12	127	**6281**
C.MAN								14708	3214	1231	12652	**93735**
C.TRADE									0	0	0	**21034**
C.SERV								11783	4168	1351	3986	**96802**
INF-C.AGRI												**0**
INF-C.MINE												**0**
INF-C.MAN												**0**
INF-C.TRADE												**0**
INF-C.SERV												**0**

Note: features are in Billion MT

Source: *Author's own calculations based on Thurlow (2008)*

The Institutional Part of the Commodity Columns

	C.AGRI	C.MINE	C.MAN	C.TRADE	C.SERV	INF-C.AGRI	INF-C.MINE	INF-C.MAN	INF-C.TRADE	INF-C.SERV
SK-LAB										
SSK-LAB										
USK-LAB										
CAP										
ENTR										
R-HHDS										
U-HHDS										
TRD	4814	353	11189		-573					
TRE	743	11	419							
TRM	472	10	3596							
GOVT										
YTAX										
VATB-RSA	22	4	1110		65					
VATB-RoSADC	3		151		4					
VATB-ROW	59	16	2481		1374					
VATD		39	1409		2579					
REB										
STAX			2468							
ATAX										
MTAX-RSA	7		619							
MTAX-RoSADC	1		84							
MTAX-ROW	40	5	1381							
S-I										
RSA	473	1274	7828		656					
RoSADC	53	142	873		41					
ROW	1359	3659	22488		13786					
TOTALS	18089	6281	93735	21034	96802	0	0	0	0	0

Note: features are in Billion MT

Source: *Author's own calculations based on Thurlow (2008)*

Appendix A

The Institutional Diagonal Matrix

	SK-LSB	SSK-LAB	USK-LAB	CAP	ENTER	R-HHDS	U-HHDS	TRD	TRE	TRM	GOVT	YTAX	VATB-RSA	VATB-RoSADC	VATB-ROW
SK-LAB															
SSK-LAB															
USK-LAB															
CAP															
ENTR	0	0	0	32281							146				
R-HHDS	272	1899	31533	7219	3382						117				
U-HHDS	9914	12701	5503	0	22512						294				
TRD															
TRE															
TRM															
GOVT												3129	1201	158	3930
YTAX					102										
VATB-RSA					925	133	2071								
VATB-RoSADC															
VATB-ROW															
VATD															
REB															
STAX															
ATAX															
MTAX-RSA															
MTAX-RoSADC															
MTAX-ROW															
S-I					1673	445	1837				-1518				
RSA					3833										
RoSADC															
ROW															
TOTALS	10186	14600	37036	39500	32427	44422	52267	15783	1173	4078	13784	3129	1201	158	3930

(The Institutional Diagonal Matrix continues)

	VATD	REB	STAX	ATAX	MTAX-RSA	MTAX-RoSADC	MTAX-ROW	S-I	RSA	RoSADC	ROW	TOTALS
SK-LAB												**10186**
SSK-LAB												**14600**
USK-LAB												**37036**
CAP												**39500**
ENTR												**32427**
R-HHDS												**44422**
U-HHDS									1343			**52267**
TRD												**15783**
TRE												**1173**
TRM												**4078**
GOVT	4027	-3178	2468	-190	626	85	1426					**13784**
YTAX												**3129**
VATB-RSA												**1201**
VATB-RoSADC												**158**
VATB-ROW												**3930**
VATD												**4027**
REB												**-3178**
STAX												**2468**
ATAX												**-190**
MTAX-RSA												**626**
MTAX-RoSADC												**85**
MTAX-ROW												**1426**
S-I												**27033**
RSA									4601	-1755	21750	**14064**
RoSADC												**1109**
ROW												**41292**
TOTALS	4027	-3178	2468	-190	626	85	1426	27033	14064	1109	41292	

Note: features are in Billion MT

Source: *Author's own calculations based on Thurlow (2008).*

Appendix B: The IFPRI CGE Model Specifications

Indices

Index	Variable definition
s	Formal activities
	Aliases of *s*: *g*
	Elements of *s*:
	agri,
	min,
	man,
	trade,
	serv;
is	Informal activities
	Aliases of *is*: *ig*
	Elements of *is*:
	agri,
	min,
	man,
	trade,
	serv;
f	Factors of production
	Elements of *f*:
	skl-lab,
	sskl-lab,
	uskl-lab,
	cap;
h	Households
	Elements of *h*:
	r-hhds,
	u-hhds;
r	Regions
	Elements of *r*:
	rsa,
	rosadc,
	row;

Parameters

Parameter	Symbol	Definition
va (s)		Elasticity of substitution among primary factors in the production function of sector s
sigmaT (s)	σ^T_s	Elasticity of transformation between domestic uses and exports in sector s
relacet (s)		Elasticity of transformation among exports to different destinations
sigmaQ (s)	σ^Q_s	Elasticity of substitution between domestic uses and imports of sector s
relasarm (s)		Elasticity of substitution among imports from different origins
at0 (s)		Activity tax rate for sector s
rebt0 (s)		VAT rebate tax rate for sector s
st0 (g)		Sales tax rate on commodity g
vtd0 (g)		VAT collected domestically tax rate on commodity g
th0 (h)		Household h income tax rate
te0		Enterprise income tax rate
mrge0 (g, r)		Share of export margins by commodity g and country of destination r
tm0 (g, r)		Import tax rate on good g from region r
vtb0 (g, r)		VAT collected at borders tax rate on good g imported from region r

Prices

Variable	Definition
PY (g)	Price index for domestic formal production s
PIY (is)	Domestic price for home- consumed commodity good g
PD (g)	Domestic price for marketed commodity good g
PX (r, g)	Producer price index for exports of commodity g to region r
PA (g)	Price index for aggregate Armington supply for good g
PC (h)	Consumption price for composite good g consumed by household h
PT	Price for transportation and marketing margins
PG	Price index for government expenditures
PTRAN	Price for social transfers
PE	Price for distributed profits
PINV	Investment price for composite good g
PFX (r)	Exchange rate respect region r
PY0(s)	Reference price for formal sector s production gross of activity tax
PA0(g,s)	Reference price for intermediate composite good g employed in sector s gross of VAT rebate

Production

Variable	Definition
X(s)	Domestic production of exports in sector s
Y(s)	Domestic total production (exports + domestic uses) in sector s
IY(s)	Home- consumption of commodity of sector s
ES(r)	Exports according to destination r
A(s)	Domestic output of composite activity s
MG	Domestic output of composite margins
C(h)	Household h total consumption
G	Government total consumption
INVEST	Domestic output of composite investment good

Factors

Variable	Definition
PF (f)	Price for factor f
FA0 (f, s)	Factor f demand in activity s
FIA0 (f, is)	Factor f demand in activity is
HF0 (h)	Factor f income for household h
EF0	Factor demand f income for enterprises

Income and expenditures

Variable	Definition
CA0 (g,s)	Intermediate demand of composite good g in sector s
CIA0 (g, is)	Intermediate demand of composite good g in sector is
CH0 (g,h)	Final demand of household h for marketed good g
IAH0 (s, h)	Final demand of household h for home consumed products of sector is
C0 (h)	Aggregate household h consumption
HR0 (r,h)	Remittances of household h from region r
HSV0 (h,)	Household h savings
HE0 (h)	Household h distributed profits
HG0 (h)	Household h social transfers
TP0 ("YTAX", h)	Household h income tax

Variable	Definition
XE0 (r)	Enterprise payments to region *r*
ESV0	Enterprise savings
EG0	Enterprise social transfers
TE0 ("YTAX", h)	Enterprise income tax
GD0 (g)	Final government demand for composite good *g*
FSV0 (r)	Foreign savings from region *r*
GSV0	Government savings
GE0	Government distributed profits
MTX0 (r, g)	Import duties on good *g* from region *r*
VTX0 (r, g)	VAT on imports of good *g* from region *r*
CS (g)	Final investment demand for good *g*
TA0 ("ATAX", s)	Activity tax in sector *s*
TA0 ("REB", s)	VAT rebate in sector *s*
TC0 ("VTD", g)	Domestic VAT on good *g*
TC0 ("STAX", g)	Sales tax on good *g*

Scaling parameters

Parameter	Definition
fsav (r)	Scaling parameter on foreign savings from region *r*
gsav	Scaling parameter on government savings

Appendix C: The GAMS/MPSGE Code for the IFPRI Model

In this appendix we present the GAMS/MPSGE code to perform and evaluate our simulations. This code is mainly compose of 3 parts:

1) The SAM, presented in Appendix A, is called and imported into the GAMS code. Then, we check for SAM consistency imposing that rows sums equal columns sums (the notion of double- book keeping). Finally, we report if there are negative values or empty rows or columns.

2) The SAM is manipulated and we move from a square matrix with numeric indices to model-relevant subtraces with meaningful text labels. This relies on the concept of "*tuples*". According to Rutherford (2003) "*these are multidimensional sets which can associated a numeric index with a text index*". In our case the SAM has 37 rows and columns and in this part of the code it is broken down into 11 logical subsets, whose dimension is indicated in brackets:

```
Production activities            A(5)
Production informal activities   IA(5)
Commodities                      C(5)
Trade margins                    M(3)
Primary factors                  F(4)
Enterprises                      E(1)
Private households               H(2)
Government                       G(1)
Types of taxes                   T(7)
Rest of world                    X(3)
Investment- savings              I(1)
```

This allows us to divide the SAM into sub- matrices as in the map below. Note that the same labels are employed later in the code. All cells with no labels are empty.

	A	IA	C	M	F	E	H	G	T	X	I
A			ac								
IA							iah				
C	ca	cia		cm			ch	gd		er	cs
M			mc								
F	fa										
E					ef			eg			
H					hf	he		hg		hr	
G						ge			tr		
T	ta	tc				te	tp				
X		rc				xe					
I						esv	hsv	gsv		fsv	

3)The model itself is constructed. Using the MPSGE solver, we need zero profit conditions (block $sectors:), market clearing conditions (block $commodities:), and income balance (block $consumers:).

```
$TITLE An IFPRI CGE Model for Mozambique

$ontext
This model was developed to assess the impact of the Mozambican participation into the
Southern Africa Development Community (SADC). This code is part of the Ph.D. thesis "The
Mozambican Participation in SADC- A Liberalization Process trough Different Models and
Different Closures".
The study was conducted by Elisa Delpiazzo, under the supervision of Prof. Marco
Missaglia, University of Pavia. The analysis uses a GAMS/MPSGE CGE model based on the
2003 Mozambique SAM. The focus of the study is on examining the impact of a tariff
reduction as the one scheduled in the SADC Trade Protocol.
$offtext

set colorder /chk/;

set i SAM rows and column indices   /1*37/;

*SAM rows and columns are the same set:

alias (i,j);

table sam(i,j)  Base year social accounts

*Call the SAM from the worksheet in Excel format and import it in GAMS:

$call=xls2gms  i=sam5sectors2hhds3reg.xls   o=sam5sectors2hhds3reg.inc
$include sam5sectors2hhds3reg.inc
;

*Computation works best when features are around unit, so we scale the SAM values:

sam(i,j)        = sam(i,j)/1000;

display sam;

*Check the consistency of the SAM and report negative values and empty rows or columns:

parameter        samchk  Check of SAM consistency;
samchk(i) = (sum(j, sam(i,j)-sam(j,i)));
display samchk;
```

```
set   negval(i,j)   flag for negative elements;
negval(i,j) = yes$(sam(i,j)<0);
display negval;


set   empty(i,*)      flag for empty rows and columns;
empty(i, "row")= 1$(sum(j,sam(i,j))=0);
empty(j,"col")= 1$(sum(i,sam(i,j))=0);


display empty;


*Declare sets with which the SAM should be relabelled:


set     s     List of formal activities and commodities/
              AGRI     agriculture fishing forestry and breeding activities,
              MIN      mining,
              MAN      industry (food processing and beverages light and heavy
                       manufacturing metal products),
              TRADE    wholesales and retail trade,
              SERV     services/,


        is    List of informal activities and commodities/
              INF-AGRI    agriculture fishing forestry and breeding activities,
              INF-MIN     mining,
              INF-MAN     industry (food processing and beverages light and heavy
                          manufacturing metal products),
              INF-TRADE   wholesales and retail trade,
              INF-SERV    services/,


        m     Margins/
              TMD      domestic sales transactions costs,
              TMM      import transactions costs,
              TME      export transactions costs/,


        f     Factors of production/
              L1       unskilled labour,
              L2       semi-skilled labour,
              L3       skilled labour,
              K        capital/,


        h     Household /
              R-HHDS  rural households,
              U-HHDS  urban households /,


        e     Enterprise /ENTR/,


        t     Taxes/
```

```
                ATAX   Activity tax (subsidy),
                REB    Vat rebate (on intermediate uses),
                YTAX   Income tax (for households and private firms),
                VATB   VAT tax collected at borders (on imports gross of tariffs),
                VATD   VAT tax collected on domestic sales,
                STAX   Sales tax,
                MTAX   Import tax/,


        r    Regions/
                RSA       Republic of South Africa,
                ROSADC    Rest of SADC,
                ROW       Rest of World/


alias  (i,j),  (s,g),  (is,ig),  (m,mm);


*Mapping the activities:


Set     mapa(i,s) Mapping from SAM to formal activities/
                1.AGRI,
                2.MIN,
                3.MAN,
                4.TRADE,
                5.SERV /,


        mapia(i,is) Mapping from SAM to informal activities/
                6.INF-AGRI,
                7.INF-MIN,
                8.INF-MAN,
                9.INF-TRADE,
                10.INF-SERV /,


        mapc(i,g) Mapping from SAM to commodities/
                11.AGRI,
                12.MIN,
                13.MAN,
                14.TRADE,
                15.SERV /,


        mapf(i,f) Mapping from SAM to factors of production /
                16.L1,
                17.L2,
                18.L3,
                19.K /,


        mapm(i,m) Mapping from SAM to marketing margins /
                20.TMD,
                21.TMM,
```

```
          22.TME /,


     maph(i,h) Mapping from SAM to households /
          23.R-HHDS,
          24.U-HHDS /,


     mape(i) Mapping from SAM to enterprise account /25/,


     mapg(i)   Identifying government row          /26/,


     mapt(i,t) Mapping from SAM to source of taxes /
          27.REB,
          28.ATAX,
          29.VATD,
          30.VATB,
          31.MTAX,
          32.STAX,
          33.YTAX /,


      mapi(i)   Identifying the investment and saving row /34/,


     mapx(i,r) Identifying the rest of the world /
          35.RSA,
          36.ROSADC,
          37.ROW /;


set     ss/a, ia, c, m, f, e, h, g, t, x, i/


*Generate a report of submatrix totals:


parameter     totals(*,*)         SAM totals for reporting;
totals("a","c") = sum((mapa(i,s), mapc(j,g)), sam(i,j));
totals("ia","h") = sum((mapia(i,is), maph(j,h)), sam(i,j));
totals("c","a") = sum((mapc(i,g), mapa(j,s)), sam(i,j));
totals("c","ia") = sum((mapc(i,g), mapia(j,is)), sam(i,j));
totals("c","m") = sum((mapc(i,g), mapm(j,m)), sam(i,j));
totals("c","h") = sum((mapc(i,g), maph(j,h)), sam(i,j));
totals("c","g") = sum((mapc(i,g), mapg(j)), sam(i,j));
totals("c","x") = sum((mapc(i,g), mapx(j,r)), sam(i,j));
totals("c","i") = sum((mapc(i,g), mapi(j)), sam(i,j));
totals("m","c") = sum((mapm(i,m), mapc(j,g)), sam(i,j));
totals("f","a") = sum((mapf(i,f), mapa(j,s)), sam(i,j));
totals("f", "ia") = sum((mapf(i,f), mapia(j,is)), sam(i,j));
totals("e","f") = sum((mape(i),   mapf(j,f)), sam(i,j));
totals("e","g") = sum((mape(i),   mapg(j)), sam(i,j));
totals("h","f") = sum((maph(i,h), mapf(j,f)), sam(i,j));
totals("h","e") = sum((maph(i,h), mape(j)), sam(i,j));
```

```
totals("h","g") = sum((maph(i,h), mapg(j)), sam(i,j));
totals("h","x") = sum((maph(i,h), mapx(j,r)), sam(i,j));
totals("g","e") = sum((mapg(i),   mape(j)), sam(i,j));
totals("g","t") = sum((mapg(i),   mapt(j,t)), sam(i,j));
totals("t","a") = sum((mapt(i,t), mapa(j,s)), sam(i,j));
totals("t","c") = sum((mapt(i,t), mapc(j,g)), sam(i,j));
totals("t","e") = sum((mapt(i,t), mape(j)), sam(i,j));
totals("t","h") = sum((mapt(i,t), maph(j,h)), sam(i,j));
totals("x","c") = sum((mapx(i,r),   mapc(j,g)), sam(i,j));
totals("x","e") = sum((mapx(i,r),   mape(j)), sam(i,j));
totals("i","e") = sum((mapi(i),   mape(j)), sam(i,j));
totals("i","h") = sum((mapi(i),   maph(j,h)), sam(i,j));
totals("i","g") = sum((mapi(i),   mapg(j)), sam(i,j));
totals("i","x") = sum((mapi(i),   mapx(j,r)), sam(i,j));


alias (ss,sss);


totals(ss,"total") = sum(sss, totals(ss,sss));
totals("total",ss) = sum(sss, totals(sss,ss));


option totals:1;
display totals;


*Extract sub- matrices from the SAM. When a sub- matrix is extracted the associated
*values in the original SAM are set equal to zero.


*Extraction of domestic production- related data from SAM:


Parameter
        ca0(g,s)    Intermediate inputs demand for formal sectors,
        cia0(g,is)  Intermediate input demand for informal sectors,
        fa0(f,s)    Factor demand (or value added) for formal sectors,
        fia0(f,is)  Factor demand (or value added) for informal sectors,
        ta0(t,s)    Tax collection,
        iah0(is,h)  Household consumption of own production,
        ac0(s,g)    Marketed output,
        iac0(is)    production of informal sectors;


loop((mapc(i,g), mapa(j,s)),      ca0(g,s) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapia(j,is)),    cia0(g,is) = sam(i,j); sam(i,j)=0;);
loop((mapf(i,f), mapa(j,s)),      fa0(f,s) = sam(i,j); sam(i,j)=0;);
loop((mapf(i,f), mapia(j,is)),    fia0(f,is) = sam(i,j); sam(i,j)=0;);
loop((mapt(i,t), mapa(j,s)),      ta0(t,s) = sam(i,j); sam(i,j)=0;);
loop((mapia(i,is), maph(j,h)),    iah0(is,h) = sam(i,j); sam(i,j)=0;);
loop((mapa(i,s), mapc(j,g)),      ac0(s,g) = sam(i,j); sam(i,j)=0;);


iac0(is) = sum(h,iah0(is,h));
```

```
*Extraction of commodity demand components from SAM:


Parameter
        mc0(m,g)          Marketing and transportation costs,
        tc0(t,g)          Indirect taxes,
        rc0(r,g)          Value of imports at cif price,
        cm0(g,m)          Sales to wholesale and retail margins,
        gd0(g)            Government demand,
        er0(g,r)          Export (fob),
        cs0(g)            Investment demand,
        ch0(g,h)          Private consumption;


loop((mapm(i,m), mapc(j,g)),     mc0(m,g) = sam(i,j); sam(i,j)=0;);
loop((mapt(i,t), mapc(j,g)),     tc0(t,g) = sam(i,j); sam(i,j)=0;);
loop((mapx(i,r), mapc(j,g)),     rc0(r,g) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapm(j,m)),     cm0(g,m) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapg(j)),       gd0(g) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapx(j,r)),     er0(g,r) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapi(j)),       cs0(g) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), maph(j,h)),     ch0(g,h) = sam(i,j); sam(i,j)=0;);


*Extraction of factor- related data from SAM:


parameter
        hf0(h,f)     Factors income to households,
        ef0(f)       Factors income to enterprises;


loop((maph(i,h), mapf(j,f)),     hf0(h,f) = sam(i,j); sam(i,j)=0;);
loop((mape(i), mapf(j,f)),       ef0(f) = sam(i,j); sam(i,j)=0;);


*Extraction of household- related data from SAM:


parameter
        tp0(t,h)          Income tax payment by households
        he0(h)            Enterprise payment to households
        hg0(h)            Government transfer to households
        hr0(h,r)          Household income from abroad
        hsv0(h)           Household savings;


loop((mapt(i,t), maph(j,h)),     tp0(t,h) = sam(i,j); sam(i,j)=0;);
loop((maph(i,h), mape(j)),       he0(h) = sam(i,j); sam(i,j)=0;);
loop((maph(i,h), mapg(j)),       hg0(h) = sam(i,j); sam(i,j)=0;);
loop((maph(i,h), mapx(j,r)),     hr0(h,r) = sam(i,j); sam(i,j)=0;);
loop((mapi(i), maph(j,h)),       hsv0(h) = sam(i,j); sam(i,j)=0;);


*Extraction of enterprise- related data from SAM:
```

```
parameter
        te0(t)          Enterprise direct taxes
        ge0             Enterprise dividends paid to Government
        xe0(r)          Enterprise payments to foreigners
        esv0            Enterprise savings
        eg0             Government transfers to enterprise;


loop((mapt(i,t), mape(j)),      te0(t) = sam(i,j); sam(i,j)=0;);
loop((mapg(i), mape(j)),        ge0 = sam(i,j); sam(i,j)=0;);
loop((mapx(i,r), mape(j)),      xe0(r) = sam(i,j); sam(i,j)=0;);
loop((mapi(i), mape(j)),        esv0 = sam(i,j); sam(i,j)=0;);
loop((mape(i), mapg(j)),        eg0 = sam(i,j); sam(i,j)=0;);


*Extraction of other saving- related data from SAM:


parameter
        gsv0        Government saving
        fsv0(r)     Foreign saving;


loop((mapi(i), mapg(j)),     gsv0 = sam(i,j); sam(i,j)=0;);
loop((mapi(i), mapx(j,r)),   fsv0(r) = sam(i,j); sam(i,j)=0;);


*Extraction of other tax- related data from SAM:


parameter
        tr0(t)      Tax revenue;


loop((mapg(i), mapt(j,t)),      tr0(t) = sam(i,j); sam(i,j)=0;);


*Check if all values have been extracted from SAM:


display "All values should be zero if all data has been read:", sam;


display ca0,fa0,ta0,iah0,ac0,iac0,
        mc0,tc0,rc0,cm0,gd0,er0,cs0,ch0,
        hf0,ef0,
        tp0,he0,hg0,hr0,hsv0,
        te0,ge0,xe0,esv0,eg0,
        gsv0,fsv0,
        tr0;


*Introduction of tax and trade- related data:


table regtm(r,g) tariff revenue by country of origin and good
```

	AGRI	MIN	MAN
RSA	0.007	0.001	0.618
ROSADC	0.001	0	0.084
ROW	0.040	0.004	1.382

```
;


table regvatb(r,g)   vat collected at borders by country of origin and good
```

	AGRI	MIN	MAN	SERV
RSA	0.022	0.004	1.110	0.065
ROSADC	0.003	0	0.151	0.004
ROW	0.059	0.016	2.481	1.374

```
;


parameter
    mtx0(r,g)    total import duties on imports of good g from region r,
    tm0(g,r)     import tariff rate,
    vtx0(r,g)    total vat collected at borders on good g from region r,
    vtb0(g,r)    vat rate collected at borders on imports entering Armington supply;

mtx0(r,g) = regtm(r,g);
vtx0(r,g) = regvatb(r,g);
tm0(g,r)$rc0(r,g) = mtx0(r,g)/rc0(r,g);
vtb0(g,r)$rc0(r,g) = vtx0(r,g)/((1+tm0(g,r))*rc0(r,g));


display
mtx0, vtx0, tm0, vtb0;


*Manipulation of extracted values from SAM:


parameter
    at0(s)       activity tax (subsidies),
    rebt0(s)     vat rebate (on intermediate uses),
    st0(g)       sales tax,
    vtd0(g)      vat collected on domestic sold commodities entering Armington supply,
    th0(h)       household tax rate (on income from wages capital dividends and
                 transfers),
    et0          enterprise tax rate (on income from capital and transfers),
    as0(g)       total Armington supply,
    ex0(r,g)     exports of good G at producer price for region R,
    dm0(g)       domestic uses,
    ya0(g)       aggregate output from all sectors,
    c0(h)        total household consumption (own + marketed),
    ter0(g)      total exports of good G,
    tex0(r)      total exports to region R,
    mrge0(g,r)   export margin by country of destination and good
;
```

```
ter0(g) = sum(r, er0(g,r));

mrge0(g,r)$er0(g,r) = mc0("TME",g)*(er0(g,r)/ter0(g));

ex0(r,g) = er0(g,r) - mrge0(g,r);

tex0(r) = sum(g, ex0(r,g));

ya0(g) = max(sum(s, ac0(s,g)), ter0(g));

dm0(g) = ya0(g) - (sum(r, ex0(r,g)));

at0(s)$(not sum(g,ac0(s,g))=0) = ta0("ATAX",s)/sum(g,ac0(s,g));

rebt0(s)$(not(sum(g,ca0(g,s))=0)) = ta0("REB",s)/sum(g,ca0(g,s));

vtd0(g)$dm0(g) = tc0("VATD",g)/dm0(g);

th0(h) = tp0("YTAX",h)/(sum(f,hf0(h,f)) + he0(h) + hg0(h) + (sum(r,hr0(h,r))));

et0 = te0("YTAX")/(sum(f,ef0(f)) + eg0);

as0(g) = sum(r,rc0(r,g)) + sum(t,tc0(t,g)) + mc0("TMD",g) + mc0("TMM",g) + dm0(g);

st0(g)$as0(g) = tc0("STAX",g)/as0(g);

c0(h) = sum(g, ch0(g,h)) + sum(is, iah0(is,h));


display at0, rebt0, vtd0, th0, et0, as0, st0, ex0, ya0, dm0, ter0, tex0, mrge0;


parameter
py0(s)          Reference price of final activity products gross of activity tax,
pa0(g,s)        reference price of intermediate uses gross of VAT rebate;


py0(s)          = 1-at0(s);
pa0(g,s)        = 1+rebt0(s);


*Introduction of trade elasticities:


table elasticity(*,*) elasticities in CES and CET functions


               sigmaQ     sigmaT     RELASARM     RELACET
AGRI            2.1        2.1          5.8          5.8
MIN             3.1        3.1         13.2         13.2
MAN             2.6        2.6          6.7          6.7
TRADE           1.9        1.9          3.8          3.8
SERV            2.1        2.1          3.9          3.9
;


parameter


sigmaQ(s)    Elasticity of substitution between imports and domestic uses,
sigmaT(s)    Elasticity of transformation between exports and domestic uses,
relasarm(s)  Elasticity of substitution among imports from different origins,
relacet(s)   Elasticity of transformation among exports to different destinations;


sigmaQ(s) = elasticity(s,"sigmaQ");
sigmaT(s) = elasticity(s,"sigmaT");
relasarm(s) = elasticity(s,"relasarm");
```

```
relacet(s) = elasticity(s, "relacet");



$ontext
$model:moz


$sectors:
x(s)                        !allocation of output to domestic and export markets
y(s)                        !sectoral output (domestic production) for formal sectors
iy(is)$iac0(is)             !sectoral output (domestic production) for informal sectors
es(r)$tex0(r)               !export activity (applies margins) per destination
a(s)                        !aggregate supply (armington aggregate)
mg                          !transport margins
c(h)                        !household consumption
gd                          !government consumption
invest                      !aggregate investment


$commodities:
py(g)                       !output price for formal sectors
piy(is)$iac0(is)            !output price for informal sectors
pd(g)$dm0(g)                !domestic sales price
px(r,g)$ex0(r,g)            !export price
pa(g)                       !composite demand price for marketed output
pc(h)                       !household consumption price
pt                          !trade and transportation margins
pf(f)                       !factor prices
pg                          !government consumption price
pe                          !enterprise rents
pfx(r)                      !price of foreign exchange
pinv                        !price of investments
ptran                       !price of social transfers


$consumers:
ra(h)                       !private households
entr                        !private firms
govt                        !government
foreign(r)                  !foreigners


$auxiliary:
fsav(r)      !scaling parameter for foreign savings from region r
gsav         !scaling parameter for government savings


*Sectoral production combines primary factors and intermediates. the first sector
*produces market output and pays taxes, the second produces non- market output.


$prod:y(s)        s:0  va:0.5
o:py(g)           q:ac0(s,g)                a:govt    t:(at0(s))     p:py0(s)
```

```
i:pa(g)          q:ca0(g,s)                a:govt     t:(rebt0(s))  p:pa0(g,s)
i:pf(f)          q:fa0(f,s)     va:


$prod:iy(is)$iac0(is)        s:0   va:0.5
o:piy(is)          q:iac0(is)
i:pa(g)            q:cia0(g,is)
i:pf(f)            q:fia0(f,is)     va:


*Commodity supply to domestic and export markets is modelled as a constant
*elasticity of transformation function:


$prod:x(g)       td:relacet(g)   t(td):sigmaT(g)
o:pd(g)          q:dm0(g)
o:px(r,g)        q:ex0(r,g)
i:py(g)          q:ya0(g)


*Domestic production for export markets (at producer price) is decomposed into
*exports for different destinations (at final prices applying margins):


$prod:es(r)$tex0(r)
o:pfx(r)         q:(sum(g,er0(g,r)))
i:px(r,g)        q:ex0(r,g)
i:pt             q:(sum(g,mrge0(g,r)))


*Production of marketing and transportation services:


$prod:mg   s:0
o:pt             q:(sum((m,g),mc0(m,g)))
i:pa(g)          q:(sum(m, cm0(g,m)))


*Supply of Armington composite supply involves collection of import duties and
*other indirect taxes, the application of distribution margins:


$prod:a(g)       ddm:relasarm(g)   dm(ddm):sigmaQ(g)    d:0    m(dm):0
o:pa(g)          q:as0(g)                 a:govt    t:st0(g)
i:pd(g)          q:dm0(g)           d:    a:govt    t:vtd0(g)
i:pt             q:mc0("TMD",g)     d:
i:pfx(r)         q:rc0(r,g)         m:    a:govt    t:(vtb0(g,r)+(tm0(g,r)*(1+vtb0(g,r))))
i:pt             q:mc0("TMM",g)     m:


*Investment demand:


$prod:invest
o:pinv           q:(sum(g,cs0(g)))
i:pa(g)          q:cs0(g)


*Household demand for market and non- market goods and services:
```

```
$prod:c(h)
o:pc(h)          q:(sum(g,ch0(g,h)) + sum(is,iah0(is,h)))
i:pa(g)          q:ch0(g,h)
i:piy(is)        q:iah0(is,h)


*Government demand:
$prod:gd
o:pg             q:(sum(g,gd0(g)))
i:pa(g)          q:gd0(g)


*Household income and expenditures:


$demand:ra(h)
d:pc(h)          q:c0(h)
e:pf("l")        q:(hf0(h,"l")*(1-th(h)))            !labour income net of tax
e:pf("k")        q:(hf0(h,"k") *(1-th(h)))           !capital income net of tax
e:pfx(r)         q:(hr0(h,r) *(1-th(h)))             !remittances net of tax
e:pinv           q:(-hsv0(h))                        !private savings
e:pe             q:(he0(h) *(1-th(h)))               !distributed profits net of tax
e:ptran          q:(hg0(h) *(1-th(h)))               !social transfers net of tax


*Enterprise income and expenditures:


$demand:entr
d:pe             q:(sum(h,he0(h)) + ge0)
e:pf("k")        q:(ef0("k")*(1-et0))                !capital income net of tax
e:pfx(r)         q:(-xe0(r))                         !payments to foreigners
e:ptran          q:(eg0*(1-et0))                     !social transfers net of tax
e:pinv           q:(-(betaz)*(sum(g,cs0(g))))        !enterprise savings


*Government income and expenditures:


$demand:govt
d:pg             q:(sum(g,gd0(g)))
e:pinv           q:(-gsv0)                r:gsav     !government savings
e:ptran          q:(-(eg0+sum(h,hg0(h))))           !social trasnfers
e:pe             q:ge0                               !distributed profits
e:pf("k")        q:(sum(h, (hf0("k",h)*(th0(h)))))  !tax on household capital
e:pf("l")        q:(sum(h, (hf0("L",h)*(th0(h)))))  !tax on household labour
e:pfx(r)         q:(sum(h, (hr0(h,r)*(th0(h)))))    !tax on household
                                                       remittances
e:pe             q:(sum(h, (he0(h)*(th0(h)))))      !tax on household
                                                       distributed profits
e:ptran          q:(sum(h,hg0(h)*(th0(h))))         !tax on household social
                                                       transfers
e:pf("k")        q:(ef0("k")*(et0))                 !tax on enterprise capital
```

260

```
e:ptran          q:(eg0*(et0))                                        !tax on enterprise social
                                                                        transfers


*Foreigners' income and expenditures:


$demand:foreign(r)
d:pfx(r)         q:(sum(g,er0(g,r)))
e:pinv           q:(-fsv0(r))                      r:fsav(r)      !foreign savings
e:pfx(r)         q:(xe0(r))                                       !enterprise payments to
                                                                   foreigners
e:pfx(r)         q:(-sum(h,hr0(h,r)))                             !household remittances
e:pfx(r)         q:(sum(g,rc0(r,g)))                              !imports


*Complementarity condition for the scaling parameter fsav:


$constraint:fsav(r)


 fsav(r)*fsv0(r)*pinv =e= pfx(r)*((sum(g,rc0(r,g)))-(sum(g,er0(g,r)))+ (xe0(r))-
                          sum(h,hr0(h,r))) ;


*Complementarity condition for the scaling parameter gsav:


$constraint:gsav


 govt/pg =e= (sum(g,gd0(g)));


$report:
v:formprod(s,g) o:py(g)       prod:y(s)
v:inforprod(is) o:piy(is)     prod:iy(is)
v:import(r,g)   i:pfx(r)      prod:a(g)
v:export(r,g)   o:px(r,g)     prod:x(g)
v:exportfp(r)   o:pfx(r)      prod:es(r)
v:domuses(g)    o:pd(g)       prod:x(g)
v:margins       o:pt          prod:mg
v:intermed(g,s) i:pa(g)       prod:y(s)
v:factdeminf(f,is)  i:pf(f)   prod:iy(is)
v:factdem(f,s)  i:pf(f)       prod:y(s)
v:armington(g)  o:pa(g)       prod:a(g)
v:rinvest       o:pinv        prod:invest
v:rcons(h)      o:pc(h)       prod:c(h)
v:rgovt         o:pg          prod:gd
v:renter        d:pe          demand:entr


$offtext
$sysinclude mpsgeset  moz


*Initialization of the scaling parameters and choice of the appropriate closure rule.
```

261

```
km.L=1;

*If the closure rule is EXOGENOUS foreign savings put an asterix before these commands:
fsav.L(r)=1;
fsav.LO(r)= -inf;
**If the closure rule is ENDOGENOUS foreign savings put an asterix before the command:
fsav.FX(r)=1;
*If the closure rule is EXOGENOUS governmemnt savings put an asterix before these
commands:
gsav.L=1;
gsav.LO=-inf;
*If the closure rule is ENDOGENOUS government savings put an asterix before the command:
gsav.FX=1;

$include moz.gen
solve moz using mcp;

*Counterfactual: trade liberalization in the SADC area:

tm0(g,"rsa") = 0;
tm0(g,"rosadc") =0;

$include moz.gen
solve moz using mcp;
```

Appendix D: The "Bastard Keynesian" CGE Model Specifications

Indices

Index	Variable definition
s	Formal activities
	Aliases of *s*: *g*
	Elements of *s*:
	agri,
	min,
	man,
	trade,
	serv;
is	Informal activities
	Aliases of *is*: *ig*
	Elements of *is*:
	agri,
	min,
	man,
	trade,
	serv;
f	Factors of production
	Elements of *f*:
	lab,
	cap;
h	Households
	Elements of *h*:
	r-hhds,
	u-hhds;
r	Regions
	Elements of *r*:
	rsa,
	rosadc,
	row;

Appendix D

Parameters

Parameter	Symbol	Definition
va (s)		Elasticity of substitution among primary factors in the production function of sector s
sigmaT (s)	$\sigma^T{}_s$	Elasticity of transformation between domestic uses and exports in sector s
relacet (s)		Elasticity of transformation among exports to different destinations
sigmaQ (s)	$\sigma^Q{}_s$	Elasticity of substitution between domestic uses and imports of sector s
relasarm (s)		Elasticity of substitution among imports from different origins
at0 (s)		Activity tax rate for sector s
rebt0 (s)		VAT rebate tax rate for sector s
st0 (g)		Sales tax rate on commodity g
vtd0 (g)		VAT collected domestically tax rate on commodity g
th0 (h)		Household h income tax rate
te0		Enterprise income tax rate
mrge0 (g, r)		Share of export margins by commodity g and country of destination r
tm0 (g, r)		Import tax rate on good g from region r
vtb0 (g, r)		VAT collected at borders tax rate on good g imported from region r
alphaz(h)		Share of household h savings on total investments
betaz		Share of enterprise savings on total investments

Prices

Variable	Definition
PY (g)	Price index for domestic formal production s
PIY (is)	Domestic price for home- consumed commodity good g
PD (g)	Domestic price for marketed commodity good g
PX (r, g)	Producer price index for exports of commodity g to region r
PA (g)	Price index for aggregate Armington supply for good g
PC (h)	Consumption price for composite good g consumed by household h
PT	Price for transportation and marketing margins
PG	Price index for government expenditures
PTRAN	Price for social transfers
PE	Price for distributed profits
PINV	Investment price for composite good g
PFX (r)	Exchange rate respect region r
PY0(s)	Reference price for formal sector s production gross of activity tax
PA0(g,s)	Reference price for intermediate composite good g employed in sector s gross of VAT rebate

Appendix D

Production

Variable	Definition
X(s)	Domestic production of exports in sector *s*
Y(s)	Domestic total production (exports + domestic uses) in sector *s*
IY(s)	Home- consumption of commodity of sector *s*
ES(r)	Exports according to destination *r*
A(s)	Domestic output of composite activity *s*
MG	Domestic output of composite margins
C(h)	Household *h* total consumption
G	Government total consumption
INVEST	Domestic output of composite investment good

Factors

Variable	Definition
PF (f)	Price for factor *f*
FA0 (f, s)	Factor *f* demand in activity *s*
FIA0 (f, is)	Factor *f* demand in activity *is*
HF0 (h)	Factor *f* income for household *h*
EF0	Factor demand *f* income for enterprises

Income and expenditures

Variable	Definition
CA0 (g,s)	Intermediate demand of composite good *g* in sector *s*
CIA0 (g, is)	Intermediate demand of composite good *g* in sector *is*
CH0 (g,h)	Final demand of household *h* for marketed good *g*
IAH0 (s, h)	Final demand of household *h* for home consumed products of sector *is*
C0 (h)	Aggregate household *h* consumption
HR0 (r,h)	Remittances of household *h* from region *r*
HSV0 (h,)	Household *h* savings
HE0 (h)	Household *h* distributed profits
HG0 (h)	Household *h* social transfers
TP0 ("YTAX", h)	Household *h* income tax

Appendix D

Variable	Definition
XE0 (r)	Enterprise payments to region *r*
ESV0	Enterprise savings
EG0	Enterprise social transfers
TE0 ("YTAX", h)	Enterprise income tax
GD0 (g)	Final government demand for composite good *g*
FSV0 (r)	Foreign savings from region *r*
GSV0	Government savings
GE0	Government distributed profits
MTX0 (r, g)	Import duties on good *g* from region *r*
VTX0 (r, g)	VAT on imports of good *g* from region *r*
CS (g)	Final investment demand for good *g*
TA0 ("ATAX", s)	Activity tax in sector *s*
TA0 ("REB", s)	VAT rebate in sector *s*
TC0 ("VTD", g)	Domestic VAT on good *g*
TC0 ("STAX", g)	Sales tax on good *g*

Scaling parameters

Parameter	Definition
km	Scaling parameter on labour supply
fsav (r)	Scaling parameter on foreign savings from region *r*
gsav	Scaling parameter on government savings

Appendix E: The GAMS/MPSGE Code for the "Bastard Keynesian" Model

```
$TITLE A "Bastard Keynesian" CGE model for Mozambique

$ontext
This model was developed to assess the impact of the Mozambican participation into the
Southern Africa Development Community (SADC). This code is part of the Ph.D. thesis "The
Mozambican Participation in SADC- A Liberalization Process trough Different Models and
Different Closures".
The study was conducted by Elisa Delpiazzo, under the supervision of Prof. Marco
Missaglia, University of Pavia. The analysis uses a GAMS/MPSGE CGE model based on the
2003 Mozambique SAM. The focus of the study is on examining the impact of a tariff
reduction as the one scheduled in the SADC Trade Protocol.
$offtext


set colorder /chk/;


set i SAM rows and column indices   /1*35/;


*SAM rows and columns are the same set:


alias (i,j);


table sam(i,j)  Base year social accounts


*Call the SAM from the worksheet in Excel format and import it in GAMS:


$call=xls2gms  i=bksam.xls   o=bksam.inc
$include bksam.inc
;


*Computation works best when features are around unit, so we scale the SAM values:


sam(i,j)        = sam(i,j)/1000;


display sam;


*Check the consistency of the SAM and report negative values and empty rows or columns:
parameter       samchk  Check of SAM consistency;
samchk(i) = (sum(j, sam(i,j)-sam(j,i)));
display samchk;


set  negval(i,j)   flag for negative elements;
negval(i,j) = yes$(sam(i,j)<0);
```

```
display negval;

set   empty(i,*)      flag for empty rows and columns;
empty(i, "row")= 1$(sum(j,sam(i,j))=0);
empty(j,"col")= 1$(sum(i,sam(i,j))=0);

display empty;

*Declare sets  with which the SAM should be relabbeled:

set    s     List of formal activities and commodities/
             AGRI    agriculture fishing forestry and breeding activitities,
             MIN     mining,
             MAN     industry (food  processing  and  beverages  light  and  heavy
                     manufacturing metal products),
             TRADE   wholesales and retail trade,
             SERV    services/,

       is    List of informal activities and commodities/
             INF-AGRI   agriculture fishing forestry and breeding activitities,
             INF-MIN    mining,
             INF-MAN    industry (food  processing  and  beverages  light  and  heavy
                        manufacturing metal products),
             INF-TRADE  wholesales and retail trade,
             INF-SERV   services/,

       m     Margins/
             TMD     domestic sales transactions costs,
             TMM     import transactions costs,
             TME     export transactions costs/,

       f     Factors of production/
             L       labour,
             K       capital/,

       h     Household /
             RHHDS   rural households
             UHHDS   urban households/,

       e     Enterprise /ENTR/,

       t     Taxes/
             ATAX   Activity tax (subsidy),
             REB    Vat rebate (on intermediate uses),
             YTAX   Income tax (for households and private firms),
             VATB   VAT tax collected at borders (on imports gross of tariffs),
```

```
                      VATD    VAT tax collected on domestic sales,
                      STAX    Sales tax,
                      MTAX    Import tax/,


          r     Regions/
                      RSA        Republic of South Africa,
                      ROSADC  Rest of SADC,
                      ROW        Rest of World/


alias   (i,j), (s,g), (is,ig), (m,mm);


*Mapping the activities:


Set     mapa(i,s) Mapping from SAM to formal activities/
                      1.AGRI,
                      2.MIN,
                      3.MAN,
                      4.TRADE,
                      5.SERV /,


        mapia(i,is) Mapping from SAM to informal activities/
                      6.INF-AGRI,
                      7.INF-MIN,
                      8.INF-MAN,
                      9.INF-TRADE,
                      10.INF-SERV /,


        mapc(i,g) Mapping from SAM to commodities/
                      11.AGRI,
                      12.MIN,
                      13.MAN,
                      14.TRADE,
                      15.SERV /,


        mapf(i,f) Mapping from SAM to factors of production /
                      16.L,
                      17.K /,


        mapm(i,m) Mapping from SAM to marketing margins /
                      18.TMD,
                      19.TMM,
                      20.TME /,


        maph(i,h) Mapping from SAM to households /
                      21.RHHDS,
                      22.UHHDS/,
```

```
        mape(i) Mapping from SAM to enterprise account /23/,


        mapg(i) Identifying government row            /24/,


        mapt(i,t) Mapping from SAM to source of taxes /
                25.REB,
                26.ATAX,
                27.VATD,
                28.VATB,
                29.MTAX,
                30.STAX,
                31.YTAX /,


         mapi(i) Identifying the investment and saving row /32/,


        mapx(i,r) Mapping from SAM to the rest of the world /
                33.RSA,
                34.ROSADC,
                35.ROW /;


set     ss/a, ia, c, m, f, e, h, g, t, x, i/


*Generate a report of submatrix totals:


parameter      totals(*,*)        SAM totals for reporting;
totals("a","c") = sum((mapa(i,s), mapc(j,g)), sam(i,j));
totals("ia","h") = sum((mapia(i,is), maph(j,h)), sam(i,j));
totals("c","a") = sum((mapc(i,g), mapa(j,s)), sam(i,j));
totals("c","ia") = sum((mapc(i,g), mapia(j,is)), sam(i,j));
totals("c","m") = sum((mapc(i,g), mapm(j,m)), sam(i,j));
totals("c","h") = sum((mapc(i,g), maph(j,h)), sam(i,j));
totals("c","g") = sum((mapc(i,g), mapg(j)), sam(i,j));
totals("c","x") = sum((mapc(i,g), mapx(j,r)), sam(i,j));
totals("c","i") = sum((mapc(i,g), mapi(j)), sam(i,j));
totals("m","c") = sum((mapm(i,m), mapc(j,g)), sam(i,j));
totals("f","a") = sum((mapf(i,f), mapa(j,s)), sam(i,j));
totals("f", "ia") = sum((mapf(i,f), mapia(j,is)), sam(i,j));
totals("e","f") = sum((mape(i),    mapf(j,f)), sam(i,j));
totals("e","g") = sum((mape(i),    mapg(j)), sam(i,j));
totals("h","f") = sum((maph(i,h), mapf(j,f)), sam(i,j));
totals("h","e") = sum((maph(i,h), mape(j)), sam(i,j));
totals("h","g") = sum((maph(i,h), mapg(j)), sam(i,j));
totals("h","x") = sum((maph(i,h), mapx(j,r)), sam(i,j));
totals("g","e") = sum((mapg(i),    mape(j)), sam(i,j));
totals("g","t") = sum((mapg(i),    mapt(j,t)), sam(i,j));
totals("t","a") = sum((mapt(i,t), mapa(j,s)), sam(i,j));
totals("t","c") = sum((mapt(i,t), mapc(j,g)), sam(i,j));
```

```
totals("t","e") = sum((mapt(i,t), mape(j)), sam(i,j));
totals("t","h") = sum((mapt(i,t), maph(j,h)), sam(i,j));
totals("x","c") = sum((mapx(i,r),   mapc(j,g)), sam(i,j));
totals("x","e") = sum((mapx(i,r),   mape(j)), sam(i,j));
totals("i","e") = sum((mapi(i),    mape(j)), sam(i,j));
totals("i","h") = sum((mapi(i),    maph(j,h)), sam(i,j));
totals("i","g") = sum((mapi(i),    mapg(j)), sam(i,j));
totals("i","x") = sum((mapi(i),    mapx(j,r)), sam(i,j));


alias (ss,sss);


totals(ss,"total") = sum(sss, totals(ss,sss));
totals("total",ss) = sum(sss, totals(sss,ss));


option totals:1;
display totals;


*Extract sub- matrices from the SAM. When a sub- matrix is extracted the associated
*values in the original SAM are set equal to zero.


*Extraction of domestic production- related data from SAM:


Parameter
        ca0(g,s)    Intermediate inputs demand for formal sectors,
        cia0(g,is)  Intermediate input demand for informal sectors,
        fa0(f,s)    Factor demand (or value added) for formal sectors,
        fia0(f,is)  Factor demand (or value added) for informal sectors,
        ta0(t,s)    Tax collection,
        iah0(is,h)  Household consumption of own production,
        ac0(s,g)    Marketed output,
        iac0(is)    production of informal sectors;


loop((mapc(i,g), mapa(j,s)),      ca0(g,s) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapia(j,is)),    cia0(g,is) = sam(i,j); sam(i,j)=0;);
loop((mapf(i,f), mapa(j,s)),      fa0(f,s) = sam(i,j); sam(i,j)=0;);
loop((mapf(i,f), mapia(j,is)),    fia0(f,is) = sam(i,j); sam(i,j)=0;);
loop((mapt(i,t), mapa(j,s)),      ta0(t,s) = sam(i,j); sam(i,j)=0;);
loop((mapia(i,is), maph(j,h)),    iah0(is,h) = sam(i,j); sam(i,j)=0;);
loop((mapa(i,s), mapc(j,g)),      ac0(s,g) = sam(i,j); sam(i,j)=0;);


iac0(is) = sum(h,iah0(is,h));


*Extraction of commodity demand components from SAM:


Parameter
        mc0(m,g)        Marketing and transportation costs,
        tc0(t,g)        Indirect taxes,
```

```
        rc0(r,g)           Value of imports at cif price,
        cm0(g,m)           Sales to wholesale and retail margins,
        gd0(g)             Government demand,
        er0(g,r)           Export (fob),
        cs0(g)             Investment demand,
        ch0(g,h)           Private consumption;


loop((mapm(i,m), mapc(j,g)),     mc0(m,g) = sam(i,j); sam(i,j)=0;);
loop((mapt(i,t), mapc(j,g)),     tc0(t,g) = sam(i,j); sam(i,j)=0;);
loop((mapx(i,r), mapc(j,g)),     rc0(r,g) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapm(j,m)),     cm0(g,m) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapg(j)),       gd0(g) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapx(j,r)),     er0(g,r) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), mapi(j)),       cs0(g) = sam(i,j); sam(i,j)=0;);
loop((mapc(i,g), maph(j,h)),     ch0(g,h) = sam(i,j); sam(i,j)=0;);


*Extraction of factor- related data from SAM:


parameter
        hf0(f,h)     Factors income to households,
        ef0(f)       Factors income to enterprises;


loop((maph(i,h), mapf(j,f)),      hf0(f,h) = sam(i,j); sam(i,j)=0;);
loop((mape(i), mapf(j,f)),        ef0(f) = sam(i,j); sam(i,j)=0;);


*Extraction of household- related data from SAM:


parameter
        tp0(t,h)           Income tax payment by households
        he0(h)             Enterprise payment to households
        hg0(h)             Government transfer to households
        hr0(h,r)           Household income from abroad
        hsv0(h)            Household savings;


loop((mapt(i,t), maph(j,h)),      tp0(t,h) = sam(i,j); sam(i,j)=0;);
loop((maph(i,h), mape(j)),        he0(h) = sam(i,j); sam(i,j)=0;);
loop((maph(i,h), mapg(j)),        hg0(h) = sam(i,j); sam(i,j)=0;);
loop((maph(i,h), mapx(j,r)),      hr0(h,r) = sam(i,j); sam(i,j)=0;);
loop((mapi(i), maph(j,h)),        hsv0(h) = sam(i,j); sam(i,j)=0;);


*Extraction of enterprise- related data from SAM:
parameter
        te0(t)             Enterprise direct taxes
        ge0                Enterprise dividends paid to Government
        xe0(r)             Enterprise payments to foreigners
        esv0               Enterprise savings
        eg0                Government transfers to enterprise;
```

```
loop((mapt(i,t), mape(j)),       te0(t) = sam(i,j); sam(i,j)=0;);
loop((mapg(i), mape(j)),         ge0 = sam(i,j); sam(i,j)=0;);
loop((mapx(i,r), mape(j)),       xe0(r) = sam(i,j); sam(i,j)=0;);
loop((mapi(i), mape(j)),         esv0 = sam(i,j); sam(i,j)=0;);
loop((mape(i), mapg(j)),         eg0 = sam(i,j); sam(i,j)=0;);


*Extraction of other saving- related data from SAM:


parameter
        gsv0        Government saving
        fsv0(r)     Foreign saving;


loop((mapi(i), mapg(j)),     gsv0 = sam(i,j); sam(i,j)=0;);
loop((mapi(i), mapx(j,r)),   fsv0(r) = sam(i,j); sam(i,j)=0;);


*Extraction of other tax- related data from SAM:


parameter
        tr0(t)     Tax revenue;


loop((mapg(i), mapt(j,t)),     tr0(t) = sam(i,j); sam(i,j)=0;);


*Check if all values have been extracted from SAM:


display "All values should be zero if all data has been read:", sam;


display ca0,fa0,ta0,iah0,ac0,iac0,
        mc0,tc0,rc0,cm0,gd0,er0,cs0,ch0,
        hf0,ef0,
        tp0,he0,hg0,hr0,hsv0,
        te0,ge0,xe0,esv0,eg0,
        gsv0,fsv0,
        tr0;


*Introduction of tax- and trade- related data:


table regtm(r,g) tariff revenue by country of origin and good
```

	AGRI	MIN	MAN
RSA	0.007	0	0.619
ROSADC	0.001	0	0.084
ROW	0.040	0.005	1.381

```
;


table regvatb(r,g)   vat collected at borders by country of origin and good
```

	AGRI	MIN	MAN	SERV
RSA	0.022	0.004	1.110	0.065
ROSADC	0.003	0	0.151	0.004
ROW	0.059	0.016	2.481	1.374

;


```
parameter
    mtx0(r,g)    total import duties on imports of good g from region r,
    tm0(g,r)     import tariff rate,
    vtx0(r,g)    total vat collected at borders on good g from region r,
    vtb0(g,r)    vat rate collected at borders on imports entering Armington supply;


mtx0(r,g) = regtm(r,g);
vtx0(r,g) = regvatb(r,g);
tm0(g,r)$rc0(r,g) = mtx0(r,g)/rc0(r,g);
vtb0(g,r)$rc0(r,g) = vtx0(r,g)/((1+tm0(g,r))*rc0(r,g));


display
mtx0, vtx0, tm0, vtb0;


*Manipulation of extracted vlues from SAM:


parameter
    at0(s)       activity tax (subsidies),
    rebt0(s)     vat rebate (on intermediate uses),
    st0(g)       sales tax,
    vtd0(g)      vat collected on domestic saled commodities entering Armington supply,
    th0(h)       household tax  rate  (on  income  from  wages  capital  dividends  and
                 transfers),
    et0          enterprise tax rate (on income from capital and transfers),
    as0(g)       total Armington supply,
    ex0(r,g)     exports of good G at producer price for region R,
    dm0(g)       domestic uses,
    ya0(g)       aggregate output from all sectors,
    c0(h)        total household consumtpion (own + marketed),
    ter0(g)      total exports of good G,
    tex0(r)      total exports to region R,
    mrge0(g,r)   export margin by contry of destination and good,
    alphaz(h)    household h share on total investments,
    betaz        enterprise share in total investments,
    sr(h)        saving propensity for household h
;


ter0(g) = sum(r, er0(g,r));
mrge0(g,r)$er0(g,r) = mc0("TME",g)*(er0(g,r)/ter0(g));
ex0(r,g) = er0(g,r) - mrge0(g,r);
tex0(r) = sum(g, ex0(r,g));
```

```
ya0(g) = max(sum(s, ac0(s,g)), ter0(g));

dm0(g) = ya0(g) - (sum(r, ex0(r,g)));

at0(s)$(not sum(g,ac0(s,g))=0) = ta0("ATAX",s)/sum(g,ac0(s,g));

rebt0(s)$(not(sum(g,ca0(g,s))=0)) = ta0("REB",s)/sum(g,ca0(g,s));

vtd0(g)$dm0(g) = tc0("VATD",g)/dm0(g);

th0(h) = tp0("YTAX",h)/(sum(f,hf0(f,h)) + he0(h) + hg0(h) + (sum(r,hr0(h,r))));

et0 = te0("YTAX")/(sum(f,ef0(f)) + eg0);

as0(g) = sum(r,rc0(r,g)) + sum(t,tc0(t,g)) + mc0("TMD",g) + mc0("TMM",g) + dm0(g);

st0(g)$as0(g) = tc0("STAX",g)/as0(g);

c0(h) = sum(g, ch0(g,h)) + sum(is, iah0(is,h));

alphaz(h) = hsv0(h)/sum(g, cs0(g));

betaz = esv0/sum(g,cs0(g));

sr(h) = hsv0(h)/((1-th0(h))*(sum(f,hf0(f,h)) + he0(h) + hg0(h) + (sum(r,hr0(h,r)))));


display at0, rebt0, vtd0, th0, et0, as0, st0, ex0, ya0, dm0, ter0, tex0, mrge0, c0,
alphaz, betaz, sr;


parameter

py0(s)          Reference price for final activity products gross of activity tax,

pa0(g,s)        Reference price of intermediate uses gross of VAT rebate;


py0(s)          = 1-at0(s);
pa0(g,s)        = 1+rebt0(s);


*Introduction of trade elasticities:


table elasticity(*,*) elasticities in CES and CET functions
```

	sigmaQ	sigmaT	RELASARM	RELACET
AGRI	2.1	2.1	5.8	5.8
MIN	3.1	3.1	13.2	13.2
MAN	2.6	2.6	6.7	6.7
TRADE	1.9	1.9	3.8	3.8
SERV	2.1	2.1	3.9	3.9

```
;


parameter


sigmaQ(s)    Elasticity of substitution between imports and domestic uses,

sigmaT(s)    Elasticity of transformation between exports and domestic uses,

relasarm(s)  Elasticity of substitution among imports from different origins,

relacet(s)   Elasticity of transformation among exports to different destinations
;


sigmaQ(s) = elasticity(s,"sigmaQ");
sigmaT(s) = elasticity(s,"sigmaT");
relasarm(s) = elasticity(s,"relasarm");
```

```
relacet(s) = elasticity(s, "relacet");


$ontext
$model:moz


$sectors:
x(s)                        !allocation of output to domestic and export markets
y(s)                        !sectoral output (domestic production) for formal sectors
iy(is)$iac0(is)             !sectoral output (domestic production) for informal sectors
es(r)$tex0(r)               !export activity (applies margins) per destination
a(s)                        !aggregate supply (armington aggregate)
mg                          !transport margins
c(h)                        !household consumption
gd                          !government consumption
invest                      !aggregate investments


$commodities:
py(g)            !output price for formal sectors
piy(is)$iac0(is) !output price for informal sectors
pd(g)$dm0(g)     !domestic sales price
px(r,g)$ex0(r,g) !export price
pa(g)            !composite demand price for marketed output
pc(h)            !household consumption price
pt               !trade and transportation margins
pf(f)            !factor prices
pg               !government consumption price
pe               !enterprise rents
pfx(r)           !price of foreign exchange
pinv             !price of investments
ptran            !price of social transfers


$consumers:
ra(h)       !private households
entr        !private firms
govt        !government
foreign(r)  !foreigners


$auxiliary:
Km           !Keynesian multiplier
fsav(r)      !scaling parameter for foreign savings from region r
gsav         !scaling parameter for government savings


*Sectoral production combines primary factors and intermediates. The first sector
*produces market output ad pays taxes, the second produces non- market output.


$prod:y(s)       s:0  va:0.5
o:py(g)          q:ac0(s,g)              a:govt    t:(at0(s))     p:py0(s)
```

```
i:pa(g)          q:ca0(g,s)              a:govt     t:(rebt0(s))  p:pa0(g,s)
i:pf(f)          q:fa0(f,s)     va:


$prod:iy(is)$iac0(is)        s:0   va:0.5
o:piy(is)          q:iac0(is)
i:pa(g)            q:cia0(g,is)
i:pf(f)            q:fia0(f,is)    va:


*Commodity supply to domestic and export markets is modelled as a constant
*elasticity of transformation function:


$prod:x(g)       t:sigmaT(g)    tt(t):relacet(g)
o:pd(g)          q:dm0(g)
o:px(r,g)        q:ex0(r,g)     tt:
i:py(g)          q:ya0(g)


*Domestic production for export markets (at producer price) is decomposed
*into exports for different destinations (at final prices applying margins):


$prod:es(r)$tex0(r)
o:pfx(r)         q:(sum(g,er0(g,r)))
i:px(r,g)        q:ex0(r,g)
i:pt             q:(sum(g,mrge0(g,r)))


*Production of marketing and transportation services:


$prod:mg   s:0
o:pt              q:(sum((m,g),mc0(m,g)))
i:pa(g)           q:(sum(m, cm0(g,m)))


*Supply of Armington composite supply involves collection of import dulie and
*other indirect taxes, the application of distribution margins:


$prod:a(g)        ddm:relasarm(g)  dm(ddm):sigmaQ(g)    d:0    m(dm):0
o:pa(g)    q:as0(g)                        a:govt         t:st0(g)
i:pd(g)    q:dm0(g)            d:       a:govt         t:vtd0(g)
i:pt       q:mc0("TMD",g)    d:
i:pfx(r)   q:rc0(r,g)         m:       a:govt         t:(vtb0(g,r)+(tm0(g,r)*(1+vtb0(g,r))))
i:pt       q:mc0("TMM",g)    m:


*Household demand for market and non- market goods and services:


$prod:c(h)
o:pc(h)          q:c0(h)
i:pa(g)          q:ch0(g,h)
i:piy(is)        q:iah0(is,h)
```

```
*Government demand:


$prod:gd
o:pg            q:(sum(g,gd0(g)))
i:pa(g)         q:gd0(g)


*Investment demand:


$prod:invest
o:pinv          q:(sum(g,cs0(g)))
i:pa(g)         q:cs0(g)


*Household income and expenditures:


$demand:ra(h)
d:pc(h)         q:c0(h)
e:pf("k")       q:(hf0("k",h)*(1-th0(h)))          !capital income net of tax
e:pf("l")       q:(hf0("L",h)*(1-th0(h)))     r:km  !labour income net of tax
e:pfx(r)        q:(hr0(h,r)*(1-th0(h)))            !remittances net of tax
e:pe            q:(he0(h)*(1-th0(h)))              !distributed profits net of
                                                   tax
e:ptran         q:(hg0(h)*(1-th0(h)))             !social transfers net of tax
e:pinv          q:(-alphaz(h)*(sum(g,cs0(g))))    !private savings


*Enterprise income and expenditures:


$demand:entr
d:pe            q:(sum(h,he0(h)) + ge0)
e:pf("k")       q:(ef0("k")*(1-et0))               !capital income net of tax
e:pfx(r)        q:(-xe0(r))                         !payments to foreigners
e:ptran         q:(eg0*(1-et0))                     !social transfers net of tax
e:pinv          q:(-(betaz)*(sum(g,cs0(g))))        !enterprise savings


*Government income and expenditures:


$demand:govt
d:pg            q:(sum(g,gd0(g)))
e:pinv          q:(-gsv0)                    r:gsav  !government savings
e:ptran         q:(-(eg0+sum(h,hg0(h))))             !social trasnfers
e:pe            q:ge0                                !distributed profits
e:pf("k")       q:(sum(h, (hf0("k",h)*(th0(h)))))    !tax on household capital
e:pf("l")       q:(sum(h, (hf0("L",h)*(th0(h)))))  r:km  !tax on household labour
e:pfx(r)        q:(sum(h, (hr0(h,r)*(th0(h)))))      !tax on household
                                                      remittances
e:pe            q:(sum(h, (he0(h)*(th0(h)))))        !tax on household
                                                      distributed profits
```

278

```
e:ptran          q:(sum(h,hg0(h)*(th0(h))))                          !tax on household social
                                                                       transfers
e:pf("k")        q:(ef0("k")*(et0))                    !tax on enterprise capital
e:ptran          q:(eg0*(et0))                         !tax on enterprise social
                                                                       transfers


*Foreigners' income and expenditures:

$demand:foreign(r)
d:pfx(r)         q:(sum(g,er0(g,r)))
e:pinv           q:(-fsv0(r))                    r:fsav(r)    !foreign savings
e:pfx(r)         q:(xe0(r))                                  !enterprise payments to
                                                                 foreigners
e:pfx(r)         q:(-sum(h,hr0(h,r)))                        !household remittances
e:pfx(r)         q:(sum(g,rc0(r,g)))                         !imports


*Complementarity condition for the scaling parameter km:

$constraint:km

 sum(h,ra(h)) =e= sum(h,((1-sr(h))*(1-th0(h))*(hf0("l",h)*pf("l")+hf0("k",h)*pf("k") +
                 he0(h) *pe+ hg0(h)*pg + (sum(r,hr0(h,r)*pfx(r))))));


*Complementarity condition for the scaling parameter fsav:

$constraint:fsav(r)

 fsav(r)*fsv0(r)*pinv =e= pfx(r)*((sum(g,rc0(r,g)))-(sum(g,er0(g,r)))+ (xe0(r))-
                         sum(h,hr0(h,r))) ;


*Complementarity condition for the scaling parameter gsav:

$constraint:gsav

 govt/pg =e= (sum(g,gd0(g)));


$report:
v:formprod(s,g) o:py(g)       prod:y(s)
v:inforprod(is) o:piy(is)     prod:iy(is)
v:import(r,g)   i:pfx(r)      prod:a(g)
v:export(r,g)   o:px(r,g)     prod:x(g)
v:exportfp(r)   o:pfx(r)      prod:es(r)
v:domuses(g)    o:pd(g)       prod:x(g)
v:margins       o:pt          prod:mg
v:intermed(g,s) i:pa(g)       prod:y(s)
v:factdeminf(f,is)  i:pf(f)   prod:iy(is)
v:factdem(f,s)  i:pf(f)       prod:y(s)
```

```
v:armington(g)   o:pa(g)       prod:a(g)

v:rinvest        o:pinv        prod:invest

v:rcons(h)       o:pc(h)       prod:c(h)

v:rgovt          o:pg          prod:gd

v:renter         d:pe          demand:entr


$offtext
$sysinclude mpsgeset  moz


*Initialization of the scaling parameters and choice of the appropriate closure rule.


km.L=1;


*If the closure rule is EXOGENOUS foreign savings put an asterix before these commands:
fsav.L(r)=1;
fsav.LO(r)= -inf;
**If the closure rule is ENDOGENOUS foreign savings put an asterix before the command:
fsav.FX(r)=1;
*If the closure rule is EXOGENOUS governmemnt savings put an asterix before these
commands:
gsav.L=1;
gsav.LO=-inf;
*If the closure rule is ENDOGENOUS government savings put an asterix before the command:
gsav.FX=1;


$include moz.gen
solve moz using mcp;


*Counterfactual: trade liberalization in the SADC area:


tm0(g,"rsa") = 0;
tm0(g,"rosadc") =0;


$include moz.gen
solve moz using mcp;
```

Appendix F: The 2003 Structuralist/ Post- Keynesian SAM

	Y	IY	Supply	Marg	Enter	Rhhds	Uhhds	Govt	Row	Invest
Y	148,354		-148,354							
IY		26,224				-26,224				
Supply	-51,377	-5,743	171,805	-21,034		-9165	-25,154	-14,745	-30,526	-14,061
w	-53,185	-15,856				40,923	28,118			
r	-29,617	-2,664			32,281					
Atax	190							-190		
VATreb	3,178							-3,178		
VATb	-1,446	-162				-697	-1,914	5,289		-1,070
Mtax	-585	-65				-282	-773	2,137		-432
VATd			-4,027					4,027		
Stax			-2,468					2,468		
Dtax					-925	-133	-2,071	3,129		
TMD			-15,783	15,783						
TMM	-1,115	-125		4,078		-538	-1,475			-825
TME			-1,173	1,173						
Row	-14,397	-1,609			-3,833	-6,938	-19,043		56,465	-10,645
SAV					-1,673	-445	-1,837	-1,518	-24,596	27033
Transf					146	117	294	-577		
Rem							1,343		-1,343	
Dprof					25,996	3,382	22,512	102		

Source: *Author's own calculations*

Note: features are Billion MTs

     The SAM above is expressed in its MCM format (see chapter 1 for an explanation of MCMs)

Appendix G: The Structuralist/ Post- Keynesian CGE Model Specifications

Indices

Index	Variable definition
s	Formal activities
	Informal activities
	Aliases of s: g
h	Households
	Elements of h:
	r-hhds,
	u-hhds;

Parameters

Parameter	Symbol	Definition
b(s)		Input- Output coefficient for labour in sector s
shvaz (s)		Share of value added in sector s
tau (s)		Mark- up rate in sector s
a0 (s)		Input- Output coefficient for domestic intermediates used in sector s
a1 (s)		Input- Output coefficient for imported intermediates (net of taxes and margins) in sector s
at0 (s)		Activity tax rate for sector s
rebt0 (s)		VAT rebate tax rate for sector s
st0 (g)		Sales tax rate on commodity g
vtd0 (g)		VAT collected domestically tax rate on commodity g
th0 (h)		Household h income tax rate
te0		Enterprise income tax rate
mgm0		Share of margins per unitary imports
tm0 (g, r)		Import tax rate on good g from region r
vtb0 (g, r)		VAT collected at borders tax rate on good g imported from region r
rho	ρ	Price elasticity in the final import demand function
sigma	σ	Income elasticty in the final import demand function
beta1		Share of imports in total capital formation
beta2		Share of domestic goods in total capital formation

Appendix G

Prices

Variable	Definition
PY (g)	Price index for domestic formal production *s*
PA	Final price for domestic products
PC (h)	Consumption price for composite good *g* consumed by household *h*
PT	Price for transportation and marketing margins
PG	Price index for government expenditures
PTRAN	Price for social transfers
PE	Price for distributed profits
PINV	Investment price for composite good *g*
PFX (r)	Exchange rate respect region *r*
PIM	Price of imports in domestic currency
PY0(s)	Reference price for formal sector *s* production gross of activity tax
RPL(s)	Reference price for labour employed in sector *s*
RPI(s)	Reference price for domestic intermediates
RPII(s)	Reference preice for imported intermediates
Pstar	Price of imports in foreign currency
Pbar	Price of exports in foreign currency

Production

Variable	Definition
Y(s)	Domestic total production in sector *s*
FINIMP	Final imports
X	Exports
COMMX	Domestic supply
MG	Domestic output of composite margins
C(h)	Household *h* total consumption
GD	Government total consumption
INVEST	Domestic output of composite investment good

Factors

Variable	Definition
W(s)	Wage rate for labour employed in sector *s*
FA0 (f, s)	Factor *f* demand in activity *s*
WAGEINC (h)	Factor *f* income for household *h*

Income and expenditures

Variable	Definition
DCH0 (h)	Final demand of household h for domestic good
CH0ME (s, h)	Final demand of household h for home consumed products of sector is
C0 (h)	Aggregate household h consumption
HR0 (h)	Remittances of household h from abroad
HSV0 (h,)	Household h savings
HE0 (h)	Household h distributed profits
HG0 (h)	Household h social transfers
XE0	Enterprise payments to foreigners
ESV0	Enterprise savings
EG0	Enterprise social transfers
GD0	Final government demand
DGD0	Final government demand for domestic goods
FSV0	Foreign savings
GSV0	Government savings
GE0	Government distributed profits
MTAX	Import duties on good g from region r
VATB	VAT on imports of good g from region r
DCS	Final investment demand for domestic good
INV	Aggregate total investments
ATAX (s)	Activity tax in sector s
VATREB (s)	VAT rebate in sector s
VATD	Domestic VAT on good g
STAX	Sales tax on good g

Foreign sector

Variable	Definition
NMINT(s)	Net Imported intermediate used in sector s
MINT(s)	Imported intermediates used in sector s (gross of taxes and margins)
NMC0(h)	Net household h consumption of imported goods
MC0(h)	Housheold h consumption of imported goods (gross of taxes and margins)
NMCS	Net imported goods in capital formation
MCS	Imported goods in capital formation (gross of taxes and margins)

Scaling parameters

Parameter	Definition
km	Scaling parameter on labour supply (Keynesian multiplier)
fsav	Scaling parameter on foreign savings
gsav	Scaling parameter on government savings

Appendix H: The GAMS/ MPSGE Code for the Structuralist/ Post-Keynesian Model

```
$TITLE A Structuralist/ Post- Keynesian CGE Model for Mozambique

$ontext
This model was developed to assess the impact of the Mozambican participation into the
Southern Africa Development Community (SADC).
This code is part of the Ph.D. thesis "The Mozambican Participation in SADC- A
Liberalization Process trough Different Models and Different Closures".
The study was conducted by Elisa Delpiazzo, under the supervision of Prof. Marco
Missaglia, University of Pavia.
The analysis uses a GAMS/MPSGE CGE model based on the 2003 Mozambique SAM.
The focus of the study is on examining the impact of a tariff reduction as the one
scheduled in the SADC Trade Protocol.
$offtext


*Define the sets of the model, to use them in the vectorial language of the model:

sets  s  /Y  formal production sector,
          IY informal production sector/,

      h  /RHHDS rural households,
         UHHDS urban households/
alias(s,g)
;


*Data are inserted in a SAM (in MCM format:
)
table sam(*,*)
```

	Y	IY	SUPPLY	MARG	ENTER	RHHDS	UHHDS	GOVT	ROW	INVEST
Y	148.354		-148.354							
IY		26.224				-26.224				
SUPPLY	-51.377	-5.743	171.805	-21.034		-9.165	-25.154	-14.745	-30.526	-14.061
W	-53.185	-15.856				40.923	28.118			
R	-29.617	-2.664			32.281					
ATAX	0.190							-0.190		
VATREB	3.178							-3.178		
VATB	-1.446	-0.162				-0.697	-1.914	5.289		-1.070
MTAX	-0.585	-0.065				-0.282	-0.773	2.137		-0.432
VATD			-4.027					4.027		
STAX			-2.468					2.468		
DIRTAX						-0.925	-0.133	-2.071	3.129	
TMD			-15.783	15.783						
TMM	-1.115	-0.125		4.078		-0.538	-1.475			-0.825
TME			-1.173	1.173						
ROW	-14.397	-1.609				-3.833	-6.938	-19.043	56.465	-10.645
SAV						-1.673	-0.445	-1.837	1.518	-24.596
TRANSF						0.146	0.117	0.294	-0.557	
REM								1.343	-1.343	
PROF					-25.996	3.382	22.512	0.102		

```
;


*Declare parameters:

parameters
rho           Price elasticity in final import function /-0.418/
sigma         Income elasticity in final import function /1.553/
Pstar         foreign price of imports /1/
Pbar          foreign price of exports /1/
wz(s)         Sector s wage rate in the benchmark
mx(s)         Marketed production of sector s
nmx(s)        Non- marketed production of sector s
gdpz(s)       Total production of sector s
wbill(s)      Wage bill in sector s
b(s)          Input- Output coefficient for labour of sector s
shvaz(s)      Share of value added on GDP in sector s
mrk(s)        Mark- up income in sector s
tau(s)        mark- up rate in sector s
mint(s)       Imported intermediates (gross of taxes and margins) used in sector s
dint(s)       Domestic intermediate (gross of taxes and margins) used in sector s
a0(s)         Domestic intermediate input- output coefficient in sector s
```

```
a1(s)              Imported intermediate (net of taxes and margins) input- output
                    coefficient in sector s
atax(s)            Activity tax (subsidy) in sector s
at0(s)             Activity tax rate in sector s
vatreb(s)          VAT rebate on intermediates used in sector s
rebt0(s)           VAT rebate rate on intermediates used in sector s
nmint(s)           Net imported intermediates used in sector s
vatb               Total VAT collected at borders
vtb0               Tax rate of VAT collected at borders
mtax               Total import duties
tm0                Tax rate on imports
fimp               Final imports (gross of taxes and margins)
nfimp              Net final imports (cif prices)
mrgm               Total margins on imports
imrgm(s)           Total margins on intermediate imports (cif) used in sector s
mgm0               Margins per unit of imports
dm(s)              Ttal domestic uses
exdp               Exports gross of margins
vatd               Total VAT on domestic commodity
vtd0               VAT rate on domestic commodities
stax               Total sales tax
st0                Sales tax rate
mrgd               Total margins on domestic produced goods
ts                 Total supply of domestic final goods
exp                exports net of margins
mrge               Total margins on exports
wageinc(h)         Wage income for housheold h
hr0(h)             Remittances from abroad of household h
mc0(h)             Consumption of imports of household h (gross)
nmc0(h)            Net consumption of imports of household h
c0(h)              Total consumption of household h
dtax(h)            Total direct tax of household h
th0(h)             Direct tax rate of household h
hsv0(h)            Total savings of household h
sh0(h)             Saving rate of household h
hg0(h)             Total social transfers to household h
he0(h)             Total distributed profits to household h
dch0(h)            Total consumption of domestic good of household h
chome(s,h)         Home consumption of goods of sector s of household h
mkincome           Total mark- up income
xe0                Total payments to foreigners
dtaxe              Total direct tax for enterprises
te0                Direct tax rate for enterprises
esv0               Total savings enterprise
se0                Saving rate for enterprise
eg0                Total social transfers to enterprises
gsv0               Government savings
ge0                Total distributed profits to government
dgd0               Total government expenditures in domestic goods
gd0                Aggregate total government expenditures
mcs                Total investments in imported goods (gross of taxes and margins)
nmcs               Net total investments in imported goods
inv                Total aggregate investments
dcs                Total investments in domestic goods
fsv0               Foreign savings
py0(s)             Reference price for final production of sector s
rpl(s)             Reference price for labour
rpi(s)             Reference price intermediate domestic
rpii(s)            Reference price intermediate imported
beta1              Share of imports in total capital formation
beta2              Share of domestic goods in total capital formation
;


*Extraction of data from the SAM.

wz(s)=1;
mx(s)= -sam(s,"supply");
nmx(s)= -sam(s,"rhhds");
wbill(s)= -sam("w",s);
```

```
mrk(s)= -sam("r",s);
nmint(s)= -sam("row",s);
dint(s)= -sam("supply",s);
atax(s)= sam("atax",s);
vatreb(s)= sam("vatreb",s);
vatb= sam("vatb","govt");
mtax= sam("mtax","govt");
imrgm(s) = -sam("tmm",s);
mrgm= sam("tmm","marg");
dm(s)= -sam(s,"supply");
exdp= -sam("supply","row");
vatd= sam("vatd","govt");
stax= sam("stax","govt");
mrgd= sam("tmd","marg");
ts= sam("supply","supply");
mrge= sam("tme","marg");
wageinc(h)= sam("w",h);
hr0(h)= sam("rem",h);
nmc0(h)= -sam("row",h);
dtax(h)= -sam("dirtax",h);
hsv0(h)= -sam("sav",h);
hg0(h)= sam("transf",h);
he0(h)= sam("prof",h);
dch0(h)= -sam("supply",h);
chome(s,h)= -sam(s,h);
mkincome= sam("r","enter");
xe0= -sam("row","enter");
dtaxe= -sam("dirtax","enter");
esv0= -sam("sav","enter");
eg0= sam("transf","enter");
gsv0= -sam("sav","govt");
ge0= sam("prof","govt");
dgd0= -sam("supply","govt");
nmcs= -sam("row","invest");
dcs= -sam("supply","invest");
fsv0= -sam("sav","row");

*Manipulation of data:

gdpz(s)= mx(s)+nmx(s);
mint(s)= nmint(s)- sam("mtax",s)- sam("vatb",s)- sam("tmm",s);
nfimp= nmcs+(sum(h,nmc0(h)));
fimp= nfimp-sum(h,sam("mtax",h))-sum(h,sam("vatb",h))-sum(h,sam("tmm",h))-
            sam("mtax","invest")-sam("vatb","invest")-sam("tmm","invest");
mgm0= mrgm/(nfimp+sum(s,nmint(s)));
exp= exdp-mrge;
mc0(h)=nmc0(h)+(-sam("vatb",h))+(-sam("mtax",h))+(-sam("tmm",h));
mcs= nmcs+(-sam("mtax","invest"))+(-sam("vatb","invest"))+(-sam("tmm","invest"));
c0(h)= dch0(h)+mc0(h)+(sum(s,chome(s,h)));
inv= mcs+dcs;

*Alternative definitions of tau:

*tau(s) =((gdpz(s)+atax(s))/(gdpz(s)+atax(s)-mrk(s)))-1;
tau(s)= mrk(s)/(wbill(s)+mint(s)+dint(s)-vatreb(s));
*tau(s)=   (gdpz(s)+atax(s)-wbill(s)-mint(s)-dint(s)+vatreb(s))/(wbill(s)+mint(s)+dint(s)-
*vatreb(s));

*Manipulation of tax rates:

at0(s)$mx(s)= atax(s)/mx(s);
rebt0(s)= vatreb(s)/(mint(s)+dint(s));
tm0= mtax/(nfimp+(sum(s,nmint(s))));
vtd0$(not sum(s,dm(s))=0)= vatd/(sum(s,dm(s)));
vtb0= vatb/(sum(s,nmint(s))+nfimp+mtax);
st0= stax/ts;
th0(h)= dtax(h)/(wageinc(h)+hr0(h)+hg0(h)+he0(h));
te0= dtaxe/(mkincome+eg0);

*Definition of reference prices:
```

```
py0(s) = 1-at0(s);
rpl(s)= 1+tau(s);
rpi(s)= 1-rebt0(s);
rpii(s)= ((1+tm0)-rebt0(s));


*Parameters calibrated on the benchmark:

b(s)= wbill(s)/(wz(s)*gdpz(s));
shvaz(s)= (wbill(s)+mrk(s))/gdpz(s);
a0(s)= dint(s)/gdpz(s);
a1(s)= nmint(s)/gdpz(s);
sh0(h)= hsv0(h)/(wageinc(h)+hr0(h)+hg0(h)+he0(h)-dtax(h));
se0= esv0/(mkincome+eg0-dtaxe);
beta1=mcs/inv;
beta2=(1-beta1);


*Show values for parameters:

Display
wz,mx,nmx,wbill,mrk,nmint,dint,atax,vatreb,vatb,mtax,imrgm,mrgm,dm,
exdp,vatd,stax,mrgd,ts,mrge,wageinc,hr0,nmc0,dtax,hsv0,hg0,he0,dch0,
chome,mkincome,xe0,dtaxe,esv0,eg0,gsv0,ge0,dgd0,nmcs,dcs,fsv0,
gdpz,mint,nfimp,fimp,mgm0,exp,mc0,mcs,c0,inv,tau,at0,rebt0,tm0,
vtd0,vtb0,st0,th0,te0,py0,rpl,rpi,rpii,b,shvaz,a0,a1,sh0,se0,beta1,beta2;


$ontext
$model:moz

$sectors:
y(s)          !domestic productive sectors (formal and informal)
finimp        !production of final imports
commx         !supply of domestic goods
x             !production of exports at final prices
mg            !production of wholesale and retail margins
invest        !aggregate investment
c(h)          !household consumption
gd            !government consumption


$commodities:
py(s)         !output price for domestic production (formal and informal)
w             !wage rate
pfx           !exchange rate
pim           !import price (in domestic currency)
pt            !margin price
pinv          !price of investments
pg            !price of government consumption
pe            !price of distributed profits
pa            !price of marketed domestic production (gross of taxes and margins)
pc(h)         !price of household consumption
ptran         !price of social transfers


$consumers:
ra(h)         !households
entre         !enterprises
govt          !government
foreign       !foreigners


$auxiliary:
km            !keynesian multiplier
gsav          !scaling parameter for government savings
fsav          !scaling parameter foreign savings
FINALIMPORT   !final imports (to insert the demand function)
INTIMP        !intermediate imports (to insert the demand function)


*Sectoral   production   combines   variable   costs   (labour,   imported   and   domestic
*intermediates) and a profit mark- up.
*Formal sector earns activity subsidies as Activity tax and VAT rebate.
```

```
$prod:y(s)        d:0   va:0
o:py(s)  q:gdpz(s)              p:py0(s)    a:govt    t:(-at0(s))
i:w      q:wbill(s)             p:rpl(s)    a:entre   t:((1-te0)*tau(s))
                                            a:govt    t:(te0*tau(s))
i:pa     q:dint(s)              p:rpi(s)    a:entre   t:((1-te0)*tau(s)*(1-rebt0(s)))
                                            a:govt    t:((te0*tau(s)*(1-rebt0(s)))-rebt0(s))
i:pfx    q:(nmint(s)*pstar)     p:rpii(s)   d:0
                                a:entre   t:((1-te0)*tau(s)*((1+tm0)*(1+vtb0)+mgm0)*(1-rebt0(s)))
                                a:govt    t:((te0*tau(s)*((1+tm0)*(1+vtb0)+mgm0)*(1-
                                rebt0(s)))+((1-rebt0(s))*(tm0*(1+vtb0)+vtb0)-rebt0(s)*(1+mgm0)))
i:pt     q:imrgm(s)     d:0

*Final imports is the aggregation of final uses of imports and transaction margins.
*It involves the collection of a part of import duties and other indirect taxes:

$prod:finimp
o:pim    q:fimp
i:pfx    q:(nfimp*pstar)                    a:govt    t:(tm0*(1+vtb0)+vtb0)
i:pt     q:(mrgm-(sum(s,imrgm(s))))

*Commodity supply of domestic products involves collection of indirect taxes and
*the application of distribution margins:

$prod:commx
o:pa     q:ts                   a:govt t:st0
i:py(s)  q:dm(s)                a:govt t:vtd0
i:pt     q:mrgd
i:pt     q:mrge

*Export transformation into foreign currency:

$prod:x
o:pfx    q:(Pbar*exdp)
i:pa     q:exdp

*Production of marketing and transportation margins:

$prod:mg     s:0
o:pt     q:(mrgd+mrge+mrgm)
i:pa     q:(mrgd+mrge+mrgm)

*Investment demand:

$prod:invest  s:0
o:pinv   q:inv
i:pim    q:(beta1*inv)
i:pa     q:(beta2*inv)

*Household demand for non-marketed, domestic and imported goods and services:

$prod:c(h)
o:pc(h)  q:c0(h)
i:pim    q:mc0(h)
i:pa     q:dch0(h)
i:py(s)  q:chome(s,h)

*Government demand for goods and services:

$prod:gd
o:pg     q:gd0
i:pa     q:dgd0

*Household income and expenditures:

$demand:ra(h)
d:pc(h)  q:c0(h)
e:w      q:((1-th0(h))*wageinc(h))      r:km     !net income out of wages
e:ptran  q:((1-th0(h))*hg0(h))                   !net income out of social transfers
e:pe     q:((1-th0(h))*he0(h))                   !net income out of distributed profits
e:pfx    q:((1-th0(h))*hr0(h))                   !net income out of remittances
```

```
e:pinv    q:(-hsv0(h))                              !private savings


*Enterprises' income and expenditures:

$demand:entre
d:pe      q:(sum(h,he0(h))+ge0)
e:pfx     q:(-xe0)                            !payments to foreigners
e:pinv    q:(-esv0)                           !enterprises savings
e:ptran   q:(eg0*(1-te0))                     !net income out of social transfers


*Government income and expenditures:

$demand:govt
d:pg      q:gd0
e:ptran   q:(-eg0-sum(h,hg0(h)))                  !social payments
e:pe      q:ge0                                   !distributed profits
e:pinv    q:(-gsv0)                  r:gsav       !governmemnt savings
e:w       q:(sum(h,(th0(h)*wageinc(h))))  r:km    !direct taxes out of wage income of
                                                   households
e:ptran   q:(sum(h,th0(h)*hg0(h)))                !direct taxes out of social
                                                   transfers of households
e:pe      q:(sum(h,(th0(h)*he0(h))))              !direct taxes out of distributed
                                                   profits of households
e:pfx     q:(sum(h,(th0(h)*hr0(h))))              !direct taxes out of remittances of
                                                   households
e:ptran   q:(te0*eg0)                             !direct taxes out of social
                                                   transfers of enterprises


*Foreigners' income and expenditures:

$demand:foreign
d:pfx     q:(Pbar*exdp)
e:pfx     q:xe0                               !enterprise payments to foreigners
e:pfx     q:(-sum(h,hr0(h)))                  !remittances
e:pfx     q:(1)              r:FINALIMPORT     !final imports
e:pfx     q:(1)              r:INTIMP          !intermediate imports
e:pinv    q:(-fsv0)          r:fsav           !foreign savings


*Complementarity condition for the scaling parameter km:

$constraint:km
sum(h,ra(h)) =e= sum(h, ((1-sh0(h))*(1-
th0(h))*(w*km*wageinc(h)+ptran*hg0(h)+pe*he0(h)+pfx*hr0(h))));


*Complementarity condition for the scaling parameter gsav:

$constraint:gsav
govt/pg =e= gd0;


*Complementarity condition for the scaling parameter fsav:

$constraint:fsav

fsav*fsavz*pinv =e= pfx*((nfimp*Pstar)+(sum(s,nmint(s)*Pstar))-(Pbar*exdp))+pfx*(xe0-
sum(h,hr0(h)));


*Constraint to define the functional form of the intermediate import demand:

$constraint:INTIMP
INTIMP =e= sum(s,(a1(s)*Pstar*gdpz(s)*y(s)));


*Constraint to define the functional form of the intermediate import demand:

$constraint: FINALIMPORT
FINALIMPORT =e=
(nfimp/(sum(s,gdpz(s)*y(s)))**sigma)*(pfx*Pstar/pa)**rho*(sum(s,gdpz(s)*y(s)))**sigma;


$report:
v:rgdp(s)    o:py(s)     prod:y(s)
v:rlab(s)    i:w         prod:y(s)
```

```
v:realint(s)  i:pfx      prod:y(s)
v:rfinimp     i:pfx      prod:finimp
v:rexp        o:pfx      prod:x
v:totmrg      o:pt       prod:mg
v:rinv        o:pinv     prod:invest
v:rcons(h)    o:pc(h)    prod:c(h)
v:rgovt       o:pg       prod:gd
v:prof        d:pe       demand:entre


$offtext
$sysinclude mpsgeset moz

*Initialization of the scaling parameters and choice of the appropriate closure rule.

km.L = 1;

*Inizialization of the value of INTIMP.

INTIMP.L=sum(s,nmint(s));

*Initialization of the value of FINALIMPORT.

FINALIMPORT.L=nfimp;

*If the closure rule is EXOGENOUS foreign savings put an asterix before these commands:
fsav.L = 1;
fsav.LO = -inf;
*If the closure rule is ENDOGENOUS foreign savings put an asterix before the command:
fsav.FX = 1;
*If the closure rule is EXOGENOUS governmemnt savings put an asterix before these
commands:
gsav.L = 1;
gsav.LO = -inf;
*If the closure rule is ENDOGENOUS government savings put an asterix before the command:
gsav.FX = 1;

*Numeraire of the model:
w.FX = 1;

$include moz.gen
solve moz using mcp;

*Counterfactual: Trade liberalization in the SADC area.

mtx= 0.027;
$include moz.gen
Solve moz using MCP;
```