

*A Note On Changes
Since GTAP Book Model (Version 2.2a / GTAP94)*

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Changes to GTAP.TAB model file: From v.5.0 to v.6.0

New Regional Household Demand System

In a recent GTAP technical paper, Robert McDougall (2000) proposes a new regional household demand system for the GTAP model. This demand system fixes a problem with the original demand system stemming from the inconsistency of the constant budget share assumption with the non-homothetic, CDE expenditure function for private consumption. McDougall points out that the cost of private utility in this model varies according to the amount “purchased” by the regional household. If the regional household’s utility maximization problem is reformulated to take this into account, then the optimal share of expenditure devoted to private, public and future savings consumption varies as a function of per capita expenditure. While the empirical difference between this model and the original one is small for many applications (see Hertel (2001) for some examples). This is not always the case, and the conceptual difference is substantial. Incorporating McDougall’s theory has required a significant rewrite of the regional household module. In so doing, McDougall (2000) also introduces a new approach to fixing any of the components of final demand via preference shifts. So, for example, if the user chooses to fix real government spending, she now does so by swapping a preference shift variable, $dpgov(r)$, with $ug(r)$. Preferences are accordingly altered in order to accommodate the desired pattern of expenditure in the new equilibrium. This preference shift also has implications for the welfare decomposition, to which we now turn.

New Welfare Decomposition

The version 6.0 GTAP.TAB file incorporates some significant changes, which are also reflected in DECOMP.TAB. The first of these involves eliminating the term relating to non-homothetic preferences. In the new welfare decomposition proposed by Hanslow (2000) and McDougall (2000) the influence of non-homothetic preferences – as evidenced in the cost elasticity of utility – is embodied in the common scaling factor. Therefore it is no longer present as a separate term. McDougall also corrects the computation of Equivalent Variation (EV) so that it is no longer an approximation, but rather now provides an exact measure of the EV associated with a given policy simulation. His new formulation also has the virtue of being invariant to the scaling of the CDE parameters. Two further changes to the welfare decomposition include: (a) explicit treatment of preference changes and (b) normalization with respect to population. The first of these means that when a non-standard closure, such as fixing real government spending, is employed, the welfare decomposition identifies the “contribution” of this change in preference to the overall welfare change. The fact that the decomposition is now done on a per capita basis means that if population is shocked in the model simulation, this will show up as a separate “contribution” to aggregate regional welfare.

Iceberg Trade Costs “ams” import-augmenting “tech change” variable

The parameter “ams(i,r,s)” has been introduced to handle bilateral services liberalization as well as other efficiency-enhancing measures that serve to reduce the effective price of goods and services imports. Shocks to ams(i,r,s) represent the negative of the rate of decay on imports of commodity or service i from region r imported by region s. When ams(i,r,s) is shocked by 20%, then 20% more of the product becomes available to domestic consumers -- given the same level of exports from the source country. In order to ensure that producers still receive the same revenue on their sales, effective import prices (pms) fall by 20%. The introduction of this variable also facilitates simulation of efficiency improvements such as customs automatization or e-commerce.

Baldwin-type capital accumulation

Francois, et al. (1996) explores the interaction between trade policy and capital accumulation in the GTAP model. They follow Richard Baldwin in arguing that in the standard static setting CGE models undervalue the positive relationship between trade, investment and growth due to the absence of capital accumulation effect. A simple, one-sector neoclassical growth model is used to illustrate the basic idea behind this argument. An efficiency-enhancing reform such as trade liberalization shifts upwards the economy-wide production function. The same amount of capital and labor now can produce more than before, thus increasing income. This is the static effect of the reform. Under the assumption of fixed saving rates, part of the increased income is saved and invested to form new capital, which results in further income gains. This medium-run effect is missing in the standard comparative static GTAP model. The version 6.0 GTAP model introduces an equation named BALDWIN to incorporate the multiplier effect by feeding increase in gross investment back to capital services available in economy, following the approach outlined in Francois, et al. (1996).

Uniform consumption tax, “tp”

A new tax variable, tp(r), is introduced to permit implementation of a uniform adjustment to all private consumption taxes in a particular region. The variable can be swapped with the variable DTAXR(r), the change in ratio of taxes to regional income, to generate a tax replacement scenario, whereby taxes remain a constant share of regional income with the adjustment (increase or decrease in revenue) fully absorbed by this consumption tax. This is commonly used to replace lost tariff revenue under trade liberalization scenarios.

Correction on equations for the ratio of taxes to income

The variables of the ratio of taxes to income were introduced in the version 5 of GTAP.TAB model file. The idea was to look at the ratio of taxes to income in order to

preserve homogeneity in prices. We can also look at changes in tax revenue, but then a uniform price increase would change those variables. Obviously a simple percent change variable doesn't work, since many taxes are initially zero. The basic logic of this approach is as follows:

Let R be the ratio of taxes to income: $R = T/Y$, then:

$$dR = d(T/Y) = R(t - y)$$

where $t = dT/T$ and $y = dY/Y$, and multiply through by Y to get:

$$YdR = dT - yT \quad (1)$$

This ratio change is computed for each tax type and for total taxes.

Then the change in tax revenue itself may be computed as:

$$dT = YdR + yT$$

in order to determine regional income.

In the v.5.0 GTAP.TAB file the equations were written as in the form of (1). As a rule used in the GTAP model, however, small letters are defined as percent change so the equations in the form of (1) should look as seen in the equation, TOUTRATIO:

$$\begin{aligned} &100.0 * INCOME(r) * TOUTR(r) \\ &= \text{sum}(i, \text{PROD_COMM}, \text{VOA}(i,r) * [-\text{to}(i,r)]) \\ &+ \text{sum}(i, \text{PROD_COMM}, \text{PTAX}(i,r) * [\text{pm}(i,r) + \text{qo}(i,r)]) \\ &- \text{TOUT}(r) * y(r) \end{aligned}$$

From v.4.1 to v.5.0

Module Structure

The organization of the GTAP.TAB file was changed with version 5.0 to introduce a modular structure. This reorganization aims to facilitate an improved understanding of the structure of GTAP model as well as to make it easier to modify the model. Each module is a collection of coefficients, variables, formulae and equations, grouped by economic functions. For example, the Government Consumption Module is a group of coefficients, variables, formulae and equations associated with government demands for goods and services. Further the module breaks down into two sub-modules corresponding to the nested CES structure of government consumption. One of the sub-modules represents government consumption demands for domestic and imported goods (the bottom of the nest), and the other for the composite demands (the top of the nest). Organizing related bits and pieces in this way offers intuitive comprehension of GTAP model structure. It results in eight main modules representing the essential building blocks of the GTAP model. The modular structure also facilitates modification and revision of the GTAP model. All modules are knitted together by thread of common coefficients or variables, which are defined as shared across modules. If one of the common (shared) variable's name is changed, for a simple example, all the modules

containing the variables will be affected by this change and must be modified accordingly. If a new name is assigned to the variable only used in one module, this change only affects the module locally, so there is no need to worry about other modules. This may sound obvious but organizing the model file in this way provides an important practical tool for those trying to alter the model by indicating clearly whether the change she is making is only local to a module or global to other modules.

Multiple Margins Sectors

The GTAP database has historically treated the international freight and insurance margin as a single service, supplied by national trade and transport sectors, and provided by a mythical global transport sector. The version 5 GTAP database has disaggregated transport into three modes: sea, air, land. This increased attention to international transport costs comes at an opportune time, as increased attention is focused on the role of these costs in international trade (see, for example, Hummels (2000)). It will also support improved analysis of liberalization of services under the WTO's General Agreement on Trade in Services (GATS). In order to accommodate this change in data structure, the model had to be revised.

Correction on “ao” when $ESUBT > 0$

When the GTAP model was generalized to permit a non-zero substitution elasticity between intermediates and value-added ($ESUBT > 0$), the technology shock at the top level of the production function was not properly generalized. The derivation of the proper equation is provided in Gohin and Hertel (2000). The version 5.0 GTAP.TAB file implemented this correction.

From v.4.0 to v.4.1

Switch for changing sluggish endowments via parameter file

This was merely technical issue and did not affect the structure of the GTAP model. In the v.4.0 the SET file was used to define which endowments are sluggish. Introduction of a binary parameter “SLUG” offers a facility to users to switch an endowment from sluggish to mobile by choosing value of zero or one in the parameter file.

Intermediate input substitution

A non-zero elasticity of substitution between intermediate and value-added ($ESUBT$) was introduced to generalize the GTAP model. This modification allowed the

model to account for the substitution at the top nest of composite production structure, at where the ratio of intermediate inputs and value-added components were used to be fixed in the v.4.0. GTAP model.

From v.2.2a/GTAP94 to v.4.0

Region specific “psave(r)”

The region specific savings price was introduced and is equal to the price of regional investment plus a region-generic adjustment factor, which accounts for the fact that regions also invest abroad.

Factor prices, “pfactor(r)” (also “pfactreal(i,r)” and “pfactwld”)

The global primary factor price index, pfactwld, is new numeraire. Therefore regional primary factor price indices, pfactor(r), now show directly which regions experienced real appreciation / depreciation in the wake of the simulation. The real rate of return to factors, pfactreal(i,r), was introduced to facilitate fixed real wage closure.

Eliminate dummy variables

The dummy variables used in v.2.2a to eliminate spurious percent changes in variables with zero flows were removed from v.4.0. GTAP model since this was found to have adverse computational consequences.

References

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- Hummels, David "Time as a Trade Barrier", mimeo Purdue University, (October 2000)
- McDougall, Robert A. "Two Small Extensions to SALTER", SALTER Working Paper No. 12, Industry Commission, Canberra, (1993).
- McDougall, Robert A. "A New Regional Household Demand System for GTAP", GTAP Working Paper No. 14, Center for Global Trade Analysis, Purdue University, (September 2000), (also forthcoming as GTAP Technical Paper No. 20).

Appendix I: Version 6 GTAP Model Compared with Version 2.2 / GTAP94 Book Model

(1/3)

Version 2.2 / GTAP94			Version 6		Change from version 2.2a / GTAP94 to version 6	
No	Defined at line	Equation Name	No	Defined at line		Equation Name
1	1301	MKTCLTRD		.. ..	split to MKTCLTRD_MARG and MKTCLTRD_NMRG equation	
2	1309	MKTCLIMP	1	2332	MKTCLIMP	no
3	1316	MKTCLDOM	2	2353	MKTCLDOM	no
4	1322	MKTCLENDWM	3	2366	MKTCLENDWM	modified
5	1329	MKTCLENDWS	4	2377	MKTCLENDWS	no
6	1345	PRIVATEXP		.. ..	New Regional Household Demand System	
7	1353	REGIONALINCOME	5	2132	REGIONALINCOME	modified
8	1387	KEND	6	1522	KEND	no
9	1398	WALRAS_S	7	2393	WALRAS_S	pcgdswld is introduced
10	1403	WALRAS_D	8	2404	WALRAS_D	psave is introduced
11	1408	WALRAS	9	2420	WALRAS	no
12	1423	SUPPLYPRICES		.. ..	defined in OUTPUTPRICES equation with different SET	
13	1430	MPFACTPRICE	10	1317	MPFACTPRICE	no
14	1437	SPFACTPRICE	11	1322	SPFACTPRICE	no
15	1444	PHHDPRICE	12	1051	PHHDPRICE	variable name changes to atpd(i,r)
16	1451	GHHDPRIE	13	874	GHHDPRIE	no
17	1458	DMNDDPRIE	14	1252	DMNDDPRIE	no
18	1465	PHHIPRICES	15	1072	PHHIPRICES	variable name changes to atpm(i,r)
19	1472	GHHIPRICES	16	881	GHHIPRICES	no
20	1480	DMNDIPRICES	17	1264	DMNDIPRICES	no
21	1487	MKTPRICES	18	1707	MKTPRICES	no
22	1502	PRICETGT	19	1718	PRICETGT	no
23	1517	EXPRICES	20	1694	EXPRICES	no
24	1528	DPRICEIMP	21	1753	DPRICEIMP	variable ams(i,r,s) is introduced
25	1534	IMPORTDEMAND	22	1758	IMPORTDEMAND	variable ams(i,r,s) is introduced, dummy variable D_VXWD is eliminated
26	1569	ICOMPRICE	23	1289	ICOMPRICE	no
27	1574	INDIMP	24	1294	INDIMP	no
28	1580	INDDOM	25	1299	INDDOM	no
29	1590	VAPRIE	26	1340	VAPRIE	no
30	1596	ENDWDEMAND	27	1363	ENDWDEMAND	dummy variable D_EVFA is eliminated
31	1606	VADEMAND	28	1207	VADEMAND	correction to ao when ESUBT > 0
32	1611	INTDEMAND	29	1232	INTDEMAND	correction to ao when ESUBT > 0
33	1620	ZEROPROFITS	30	1404	ZEROPROFITS	cosmetic change, by use of share form $STC(i,j,r) = VFA(i,j,r) / \sum(k, demd_comm, VFA(k,j,r))$
34	1639	UTILITY	31	2248	UTILITY	New Regional Household Demand System
35	1651	SAVINGS		.. ..	equation SAVING for New Regional Household Demand System	
36	1661	GOVERTU		.. ..	equation GOVU for New Regional Household Demand System	
37	1673	GPRICEINDEX	32	851	GPRICEINDEX	no
38	1678	GOVDMNDS	33	856	GOVDMNDS	variable pop(r) is introduced for New Regional Household Demand System
39	1689	GCOMPRICE	34	891	GCOMPRICE	no
40	1694	GHHLDAGRIMP	35	896	GHHLDAGRIMP	no

Appendix I: Version 6 GTAP Model Compared with Version 2.2 / GTAP94 Book Model

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Version 2.2 / GTAP94			Version 6		Change from version 2.2a / GTAP94 to version 6	
No	Defined at line	Equation Name	No	Defined at line		Equation Name
41	1699	GHLDDOM	36	901	GHLDDOM	no
42	1708	PRIVATEU	37	966	PRIVATEU	New Regional Household Demand System
43	1721	PRIVDMNDS	38	1033	PRIVDMNDS	no
44	1734	PCOMPRICE	39	1100	PCOMPRICE	no
45	1739	PHHLDDOM	40	1105	PHHLDDOM	no
46	1744	PHHLDAGRIMP	41	1110	PHHLDAGRIMP	no
47	1755	ENDW_PRICE	42	2070	ENDW_PRICE	no
48	1760	ENDW_SUPPLY	43	2084	ENDW_SUPPLY	no
49	1770	KAPSVCES	44	1475	KAPSVCES	no
50	1777	KAPRENTAL	45	1485	KAPRENTAL	no
51	1783	CAPGOODS	46	1491	CAPGOODS	no
52	1790	PRCGOODS	47	1501	PRCGOODS	no
53	1795	KBEGINNING	48	1506	KBEGINNING	no
54	1802	RORCURRENT	49	1540	RORCURRENT	no
55	1807	ROREXPECTED	50	1559	ROREXPECTED	no
56	1817	RORGLOBAL	51	1602	RORGLOBAL	no
57	1826	GLOBALINV	52	1615	GLOBALINV	no
58	1836	PRICGDS	53	1634	PRICGDS	replace psave with pcgdswld
59	1854	PTRANS	..	..	..	change to equation PTRANSPORT for Multiple Margins Sectors
60	1861	TRANSVCES	54	1958	TRANSVCES	same name but differs for Multiple Margins Sectors
61	1880	QTRANS	..	..	..	Multiple Margins Sectors
62	1888	FOBCIF	55	1984	FOBCIF	change to use variable ptrans(i,r,s) for Multiple Margins Sectors
63	1900	REGSUPPRICE	56	2542	REGSUPPRICE	modified and moved to Appendix A-2
64	1908	REGDEMPRICE	57	2557	REGDEMPRICE	modified and moved to Appendix A-2
65	1924	TOTeq	58	2570	TOTeq	no
66	1933	EVREG	59	2840	EVREG	modified and moved to Appendix A-3-3
67	1937	EVWLD	60	2843	EVWLD	no
68	1945	PHHLINDEX	61	959	PHHLINDEX	modified and moved to Module 2-1
69	1953	VGDP_r	62	2869	VGDP_r	moved to A-4 and change SET to MARG for Multiple Margins Sectors
70	1963	PGDP_r	63	2883	PGDP_r	moved to A-4 and change SET to MARG for Multiple Margins Sectors
71	1973	QGDP_r	64	2897	QGDP_r	no
72	1984	VREGEX_ir	..	..	..	Split MARG, NMRG for Multiple Margins Sectors
73	1989	VREGIM_is	65	2930	VREGIM_is	no
74	1993	VREGEX_r	66	2937	VREGEX_r	no
75	1997	VREGIM_s	67	2942	VREGIM_s	no
76	2001	VWLDEX_i	68	2953	VWLDEX_i	no
77	2005	VWLDIM_i	69	2964	VWLDIM_i	no
78	2009	VWLDEX	70	2975	VWLDEX	no
79	2013	VWLDOUT	71	2997	VWLDOUT	no
80	2020	PREGEX_ir	..	..	..	Split MARG, NMRG for Multiple Margins Sectors
81	2025	PREGIM_is	72	3039	PREGIM_is	no

Appendix I: Version 6 GTAP Model Compared with Version 2.2 / GTAP94 Book Model

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Version 2.2 / GTAP94			Version 6			Change from version 2.2a / GTAP94 to version 6
No	Defined	Equation Name	No	Defined	Equation Name	
	at line			at line		
82	2029	PREGEX_r	73	3046	PREGEX_r	no
83	2033	PREGIM_s	74	3053	PREGIM_s	no
84	2037	PWLDEX_i	75	3060	PWLDEX_i	no
85	2041	PWLDIM_i	76	3067	PWLDIM_i	no
86	2045	PWLDEX	77	3074	PWLDEX	no
87	2049	PWLDOUT	78	3080	PWLDOUT	no
88	2056	QREGEX_ir	79	3102	QREGEX_ir	no
89	2061	QREGIM_is	80	3113	QREGIM_is	no
90	2066	QREGEX_r	81	3124	QREGEX_r	no
91	2070	QREGIM_s	82	3131	QREGIM_s	no
92	2074	QWLDEX_i	83	3138	QWLDEX_i	no
93	2078	QWLDIM_i	84	3145	QWLDIM_i	no
94	2082	QWLDEX	85	3152	QWLDEX	no
95	2086	QWLDOUT	86	3158	QWLDOUT	no
96	2091	TRADEBAL_i	87	3186	TRADEBAL_i	no
97	2096	TRADEBALANCE	88	3196	TRADEBALANCE	no

Appendix II: Incorporated Equations in Version 6 GTAP Model Since Version 2.2a /
GTAP94 Book Model

No	Defined at line	Equation Name	No	Defined at line	Equation Name
89	861	GOVU	149	3286	WORLDDEV
90	906	TGCRATIO	150	3292	CNT_WEV_dpar
91	982	UTILELASPRIV	151	3300	CONT_EV_pop
92	1060	TPDSHIFT	152	3305	CONT_EV_qor
93	1079	TPMSHIFT	153	3312	CONT_EV_qoir
94	1084	TPCRATIO	154	3319	CONT_EV_qfer
95	1185	AOWORLD	155	3328	CONT_EV_qfeir
96	1196	AVAWORLD	156	3336	CONT_EV_qfejr
97	1227	AFWORLD	157	3343	CONT_EV_qfmr
98	1274	TIURATIO	158	3352	CONT_EV_qfmir
99	1335	AFEWORLD	159	3360	CONT_EV_qfmjir
100	1345	TFURATIO	160	3367	CONT_EV_qfdr
101	1374	OUTPUTPRICES	161	3377	CONT_EV_qfdir
102	1384	TOUTRATIO	162	3385	CONT_EV_qfdijr
103	1571	BALDWIN	163	3392	CONT_EV_qpmr
104	1653	SAVEPRICE	164	3400	CONT_EV_qpmir
105	1764	TIMPRATIO	165	3407	CONT_EV_qpdr
106	1772	TEXPRATIO	166	3415	CONT_EV_qpdir
107	1861	QTRANS_MFSD	167	3422	CONT_EV_qgmr
108	1896	TRANS_DEMAND	168	3430	CONT_EV_qgmir
109	1915	PTRANSPORT	169	3437	CONT_EV_qgdr
110	1946	TRANSCOSTINDEX	170	3445	CONT_EV_qgdir
111	1953	TRANSTECHANGE	171	3452	CONT_EV_qxsr
112	2048	FACTORINCPICES	172	3462	CONT_EV_qxsirs
113	2058	TINCRATIO	173	3469	CONT_EV_qimr
114	2101	FACTORINCOME	174	3478	CONT_EV_qimjr
115	2115	DTAXRATIO	175	3485	CONT_EV_alleffr
116	2155	DPARAV	176	3503	CONT_EV_alleffir
117	2163	UTILITELASTIC	177	3520	CONT_EV_totr
118	2167	PRIVCONSEXP	178	3532	CNT_EV_cgdsr
119	2170	GOVCONSEXP	179	3540	CONT_EV_endwr
120	2173	SAVING	180	3548	CONT_EV_endwir
121	2239	PRICEINDEXREG	181	3554	CONT_EV_techr
122	2255	DISTPARSUM	182	3569	CONT_EV_tech_aor
123	2297	MKTCLTRD_MARG	183	3577	CONT_EV_tech_aoir
124	2307	MKTCLTRD_NMRG	184	3584	CONT_EV_tech_afer
125	2500	REALRETURN	185	3593	CONT_EV_tech_afejir
126	2515	PRIMFACTPR	186	3600	CONT_EV_tech_avar
127	2526	PRIMFACTPRWLD	187	3609	CONT_EV_tech_avajr
128	2655	GOVUSHD	188	3617	CONT_EV_tech_afr
129	2700	PRIVDMNDSEV	189	3628	CONT_EV_tech_afjir
130	2712	PRIVATEUEV	190	3636	CONT_EV_tech_attr
131	2723	UTILELASPRIVEV	191	3646	CONT_EV_tech_afmfsd
132	2792	DPARAVEV	192	3653	CONT_EV_tech_amsr
133	2800	UTILITELASTICEV	193	3660	CONT_EV_tech_amsirs
134	2805	PCONSEXPEV	194	3666	CONT_EV_kbr
135	2809	GOVCONSEXP	195	3803	EXPPRICE_MARG
136	2812	SAVINGEV	196	3811	EXPPRICE_NMRG
137	2815	SAVEUEV	197	3818	IMPPRICE1_MARG
138	2828	INCOME_EQUIV	198	3825	IMPPRICE1_NMRG
139	2904	compvaladeq	199	3832	WRLDPRICEi
140	2916	VREGEX_ir_MARG	200	3837	WRLDPRICE
141	2923	VREGEX_ir_NMRG	201	3841	c1_irEQ
142	3009	VWLDOUTUSE	202	3846	c2_irEQ
143	3022	PREGEX_ir_MARG	203	3851	c3_irEQ
144	3030	PREGEX_ir_NMRG	204	3856	c1_rEQ
145	3087	PWLDUSE	205	3861	c2_rEQ
146	3165	QWLDOUTU	206	3866	c3_rEQ
147	3213	DTBALRATIO	207	3871	TOT2eq
148	3244	EV_DECOMPOSITION			