Analyzing Environmental Policies with IGEM, an Intertemporal General Equilibrium Model of U.S. Growth and the Environment Part 2

Appendix G. Government Accounts and Projections

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G.1 Government expenditures and taxes
G.2 Projections of exogenous government variables

G.1 Government expenditures and taxes

The government accounts in IGEM are described in section 1.4 of Chapter 1 and this Appendix describes how the government expenditures and taxes are constructed from the data. It also describes the projections of the exogenous components of the government sector beyond the sample period.

We summarize the main equations of section 1.4 here. The revenues, expenditures and deficit of the general government are, respectively:

$$(1.89) \quad \begin{aligned} R\_TOTAL &= R\_SALES + R\_TARIFF + R\_P + R\_K + RK^{hh} + R\_L + R\_W \\ &\quad + TAXN + R\_UNIT + R\_EXT + R\_CON^{net} + TLUMP + YK^{gov} \end{aligned}$$

$$(1.90) \quad EXPEND = VGG + G^{TRAN} + GR + GINT + GINTR$$

$$(1.93) \quad \Delta G_t = EXPEND_t - R\_TOTAL_t$$

The deficits cumulate into government debt. After adjusting for market valuation of old debt and for the discrepancies between the flow and stock estimates, the portion of public debt held by domestic residents and foreigners are, respectively:

$$(1.94) \quad BG_t = BG_{t-1} + \Delta G_t + GFI_t + \Delta P_t^{BG} + BG_t^{disc}$$

$$(1.95) \quad BG_t^* = BG_{t-1}^* - GFI - \Delta P_t^{BG^*}$$

In the top section of Table G1 we give the 2005 values of the main tax rates used in IGEM. The variable symbols used in the equations in section 1.4 are given in the table together with the model simulation code names. The tax rates that differ by industry such as sales taxes and tariffs are not included here. Note that the marginal tax rate on labor income is much higher than the average tax rate. Recall that these taxes are income taxes and does not include contributions to Social Insurance funds. Investment tax credits and taxes on consumption are zero in 2005 and in the projections of the base case, they may be used for policy simulations.

In the second section of Table G1 we give the components of total general government revenue and expenditures for 2005. The revenue sub-totals are given on the right hand side of eq. 1.89, the largest category is the tax on labor income with $894 billion, followed by taxes on capital income with $683 billion. The expenditures include

transfers to domestic residents ($568 bil.), transfers to foreigners ($27 bil.), interest paid to domestic residents ($158 bil.), and interest paid to foreigners ($101 bil.). Spending on goods and services was $2132 billion (this includes both consumption expenditures and government investment in the NIPA).

The average tax rates are calculated by dividing the above revenue estimates with the tax base. The precise definitions of the taxes are described in Jorgenson and Yun (2001), the tax base are scaled to the revenue data in the NIPA (*Survey of Current Business*, August 2007, Tables 3.2 and 3.3). Personal income taxes are allocated between labor and capital income taxes using IRS data. The IRS data on taxes paid by income categories are used to estimate the marginal labor tax rate. The government expenditure totals are also derived from the NIPA (*SCB*, Tables 3.2 and 3.3).

The government deficit in 2005 was $507 billion, of which we estimate $269 billion is financed by the rest-of-the-world. Finally, the stock of government debt to domestic residents is 5.2 trillion, and the net public debt to foreigners is 2.2 trillion.

Government purchases of the output of the business sector and the primary factors of labor and capital are denoted by *VGG* in (1.89). This corresponds to the G in the familiar "C+I+G". We should note that the National Accounts conventions make this a net measure, government sales to the household sector such as fees collected for colleges and hospitals are netted out. That is, not all the salaries for state college professors are included in *VGG*, the portion paid as tuition fees are instead included in Personal Consumption Expenditures. In IGEM we follow this NIPA convention and do not explicitly track these government sales to the household. The government purchases of each commodity are expressed as shares of total spending *VGG* (equation 1.88). The shares, α_i^G, for 2005 are given in Table G2.

The largest government expenditure is on salaries, more than 40% in 2005. This is followed by purchases from the Construction and Services industries. The largest item from the manufacturing group is Other Transportation Equipment (aircraft and ships). Energy purchases are substantial, 1.5 percent of government purchases go each to Petroleum Refining and Electric Utilities. Purchases of Petroleum Refining was between 1 and 1.5% for most years in the sample period except during the second oil shock when

it rose above 2%. The share going to electricity has been steadily rising since 1970, from 1.0% to 1.6% in 2000.

G.2 Projections of exogenous government variables

The Congressional Budget Office is the main source of intermediate term projections of variables related to the government accounts. CBO (2009a, 2009b) provide 10-year projections out to 2019 for the Federal Government deficit, balances of the Social Insurance Trust Funds, interest payments, transfers and other major items[1]. These are based on their projections of GDP and unemployment over this horizon.

We supplement these projections of the Federal government with our parallel projections of the State and Local government accounts. The S&L government historically run small "current surpluses" and we keep that in the projections. The net borrowing requirement is the current surplus combined with investment spending, capital transfers and other minor items. We assume that these items grows at the same rate as the GDP projected by CBO and thus generate a projection of the net borrowing by S&L governments. This is then combined with the CBO forecasts to give a projection of the consolidated government surplus out to 2019. This consolidated projection is given in Figure 1.9 in Chapter 1; a large deficit of $1.2 trillion is projected for both 2009 and 2010, the deficit falls to $540 billion in 2013 before rising to 750 billion in 2019.

Beyond this 10-year CBO window we assume that the government deficit falls steadily to zero by 2060. This is a simple assumption to give a gradual change in the structure of the economy towards a balanced growth path. The projection, together with the sample data, is plotted in Figure G1. The graph gives the surplus deflated by our labor price index.

These deficits cumulate into the stock of debt to US residents and foreigners as given in eq. (1.94) and (1.95) above. We do not have much guide from the literature on

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[1] The main *Budget and Economic Outlook* is released in January 2009, this was followed by *A Preliminary Analysis of the President's Budget and an Update of CBO's Budget and Economic Outlook* released in March 2009, and by *An Analysis of the President's Budgetary Proposals for Fiscal Year 2010* released in June 2009. The GDP projections are given in Table C-1 in the March release (downloaded from http://www.cbo.gov/doc.cfm?index=10014). The stock of Federal Government debt and Trust Fund surplus are in the June release (Tables 1-7, 1-3, downloaded from //www.cbo.gov/doc.cfm?index=10296). The projected income tax revenue are in Table 1-2. The projections of the Government surplus, transfer payments and interest payments are from CBO (2009b) Table 2.

the allocation of the incremental debt to domestic and foreign bond holders. For the sample period we have the estimates of Government Foreign Investment (*GFI*), in 2006 the share financed by foreigners is about 50%. We make a simple assumption that this share will fall gradually to zero by 2060. This is in line with our assumptions of falling current account deficits. The total debt owed by the U.S. government to residents and foreigners is also plotted in Figure G1 (scale on the right axis in $1982).

The elements other than *VGG* on the right hand side of (1.90) are exogenous. Transfers to households and transfers to rest-of-world are projected as a fixed shares of GDP, interest payments to residents and foreigners are interest rates multiplied by the projected debts. The domestic interest rate is taken from the CBO forecast for 2009-2019 and set as a constant thereafter. The foreign interest rate follows the same trend. The projections of these transfers and interest payments are plotted in Figure G2, again deflated using our labor price to $1982. Interest paid to domestic residents is projected to rise from $65 billion (1982$) in 2008 to $172 billion in 2020, and to $552 billion by the steady state. Transfers to households is projected to rise with GDP from $259 billion in 2008 to 644 billion in 2060.

On the revenue side, all elements are endogenous except for the non-tax revenue given in Figure G3. This is projected to rise proportionately with GDP, from $33 billion in 2008 to 117 billion in 2060.

Table G.1 Tax rates; Main revenues and expenditures

Model Code name	Appendix A symbol	2005
Tax rates		
tax_labor_m_PI	tl^m	0.2834
tax_labor_PI	tl^a	0.1183
tax_prop	tp	0.0099
tax_wealth	tw	0.0006
tax_cap	tk	0.1344
tax_itc	t^{ITC}	0.0000
tax_con	tc	0.0000
Revenues and Expenditures		(2005 bil $)
rev_prop	R_P	452.3
rev_cap	R_K	683.3
rev_lab	R_L	894.1
rev_nontax	$TAXN$	74.5
rev_tariff	R_TARIFF	25.3
rev_wealth	R_W	30.3
rev_con	R_CON	0
gov_transfer	G^{tran}	567.9
gov_to_foreign	GR	27.1
gov_interest	$GINT$	158.4
gov_int_abroad	$GINTR$	101.5
gov_expend	VGG	2131.7
gov_surplus	$-\Delta G$	-506.9
gov_for_invest	GFI	-269.4
Stocks of debt		
gov_debt	BG	5224.0
gov_debt_f	BG^*	2171.1

Table G2. Government expenditures by commodity, 2005 (% of total purchases)

1	Agriculture	0.09%
2	Metal Mining	-0.01%
3	Coal Mining	0.00%
4	Petroleum and Gas	-0.01%
5	Nonmetallic Mining	0.00%
6	Construction	17.16%
7	Food Products	1.03%
8	Tobacco Products	0.00%
9	Textile Mill Products	0.03%
10	Apparel and Textiles	0.15%
11	Lumber and Wood	0.02%
12	Furniture and Fixtures	0.34%
13	Paper Products	0.31%
14	Printing and Publishing	0.58%
15	Chemical Products	0.67%
16	Petroleum Refining	1.55%
17	Rubber and Plastic	0.18%
18	Leather Products	0.03%
19	Stone, Clay, and Glass	0.03%
20	Primary Metals	0.03%
21	Fabricated Metals	0.51%
22	Industrial Machinery	1.18%
23	Electronic & Electric Equip	1.12%
24	Motor Vehicles	1.02%
25	Other Transportation Equip	3.88%
26	Instruments	2.16%
27	Miscellaneous Manufacturing	0.21%
28	Transport and Warehouse	1.65%
29	Communications	0.88%
30	Electric Utilities	1.50%
31	Gas Utilities	0.10%
32	Trade	1.18%
33	FIRE	2.22%
34	Services	9.09%
35	Goverment Enterprises	0.26%
36	Noncomparable imports	0.61%
	Capital services	9.62%
	Labor services	40.64%

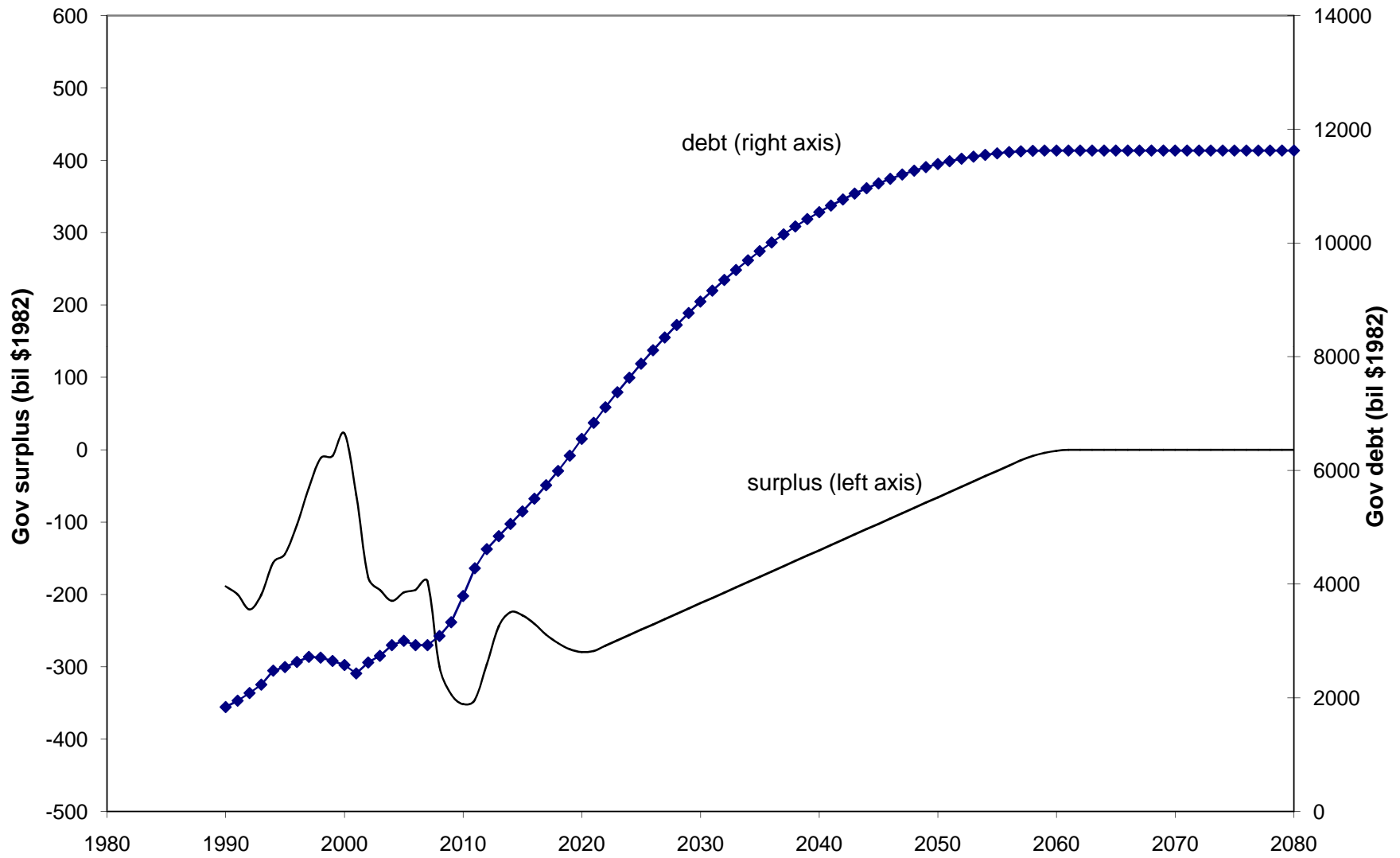Fig. G1. Projections of consolidated government surplus and govt. debt

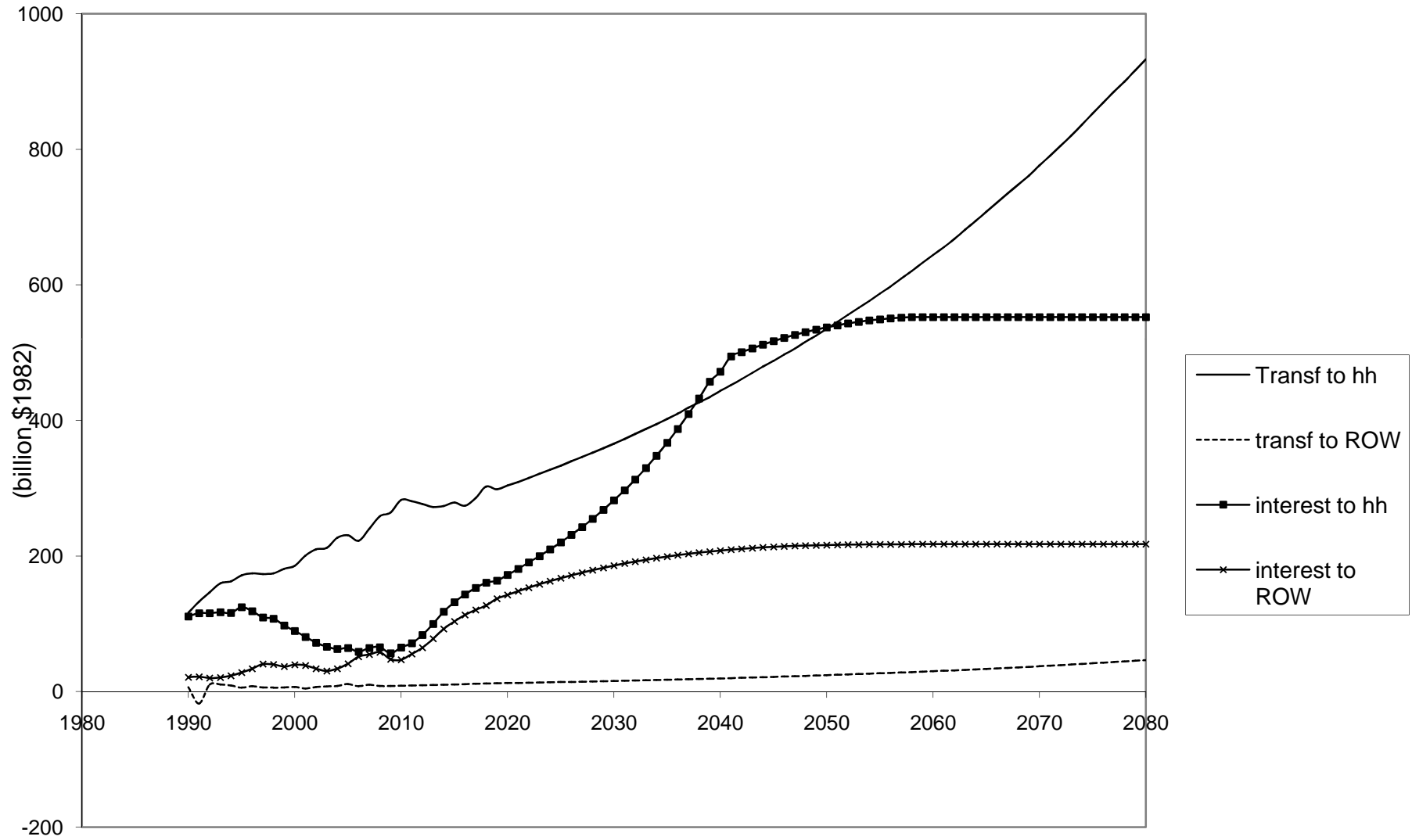Fig. G2. Projections of exogenous components ofgovernment expenditures

Fig. G3. Projections of components of government revenues