MIT Joint Program on the Science and Policy of Global Change

Comparing Tax Rates
Using OECD and GTAP6 Data

Angelo Gurgel, Gilbert Metcalf and John Reilly

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To inform processes of policy development and implementation, climate change research needs to focus on improving the prediction of those variables that are most relevant to economic, social, and environmental effects. In turn, the greenhouse gas and atmospheric aerosol assumptions underlying climate analysis need to be related to the economic, technological, and political forces that drive emissions, and to the results of international agreements and mitigation. Further, assessments of possible societal and ecosystem impacts, and analysis of mitigation strategies, need to be based on realistic evaluation of the uncertainties of climate science.

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In prior research, Babiker, Metcalf and Reilly (2003) computed capital and labor tax rates to augment GTAP 4 data that did not comprehensively cover taxes. Recently, we updated these tax rates to 2001 to match the GTAP 6 base year. We realize there was an attempt to improve representation of taxes in GTAP6, but as admitted by GTAP this was as yet incomplete. For those who might require a more complete tax accounting we have followed an approach that has the benefit of, at least in the aggregate, reconciliation with widely available tax receipt data. This note compares the tax rates derived for the OECD countries using this approach to those provided by the method GTAP uses. According to GTAP, GTAP6 tax rates derive from five sources:

- Factor tax rates: IMF, International Financial Statistics
- Energy commodity tax rates: IEA
- Agricultural input and output subsidies: OECD
- Other commodity taxes: National IO tables
- Tariffs: MacMap data base: CEPII and ITC-Geneva.

This note focuses primarily on the factor taxes, with some attention to the commodity taxes as well.

Those who are interested in economic impacts of fiscal measures—such as assuring revenue neutrality by raising tax rates in the face of a policy that reduces economic activity—may want to consider amending the tax data in GTAP. Alternatively, it may be useful to discuss the differences we note to as part of on-going efforts to improve data reported in GTAP.

Table 1 provides tax rates based on our methodology as well as from GTAP 6, aggregated to be approximately comparable. More disaggregated GTAP 6 tax rates are provided in Tables 2-3. GTAP6 reports taxes on factor income (rTF) as well as income taxes (rTO) whereas Babiker, Metcalf and Reilly (2003; hereafter referred to as BMR) combine income and factor taxes into a composite factor tax. As detailed in Appendix II, we construct an accumulated factor tax (ACC) from the GTAP6 tax data, which we believe is directly comparable to the BMR tax rates by the formula:

$$ACC = \frac{rTF + rTO}{1 + rTF}.$$

OBSERVATIONS

GTAP construct sector specific taxes in some cases as we report in **Table 2** (consumption) and **Table 3** (capital). However, the comparisons between BMR and GTAP6 (ACC) rates in Table 1 point to some large differences that are unlikely to be explained by slightly different aggregation. The aggregate OECD should be fairly accurate. Are there explanations for these differences?

(1) GTAP data for capital taxes appear unrealistically low. This may result in part from the GTAP attribution of all personal income taxes to labor, though this should lead to the GTAP labor tax rates (ACC) generally being higher than the BMR rates, not the case as noted below.

(2) The consumption taxes in GTAP are sometimes much higher and sometimes much lower. The GTAP data for several countries seem unusually low—in particular, Great Britain, the Netherlands, Spain, and the United States.

(3) Labor tax rates for GTAP also diverge significantly in a number of countries from the BMR rates. As noted above, the GTAP (ACC) rates should be biased upward due to the attribution of personal income taxes entirely to labor.

Table 1. Comparison of Tax Rates for 2001: BMR and GTAP6 (percentage rates).

Country	Consumption			Labor				Capital				Land		Natural Resources	
	BMR	GTAP6 Domestic	GTAP6 Imports	BMR	GTAP6 (ACC)	GTAP6 (rTF)	GTAP6 (rTO)	BMR	GTAP6 (ACC)	GTAP6 (rTF)	GTAP6 (rTO)	GTAP6 (rTF)	GTAP6 (rTO)	GTAP6 (rTF)	GTAP6 (rTO)
Denmark	36.1	25.2	16.1	52.1	47.4	5.2	44.7	46.6	11.6	1.7	10.1	−61.6	10.1	2.0	10.1
Finland	27.3	26.9	26.3	49.5	22.3	8.4	15.8	36.0	6.3	0.0	6.3	−75.9	6.3	0.8	6.3
France	18.2	11.6	24.6	45.4	59.9	79.5	28.0	38.4	7.2	2.5	4.9	−64.3	4.9	3.0	4.9
Germany	15.5	13.2	14.1	41.8	50.2	45.7	27.4	21.5	2.4	0.8	1.6	−62.6	1.6	1.0	1.6
Great Britain	15.7	2.0	0.9	28.0	32.8	18.0	20.7	54.1	16.1	4.0	12.7	−58.0	12.7	4.4	12.7
Italy	15.1	11.4	19.6	45.5	58.6	44.1	40.4	34.4	7.2	0.5	6.7	−51.4	6.7	0.8	6.7
Japan	6.9	4.3	4.7	28.4	25.8	18.8	11.8	40.4	13.5	3.3	10.6	−8.5	10.6	3.3	10.6
Netherlands	21.0	2.8	14.3	41.6	52.3	64.0	21.8	34.5	13.8	1.9	12.2	−21.6	12.2	2.3	12.2
Spain	14.2	3.5	0.8	29.3	40.7	34.3	20.4	22.4	7.4	1.5	6.0	−54.4	6.0	2.2	6.0
Sweden	26.0	17.5	14.4	56.6	56.2	40.8	38.3	50.4	12.4	1.7	10.9	−79.7	10.9	2.0	10.9
USA	4.7	0.4	1.0	29.5	33.7	15.9	23.2	36.0	8.4	3.0	5.7	−34.5	5.7	3.0	5.7

BMR – Rates calculated as in Babiker, Metcalf and Reilly (2003) using methodology of Mendoza *et al.* (1994).

GTAP6 – rates based on GTAP6 data: private domestic consumption taxes (rTPD), private import consumption taxes (rTPI), taxes on primary factors (rTF), income taxes (rTO). ACC refers to the accumulated factor tax: (rTF+rTO)/(1+rTF).

Table 2. GTAP6 Taxes on Private Consumption (percentage ad valorem).

Country	Food		Manufactures		Services		Energy	
	Domestic	Import	Domestic	Import	Domestic	Import	Domestic	Import
Denmark	15.4	15.3	15.4	14.6	15.4	0.0	228.4	253.3
Finland	23.4	23.2	23.5	23.5	23.5	23.4	83.7	119.6
France	7.8	7.8	7.8	7.4	7.8	7.8	177.2	437.5
Germany	9.2	9.2	9.3	9.3	9.3	9.2	133.7	181.5
Great Britain	0.0	0.0	0.0	0.0	0.0	0.0	92.1	274.9
Italy	7.2	7.2	7.3	7.0	7.2	1.3	272.0	150.8
Japan	5.0	4.5	5.6	5.6	2.0	0.0	60.7	130.1
Netherlands	15.8	4.2	0.6	11.5	-0.5	4.0	103.4	285.4
Spain	0.0	0.0	0.0	0.0	0.0	0.0	142.0	112.7
Sweden	11.2	11.1	11.2	10.9	11.2	0.7	124.6	471.1
United States	0.0	0.0	0.0	0.0	0.0	0.0	20.7	60.7

GTAP6 – rates based on GTAP6 data: private domestic consumption taxes (rTPD), private import consumption taxes (rTPI).

Breaking out consumption taxes for different sectors illustrate additional anomalies. Great Britain, for example, has a zero tax on consumption of any type (other than energy) despite having a VAT of 17.5% in 2001 (standard rate; food for home consumption is zero rated). Similarly, Spain has a standard VAT rate of 16% (4% rate for food).

Table 3. Sector Specific GTAP6 Taxes on Capital.

Country	Food	Manufactures/Services
Denmark	−1.4	2.0
Finland	−20.7	0.8
France	−7.5	3.0
Germany	−3.4	1.0
Great Britain	−4.3	4.4
Italy	−4.7	0.8
Japan	1.0	3.3
Netherlands	−4.1	2.3
Spain	−9.7	2.2
Sweden	−8.3	2.0
United States	2.8	3.0

GTAP6 – rates based on GTAP6 data: taxes on primary factors (rTF).

The sector specific taxes in Table 3 are rTF taxes only. In addition to these sector specific rates, taxes on land in all these countries only apply for the Food sector and taxes on natural resources only for the Manufactures sector.

REFERENCES

Babiker, M., G. Metcalf and J. Reilly, 2003: Tax Distortions and Global Climate Policy. *Journal of Environmental Economics and Management,* **46**: 269-287.

Mendoza, E., A. Razin and L. Tesar, 1994: Effective Tax Rates in Macroeconomics: Cross-Country Estimates of Tax Rates on Factor Incomes and Consumption. *Journal of Monetary Economics*, **34**: 297-323.

APPENDIX I: Tax Rate Calculations Using Data From OECD Datasets

Tax rates are based on formulas from Mendoza *et al.* (1994). We use data for the Babiker, Metcalf and Reilly (BMR) tax rates from two OECD data sources: *Revenue Statistics* and *National Accounts, Volume II*.

Data from OECD *Revenue Statistics*

    1100 – Taxes on income, profits and capital gains of individuals
    1200 – Taxes on income, profits and capital gains of corporations
    2000 – Social Security contributions
    2200 – Social Security contributions of employers
    3000 – Taxes on payroll and workforce
    4100 – Recurrent taxes on immovable property
    4400 – Taxes on financial and capital transactions
    5110 – General taxes on goods and services
    5121 – Excise taxes

Data from OECD *National Accounts, Volume II*

    C – Private final consumption expenditure (1.2 + 1.3)
        1.2 – Household final consumption expenditures from GDP: expenditure approach table
        1.3 – Final consumption expenditure of NPISHs from same table
    G – Government final consumption expenditure (1.4)
        1.4 – Government final consumption expenditure from same table
    GW – Compensation of employees paid by producers of government services (12.11)
        12.11 – Compensation of employees, payable from Generation of income account of
                Simplified general government accounts
    OSPUE – Operating surplus of private unincorporated enterprises (13.5 – 13.20)
        13.5 – Gross operating surplus and mixed income from Generation of income account of
                Simplified accounts for households and NPISH
        13.20 – Consumption of fixed capital from Capital account of Simplified accounts for
                households and NPISH
    PEI – Household property and entrepreneurial income (13.8 – 13.9)
        13.8 – Property income, receivable from Distribution of income account of Simplified
                accounts for households and NPISH
        13.9 – Property income, payable from Distribution of income account of Simplified
                accounts for households and NPISH
    W – Wages and salaries (3.8)
        3.8 – Wages and salaries from GDP: income approach table
    OS – Operating surplus of the economy (3.15 – 4.6)
        3.15 – Gross operating surplus and mixed income from GDP: income approach table
        4.6 – Consumption of fixed capital from Disposable income table

The numbers in parentheses are the item numbers from the NA data. For example, the formula for *C* (1.2 + 1.3) means that variables 2 and 3 from Table 1 are added to form *C*.

The tax rate formulas then are:

$$\text{Consumption:} \quad \tau_c = \frac{5110 + 5121}{C + G - GW - 5110 - 5121}$$

$$\text{Income:} \quad \tau_I = \frac{1100}{OSPUE + PEI + W}$$

$$\text{Labor:} \quad \tau_L = \frac{\tau_I W + 2000 + 3000}{W + 2200}$$

$$\text{Capital:} \quad \tau_K = \frac{\tau_I (OSPUE + PEI) + 1200 + 4100 + 4400}{OS} \, .$$

APPENDIX II: Tax Rate Calculations in GTAP[1]

GTAP defines the following factor payment flows:

  VOA: receipts by suppliers of factor services
  VOM: factor services valued at market prices (household side)
  VFA: payments by firms purchasing factor services
  VFM: factor services valued at market prices (firm side).

In GTAP6, the following tax rates are constructed at the sector and factor level:

$$rTF = \frac{VFA - VFM}{VFM}, \text{ and}$$

$$rTO = \frac{VOM - VOA}{VOM}.$$

We wish to construct a cumulative factor tax rate comparable to the BMR tax rates. Since those tax rates are *tax inclusive* (*i.e.* a tax flow relative to gross factor compensation), our rate (*ACC*) will be the following:

$$ACC = \frac{VFA - VOA}{VFA}.$$

For simplicity, we make the assumption that there is one firm (to avoid the need for sector subscripts); therefore *VFM* equals *VOM*. In that case:

$$
\begin{aligned}
ACC &= \frac{VFA - VOA}{VFA} \\
&= \frac{\dfrac{VFA}{VFM} - \dfrac{VOA}{VOM}}{\dfrac{VFA}{VFM}} \\
&= \frac{(1 + rTF) - (1 - rTO)}{1 + rTF} \\
&= \frac{rTF + rTO}{1 + rTF}.
\end{aligned}
$$

For completeness, we note that if we wished to compute the accumulated factor tax rate on a tax exclusive basis (*ACC_e*), it would equal:

$$ACC_e = \frac{VFA - VOA}{VOA} = \frac{1 + rTF}{1 - rTO} - 1 = \frac{rTF + rTO}{1 - rTO}.$$

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[1] We thank Tom Hertel for assistance in understanding GTAP tax rate construction. This section builds on comments Tom made on an earlier draft of this note of April 23, 2006.