CORPORATE TAX STATISTICS

Corporate Effective Tax Rates: Explanatory Annex

(Annex applicable for corporate effective tax rates 2017)

Annex A. Explanatory Remarks

Methodology, Exogenous Variables and Data Collection

1. This annex provides a summary of the variables and equations used to calculate the effective tax rates published in Corporate Tax Statistics. The methodology follows the model developed by Devereux and Griffith (1999, 2003) and applied by ZEW (2016, 2018) and others; the full model, as well as a derivation of the equations summarised in Annex B, is described by Hanappi (2018).

2. Table A.1 lists the exogenous variables used in the OECD model, grouping them in three categories: asset-specific, macroeconomic or tax-related. Given these variables, the equations in Annex B can be used to derive the respective results.

Table A.1. Exogenous Variables used in the OECD ETR Model

Variable	Description	Range	Category
p	*Pre-tax rate of return*	$0<p\leq1$	*(asset)*
δ	*Economic depreciation rate*	$0<\delta\leq1$	*(asset)*
r	*Real interest rate*	$r\lesseqgtr0$	*(macroeconomic)*
i	*Nominal interest rate*	$0\leq i$	*(macroeconomic)*
π	*Inflation rate*	$0\leq\pi$	*(macroeconomic)*
τ	*Corporate tax rate*	$0<\tau$	*(tax)*
φ	*Capital allowance rate (SL, DB)*	$0<\varphi\leq1$	*(tax)*
β	*Capital allowance factor (DBSL)*	$1\leq\beta$	*(tax)*
T	*Project lifetime for tax purposes (DBSL)*	$0<T$	*(tax)*
T^*	*Optimal switching period (DBSL)*	$0<T^*\leq T$	*(tax)*
A	*Net Present Value of Capital Allowances*	$0\leq A\leq\tau$	*(tax)*
v	*Indicator for Inventory Valuation Method*	$v=\{0; 0.5; 1\}$	*(tax)*
$\hat{\imath}$	*Notional Interest Deduction (ACE)*	$0\leq\hat{\imath}$	*(tax)*
$\hat{\tau}$	*Tax rate applicable to notional interest*	$0<\tau$	*(tax)*
φ_{exp}	*Share of initial investment expensed*	$0<\varphi_{exp}<1$	*(tax)*
τ_d	*Tax rate on distributions (Estonia)*	$0<\tau_d<1$	*(tax)*

1. Macroeconomic parameters include real and nominal interest rates as well as inflation. The database includes three different macroeconomic scenarios. In the first two scenarios, the macroeconomic parameters are fixed across countries. In the third, country-specific, scenario nominal interest rates are sourced from the OECD Economic Outlook, the IMF International Financial Statistics or through direct contact with delegates. Using this data, 5-year averages of the long-term rate on government bonds (10 years) are constructed and a 3 percentage points risk premium is added to the corresponding real interest rate. This

approach has several advantages. First, consistent data on government bond rates are available for all countries in the sample. Second, taking the 5-year average reduces year-on-year volatility in interest rates. Third, adding the risk premium to the long-term government bond rates better reflects the borrowing costs of corporates; in addition, it also ensures that real interest rates are not negative, which would imply a violation of one of the boundary conditions inherent in the theoretical model. Table A.2 summarises the three macroeconomic scenarios and Table A.3 shows the country-specific values for the third scenario.

Table A.2. Macroeconomic Scenarios

Scenario		Nominal Interest	Real Interest	Inflation
1	*(fixed across countries)*	0.071	0.05	0.02
2	*(fixed across countries)*	0.0403	0.03	0.01
3	*(country-specific)*	*(see Table A.3)*	*(see Table A.3)*	*(see Table A.3)*

Table A.3. Country-specific Inflation and Interest Rates in Scenario 3

Country	Inflation	Real Interest	Nominal Interest
ALB	1.74	2.81	4.61
AND	0.64	3.91	4.57
ARG	2.42	8.35	10.97
AUS	1.93	4.05	6.07
AUT	1.50	2.55	4.09
BEL	1.22	3.01	4.27
BGR	0.13	5.51	5.64
BRA	6.75	7.97	15.26
BWA	3.89	3.90	7.94
CAN	1.40	3.84	5.30
CHE	-0.26	3.62	3.35
CHL	3.33	4.26	7.74
CHN	1.91	4.64	6.65
COD	1.42	9.22	10.77
CRI	2.43	10.00	12.67
CUW	0.79	4.45	5.27
CYM	0.12	5.13	5.25
CYP	-1.00	8.75	7.66
CZE	1.05	3.09	4.17
DEU	0.97	2.75	3.75
DNK	0.64	3.28	3.94
ESP	0.50	4.88	5.41
EST	1.15	3.40	4.59
FIN	0.68	3.30	4.01
FRA	0.52	3.69	4.24
GBR	1.48	3.40	4.93
GGY	1.48	3.40	4.93
GRC	-0.73	12.03	11.20
HKG	2.92	1.87	4.84
HRV	0.30	6.40	6.72
HUN	0.84	6.19	7.08
IDN	5.30	5.15	10.72
IMN	1.48	3.40	4.93
IND	6.15	4.48	10.91
IRL	0.15	4.65	4.81
ISL	2.20	3.47	5.75
ISR	0.22	5.28	5.51
ITA	0.53	4.97	5.52
JAM	5.61	5.17	11.06
JEY	1.48	3.40	4.93
JPN	0.85	2.47	3.34
KEN	6.70	3.97	10.93
KOR	1.24	4.16	5.45
LIE	-0.26	3.62	3.35

LTU	0.98	3.97	4.99
LUX	0.97	2.90	3.90
LVA	0.77	3.86	4.66
MAC	3.94	2.66	6.71
MEX	3.88	5.25	9.34
MLT	0.96	3.98	4.97
MSR	1.32	3.92	5.29
MUS	2.54	4.77	7.43
NLD	1.16	2.83	4.02
NOR	2.35	2.58	5.00
NZL	1.03	5.01	6.09
PER	3.20	7.55	10.99
PNG	5.71	7.27	13.39
POL	0.32	6.02	6.35
PRT	0.49	6.37	6.89
ROU	0.85	3.93	4.82
RUS	8.17	3.98	12.47
SAU	2.32	2.26	4.63
SEN	0.38	8.75	9.17
SGP	0.58	4.79	5.40
SVK	0.36	4.19	4.56
SVN	0.56	5.01	5.60
SWE	0.50	3.64	4.16
SYC	2.32	5.95	8.41
TCA	1.32	3.92	5.29
THA	0.81	5.15	6.00
TUR	8.59	3.78	12.70
USA	1.32	3.92	5.29
VGB	1.32	3.92	5.29
ZAF	5.64	5.65	11.61

Source: In the third, country-specific, scenario nominal interest and inflation rates are sourced from the OECD Economic Outlook, the IMF International Financial Statistics or through direct contact with delegates.

2. Asset-specific parameters include the pre-tax rate of return and economic depreciation rates. The pre-tax rate of return is set to 20% throughout all calculations. Economic depreciation rates are based on estimates from the literature (Fraumeni, 1997; BEA, 2003; Patry, 2007; Li, 2012); Table A.4 provides information on asset-specific parameters.

Table A.4. Economic Depreciation by Asset Category

Asset	Economic Depreciation
Non-residential Structures	0.0269
Immovable Tangible Assets	0.1145
Movable Tangible Assets	0.1608
Intangible Assets	0.2548

Source: Fraumeni, 1997; BEA, 2003; Patry, 2007; Li, 2012.

3. Tax-related parameters have been obtained from two separate sources. Data on EU-28 countries is regularly collected by the Centre for European Economic Research (ZEW) at the request of the European Commission (EC). The latest cross section of this data series, reflecting tax rules as of 1 July 2017, has been shared with OECD CTPA in order to ensure

that tax parameters are consistent across the two approaches. Data for OECD and IF countries which are not in the EU-28 has been collected by OECD CTPA through a questionnaire on corporate effective tax rates circulated in 2018.

4. Some countries had an allowance for corporate equity (ACE) in place in 2017: Belgium, Brazil, Italy, Liechtenstein and Turkey. In scenarios 1 and 2, interest and inflation are constant across countries; in these two cases, it is assumed that notional interest deductions are equal to the nominal interest rate consistent with the modelling assumptions, i.e. 7.1% and 4.03% in the first and second scenario, respectively. For Liechtenstein the calculations also account for a 6% reduction of the equity stock applicable for the calculation of the notional interest deduction. Similarly, the relevant equity stock is reduced by 50% in Turkey according to the relevant tax provisions. In Italy, the ACE does not apply for purposes of the local profits tax (IRAP); this effect is accounted for by including the relevant tax rate in equation (29) of Annex B. In the country-specific scenario, notional interest deductions correspond to the actual rates that have been legislated in 2017 (see Table A.5).

Table A.5 Notional Interest Deduction

Scenario	Countries	Notional Interest Deduction
1	BEL, BRA, ITA	0.071
1	LIE	0.0667
1	TUR	0.0355
2	BEL, BRA, ITA	0.0403
2	LIE	0.0379
2	TUR	0.0202
3	BEL	0.00237
3	BRA	0.0736
3	ITA	0.0160
3	LIE	0.004
3	TUR	0.0853

5. Expensing investments implies that investment costs can be deducted immediately, i.e., at the beginning of the first period of the project lifetime. Since this reduces financing costs in the case of debt finance, equation (11b) accounts for this effect by including a parameter capturing the share of expensing or bonus depreciation available. However, this effect does not occur when investments are depreciated, e.g., based on a 100% SL or DB schedule; those cases correspond to situations where deductions become available at the end of the first year, thus not having any impact on the amount of debt that needs to be taken up.

6. Estonia taxes corporate profits only if they are distributed; retained profits are not taxed. Following ZEW (2016), the effects of this system are accounted for by modifying the parameter measuring the opportunity cost of retained earnings in terms of dividends foregone (γ). Since personal income taxes are not included in the present analysis, this parameter is equal to one throughout the rest of the analysis; however, for Estonia it is set to $(1-\tau_d)/(1-\tau)$, implying that the opportunity cost of retained earnings is reduced to 80% in 2017 where the standard rate was zero and the rate on distributions 20%.

Asset Categories and Construction of Composite ETRs

7. In the CTPA questionnaire, the four asset categories were defined as follows.

- **Non-residential structures**: e.g., office buildings or plants.
- **Immovable tangible assets**: e.g., machinery.
- **Movable tangible assets**: e.g., cars, furniture or equipment.
- **Intangible assets**: e.g., acquired patents, trade-marks or utility models.

8. The questionnaire described the most common cost recovery methods, provided examples and asked respondents to provide information on the most empirically relevant tax depreciation rules within a given asset category. For countries with more fine-grained, differentiated tax depreciation rules, additional information on asset stocks within each category was provided (based on US data from 2017), to inform the choice of the appropriate tax depreciation rule. To ensure comparability with the data obtained from the EC, immovable and movable tangible assets were combined to form a single asset category using weights derived from the US asset stock data (71:28 for movable and immovable tangible assets).

9. Using this information, ETRs are calculated separately for each asset and source of finance, i.e., debt and equity. Asset-specific ETRs, depicted in Figure 1.3, are calculated by weighting debt to equity using a 65:35 split, as is common in the empirical literature (e.g., Egger et al., 2009). The composite ETRs are then constructed as an unweighted average across the four asset categories.

References

BEA (2003), Fixed Assets and Consumer Durable Goods in the United States, 1925-1997, US Bureau of Economic Analysis.

Devereux, Michael P., and Rachel Griffith (1999), The Taxation of Discrete Investment Choices, Institute for Fiscal Studies, Working Paper Series No. W98/16.

Devereux, Michael P., and Rachel Griffith (2003), Evaluating Tax Policy for Location Decisions, International Tax and Public Finance, Vol. 10, pages 107–126.

Egger, Peter, Simon Loretz, Michael Pfaffermayr and Hannes Winner (2009), Bilateral Effective Tax Rates and Foreign Direct Investment, International Tax and Public Finance, Vol. 16, pages 822-849.

Fraumeni, Barbara, (1997), The Measurement of Depreciation in the U.S. National Income and Product Accounts, Survey of Current Business.

Hanappi, T. (2018), "Corporate Effective Tax Rates: Model Description and Results from 36 OECD and Non-OECD Countries", OECD Taxation Working Papers, No. 38, OECD Publishing, Paris, http://dx.doi.org/10.1787/a07f9958-en.

Li, Wendy C.Y., (2012), Depreciation of Business R&D Capital, Bureau of Economic Analysis/National Science Foundation, R&D Satellite Account Paper.

Patry, Andre, (2007), Economic Depreciation and Retirement of Canadian Assets: A Comprehensive Empirical Study, Statistics Canada, Catalogue No. 15-549-XIE

ZEW (2016), Project for the EU Commission: Effective Tax Levels using the Devereux/Griffith Methodology, Zentrum fuer Europaeische Wirtschaftsforschung, Project for the EU Commission, TAXUD/2013/CC/120, Final Report.

Annex B. Equations

Main Equations

$$EATR = \frac{R^* - R}{p/(1+r)} \tag{1}$$

$$R^* = \ (p-r)/(1+r) \tag{-}$$

$$R^{RE} = -(1-A) + \frac{1}{1+i}[(p+\delta)(1+\pi)(1-\tau) + (1-\delta)(1+\pi)(1-A)] \tag{9}$$

$$R = R^{RE} + F^{DE} + F_{ACE} \tag{11a}$$

$$F^{DE} = \begin{cases} \frac{(1-\tau * \varphi_{exp})}{1+i}(i - i(1-\tau)) & Debt \\ 0 & Retained\ Earnings \end{cases} \tag{11b}$$

$$\tilde{p} = \frac{(1-A)(i+\delta(1+\pi)-\pi)}{(1+\pi)(1-\tau)} - \frac{F^{DE}(1+i)}{(1-\tau)(1+\pi)} - \delta \tag{13}$$

$$EMTR = \frac{\tilde{p} - r}{\tilde{p}} \tag{14}$$

Fiscal Depreciation

$$A^{DB} = \frac{\tau\varphi}{1+i}\left[1 + \left(\frac{1-\varphi}{1+i}\right) + \left(\frac{1-\varphi}{1+i}\right)^2 + \left(\frac{1-\varphi}{1+i}\right)^3 + \cdots\right] = \frac{\tau\varphi}{\varphi+i} \tag{16}$$

$$A^{SL} = \tau\varphi\left[\left(\frac{1}{1+i}\right) + \left(\frac{1}{1+i}\right)^2 + \cdots + \left(\frac{1}{1+i}\right)^T\right] = \frac{\tau\varphi}{i}\left(1 - (1+i)^{-\frac{1}{\varphi}}\right) \tag{17}$$

$$A^{DBSL} = \tau\left[\frac{\beta}{1+i}\left(1 + \frac{(1-\beta)}{(1+i)} + \frac{(1-\beta)^2}{(1+i)^2} + \cdots + \frac{(1-\beta)^{T^*-1}}{(1+i)^{T^*-1}}\right) + \frac{(1-\beta)^{T^*}}{(T-T^*)}\left(\frac{1}{(1+i)^{T^*+1}} + \cdots + \frac{1}{(1+i)^T}\right)\right] \tag{18}$$

$$A_{HYC}^{DBSL} = \tau\left[\frac{\beta}{1+i}\left(\frac{1}{2}+\frac{(1-\beta/2)}{(1+i)}+\frac{(1-\beta/2)(1-\beta)}{(1+i)^2}+\frac{(1-\beta/2)(1-\beta)^2}{(1+i)^3}+\cdots\right.\right.$$
$$\left.+\frac{(1-\beta/2)(1-\beta)^{T^*-2}}{(1+i)^{T^*-1}}\right)$$
$$+\frac{(1-\beta/2)(1-\beta)^{T^*-1}}{(T-T^*)}\left(\frac{1}{(1+i)^{T^*+1}}+\cdots+\frac{1}{(1+i)^T}\right.$$
$$\left.\left.+\frac{1}{2}\frac{1}{(1+i)^{T+1}}\right)\right] \tag{19}$$

Inventory Valuation

$$R_v^{RE} = -(1-A)+\frac{1}{1+i}[(p+\delta)(1+\pi)(1-\tau)-v\pi\tau+(1-\delta)(1+\pi)(1-A)] \tag{26}$$

$$\widetilde{p_v} = \frac{(1-A)(i+\delta(1+\pi)-\pi)+v\pi\tau}{(1+\pi)(1-\tau)}-\frac{F^{DE}(1+i)}{(1-\tau)(1+\pi)}-\delta \tag{27}$$

Allowance for Corporate Equity

$$F_{ACE} = \begin{cases} 0 & Debt \\ \hat{\imath}(\tau-\hat{\tau})\dfrac{1}{1+i} & Retained\ Earnings \end{cases} \tag{29}$$