Corporate Effective tax rates: Modelling notes

Explanatory Annex to 2023 Corporate Tax Statistics

Annex applicable for Corporate Effective Tax Rates

1. Methodology, Exogenous Variables and Data Collection

1. This annex provides a summary of the methodology used to calculate the effective tax rates (ETRs) published in Corporate Tax Statistics. The baseline model is described in detail by Hanappi (2018[1]), following the model developed by Devereux and Griffith (2003[2]). Building on the baseline model, two methodological updates have been introduced in 2023 Corporate Tax Statistics.

- First, the time structure of the model has been adapted in line with the approach introduced by Klemm (2008[3]). That is to say, the current model version assumes a standardised investment project where investors acquire a capital asset and use it for production until the capital asset is fully depleted (i.e., there is no reselling of capital assets).
- Second, a tax-exclusive (TE) definition of the effective marginal tax rate (EMTR) has been adopted, implying that the real interest rate is used as denominator in the EMTR definition, instead of the cost of capital (Creedy and Gemmell, 2017[4])).

2. These methodological updates allow the models to better capture complex tax provisions, including tax incentives. They also ensure that the indicators can adequately capture differing macroeconomic conditions such as high inflationary environments. They also bring the baseline model in line with recent OECD work using forward-looking ETRs to assess the impact of tax incentives (Celani, Dressler and Hanappi, 2022[5]; González Cabral et al., 2023[6]) achieving greater consistency among different topic areas. The updated methodology has been retroactively applied to years 2017 through to 2022.

3. 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 Corporate ETR Model

Variable	Description	Range	Category
p	Pre-tax rate of return	$0<p\leq 1$	(asset)
δ	Economic depreciation rate	$0<\delta\leq 1$	(asset)
r	Real interest rate	$r\lesseqgtr 0$	(macroeconomic)
i	Nominal interest rate	$0\leq i$	(macroeconomic)
π	Inflation rate	$0\leq \pi$	(macroeconomic)
τ	Corporate tax rate	$0\leq \tau$	(tax)
φ	Capital allowance rate (SL, DB)	$0\leq \varphi\leq 1$	(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	$v=\{\mathbf{0};\mathbf{0.5};\mathbf{1}\}$	(tax)
$\hat{\boldsymbol{\imath}}$	Allowance for corporate equity notional rate	$0\leq \hat{\boldsymbol{\imath}}$	(tax)
$\hat{\boldsymbol{\tau}}$	Tax rate applicable to notional interest	$0\leq \tau$	(tax)
$\boldsymbol{N^{ACE}}$	ACE: Number of years over which the provision is spread (Belgium)	$\boldsymbol{N^{ACE}\geq 1}$	(tax)
$\boldsymbol{\varphi_{exp}}$	Share of initial investment expensed	$\boldsymbol{0\leq \varphi_{exp}\leq 1}$	(tax)
$\boldsymbol{\tau_d}$	Tax rate on distributions (Estonia, Latvia)	$\boldsymbol{0\leq \tau_d\leq 1}$	(tax)

4. Macroeconomic parameters include real and nominal interest rates as well as inflation. The database includes two different macroeconomic scenarios. In the first scenario, the macroeconomic parameters are fixed across countries which allows better comparisons of the tax systems, as differences across countries are not related to changes in the macroeconomic conditions.

5. In the second scenario, country-specific macroeconomic parameters are set to be country-specific. For this scenario, nominal interest rates and inflation rates are sourced from the OECD Economic Outlook, the IMF International Financial Statistics, the European Central Bank or through direct contact with delegates or from public sources in a few instances. Using this data, 5-year averages of the long-term rate on government bonds (10 years) are constructed and a 5-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 a large subset of 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. Similarly, a five-year moving average is constructed for inflation to smooth any temporary inflation spikes.

6. Table A.2 summarises the two macroeconomic scenarios and Table A.3 shows the country-specific values for the second scenario.

Table A.2. Macroeconomic scenarios

Scenario		Inflation (%)	Real interest rate (%)	Nominal interest rate (%)
1	(fixed across countries)	1	3	4.03
2	(country-specific)	(see Table A.3)	(see Table A.3)	(see Table A.3)

Source: OECD.

Table A.3. Country-specific Inflation and Interest Rates in Scenario 2

Country code	Inflation						Real interest rate					
	2017	2018	2019	2020	2021	2022	2017	2018	2019	2020	2021	2022
AGO	11.1	13.2	12.9	14.3	15.2	19.1	2.1	-0.2	0.1	0.0	-0.4	-3.1
ALB	1.7	1.8	1.7	1.7	1.8	2.8	9.8	10.3	10.3	9.6	9.5	8.1
AND	0.3	0.4	0.5	0.8	1.2	1.9	5.5	5.4	5.5	5.1	4.8	4.1
ARG	11.1	13.2	12.9	14.3	15.2	19.1	1.5	0.2	3.6	1.3	1.8	-2.1
AUS	1.9	1.8	1.7	1.5	1.8	2.8	6.0	5.9	5.7	5.5	5.0	4.2
AUT	1.5	1.5	1.5	1.6	2.0	3.3	4.5	4.3	4.0	3.7	3.2	2.2
BEL	1.3	1.5	1.6	1.6	1.9	3.5	5.0	4.4	4.0	3.8	3.5	2.1
BGR	0.1	0.5	1.4	1.8	2.6	5.2	7.5	6.6	5.1	4.3	3.1	0.6
BHS	0.9	1.3	1.6	1.2	1.8	2.7	6.1	5.8	5.6	5.7	5.1	4.5
BOL	4.4	3.7	2.9	2.3	1.7	1.5	3.5	4.3	5.1	5.4	6.0	6.1
BRA	6.7	6.2	5.7	4.6	4.5	5.6	4.5	5.3	6.0	6.8	6.4	5.2
BWA	3.9	3.4	3.0	2.8	3.6	5.4	5.9	6.5	7.0	7.5	7.0	5.9
CAN	1.4	1.7	1.7	1.6	2.0	3.0	5.4	5.1	5.0	4.9	4.6	3.8
CHE	-0.3	0.0	0.1	0.1	0.3	0.8	5.5	5.1	4.8	4.6	4.4	4.1
CHL	3.4	3.5	3.1	2.8	2.9	4.8	6.2	5.9	6.1	6.1	5.9	4.5
CHN	2.0	1.8	2.0	2.2	1.9	2.0	6.3	6.6	6.3	6.0	6.3	6.1
COD	5.2	8.8	9.5	11.6	12.8	10.5	13.5	6.9	6.6	5.7	4.9	7.0
COL	4.3	4.6	4.7	4.2	3.4	4.6	7.8	7.6	7.4	7.6	8.3	8.1
CRI	2.4	1.8	1.3	1.3	1.7	3.0	11.2	12.5	13.1	12.9	12.4	10.9
CUW	3.5	3.6	3.5	3.7	3.9	5.2	4.6	4.6	4.9	4.9	4.7	3.5
CYM	3.5	3.6	3.5	3.7	3.9	5.2	3.9	3.8	3.5	3.3	3.2	1.9
CYP	-0.4	-0.3	-0.1	-0.1	0.6	2.1	10.1	9.1	8.0	7.2	5.8	4.4
CZE	1.0	1.2	1.7	2.3	2.9	5.4	5.1	4.9	4.4	4.0	3.7	1.9
DEU	1.0	1.1	1.2	1.1	1.7	3.1	4.7	4.4	4.0	3.9	3.2	2.1
DNK	0.6	0.6	0.7	0.7	1.0	2.3	5.3	5.0	4.7	4.5	4.1	3.0
DOM	2.7	2.5	2.2	2.8	4.1	5.2	12.9	13.9	14.1	12.3	11.1	9.2
ECU	2.5	1.9	1.2	0.4	0.1	0.7	6.9	7.8	8.4	8.8	9.2	8.6
EGY	11.1	13.2	12.9	13.7	12.6	10.2	6.7	5.7	5.9	3.8	5.0	7.3
ESP	0.5	0.5	0.7	0.8	1.4	2.7	6.9	6.2	5.6	5.3	4.4	3.3
EST	1.6	1.7	2.0	1.9	2.6	5.8	8.2	8.1	7.6	7.4	6.7	3.7
FIN	0.9	0.7	0.7	0.8	1.1	2.4	5.1	5.1	4.8	4.5	4.1	3.1
FRA	0.6	0.9	1.0	1.1	1.4	2.4	5.6	5.1	4.6	4.3	3.9	3.2

Country code	Inflation						Real interest rate					
	2017	2018	2019	2020	2021	2022	2017	2018	2019	2020	2021	2022
GBR	1.5	1.5	1.5	1.7	2.1	3.4	5.4	5.2	4.8	4.4	3.9	2.9
GGY	3.5	3.6	3.5	3.7	3.9	5.2	3.5	3.1	2.8	2.4	2.4	1.2
GRC	-0.4	-0.1	0.3	0.2	0.3	2.0	13.7	12.1	10.9	9.2	7.6	5.5
GTM	3.8	3.7	3.7	3.9	3.9	4.4	7.5	8.0	7.9	7.1	7.2	6.7
HKG	3.1	2.7	2.4	1.9	1.7	1.8	3.6	4.1	4.3	4.6	4.7	4.9
HND	4.2	4.0	3.7	3.8	4.1	5.2	5.7	5.7	5.9	5.6	5.3	4.3
HRV	0.6	0.4	0.6	0.6	1.3	3.1	8.1	7.7	7.1	6.5	5.2	3.4
HUN	0.8	1.1	1.8	2.5	3.4	5.8	8.2	7.4	6.2	5.3	4.4	2.9
IDN	5.3	4.7	4.0	3.1	2.7	2.8	7.2	7.9	8.4	9.0	9.2	9.1
IMN	3.5	3.6	3.5	3.7	3.9	5.2	6.4	6.2	6.1	5.7	5.4	4.2
IND	5.7	4.5	4.2	4.5	4.7	5.3	6.9	8.0	8.0	7.4	7.0	6.5
IRL	0.2	0.2	0.3	0.2	0.8	2.3	6.6	6.0	5.5	5.3	4.7	3.3
ISL	2.2	2.0	2.2	2.4	2.9	4.3	5.5	5.6	5.0	4.3	3.4	1.9
ISR	0.2	0.1	0.2	0.1	0.6	1.4	7.3	7.1	6.7	6.5	5.9	5.2
ITA	0.6	0.6	0.7	0.6	1.0	2.5	6.9	6.6	6.3	6.3	5.7	4.5
JAM	5.6	4.5	3.6	3.9	4.6	5.6	6.6	8.2	9.0	7.9	7.3	5.0
JEY	1.9	2.2	2.5	2.5	2.2	2.6	5.0	4.4	3.7	3.5	4.1	3.5
JPN	0.9	1.0	0.5	0.4	0.3	0.7	4.5	4.2	4.5	4.6	4.7	4.3
KEN	6.7	6.5	6.2	5.9	5.9	5.8	10.9	12.0	12.3	11.1	11.3	11.5
KOR	1.2	1.3	1.1	1.1	1.4	2.0	6.3	6.1	6.0	5.9	5.6	5.2
LBR	9.3	11.5	12.7	14.3	14.3	13.3	0.3	-1.5	-2.5	-3.8	-3.7	-3.0
LIE	3.5	3.6	3.5	3.7	3.9	5.2	1.6	1.5	1.5	1.4	1.2	0.0
LTU	1.0	1.3	1.7	2.0	2.8	5.9	5.8	4.8	4.0	3.4	2.5	-0.2
LUX	0.9	1.0	1.2	1.2	1.9	3.1	4.9	4.6	4.2	4.0	3.2	2.3
LVA	0.8	1.3	1.7	1.7	2.3	5.2	5.8	4.9	4.0	3.9	3.1	0.7
MAC	3.9	3.4	2.8	2.0	1.6	1.5	2.9	3.5	4.2	4.7	5.2	5.2
MEX	3.9	4.1	4.0	4.2	4.7	5.1	7.3	7.5	7.9	7.8	7.3	7.3
MLT	1.0	1.2	1.3	1.2	1.2	2.2	5.9	5.9	5.6	5.5	5.8	3.9
MSR	3.5	3.6	3.5	3.7	3.9	5.2	1.7	1.5	1.6	1.5	3.3	2.2
MUS	2.5	2.5	1.9	2.2	2.8	4.2	6.8	6.9	7.3	6.6	5.7	4.2
NIC	4.9	4.5	4.3	4.3	4.6	5.9	2.2	2.7	2.8	2.7	2.4	1.3
NLD	0.9	0.7	1.2	1.4	1.9	4.0	5.1	5.0	4.2	3.8	3.2	1.4
NOR	2.4	2.5	2.5	2.3	2.3	3.1	4.6	4.3	4.1	4.1	4.2	3.6
NZL	1.0	1.1	1.2	1.5	2.1	3.2	7.5	7.1	6.5	5.7	4.9	4.0
PAN	1.7	1.0	0.4	0.1	0.3	0.7	8.0	9.0	9.6	9.4	9.3	8.8
PER	3.2	2.9	2.7	2.3	2.4	3.4	11.8	12.9	13.1	12.3	13.6	7.0
PNG	5.7	5.5	5.3	5.1	4.6	4.9	9.3	10.0	10.3	10.5	10.9	10.7
POL	0.3	0.5	0.9	1.8	2.9	5.4	8.0	7.7	7.0	5.9	4.6	2.7
PRT	0.6	0.7	0.8	0.7	0.8	2.1	8.1	7.1	6.4	6.1	5.5	4.0
PRY	3.7	4.0	3.5	3.2	3.4	4.6	5.9	6.0	6.4	6.1	6.1	4.9
ROU	0.9	1.0	1.5	2.2	3.5	6.0	5.9	5.4	4.7	4.4	3.3	1.7
SAU	1.6	1.4	0.6	1.0	1.2	1.9	5.8	6.2	7.1	6.3	6.2	6.4

Country code	Inflation						Real interest rate					
	2017	2018	2019	2020	2021	2022	2017	2018	2019	2020	2021	2022
SEN	0.6	0.5	0.9	1.3	1.5	3.2	9.6	10.0	9.5	8.6	8.5	5.8
SGP	0.6	0.2	0.1	0.2	0.7	1.8	6.6	7.1	7.1	6.7	6.0	5.0
SLV	0.6	0.6	0.4	0.5	1.1	2.3	9.0	9.3	9.5	8.9	8.4	7.1
SVK	0.4	0.6	1.2	1.6	2.3	4.5	6.1	5.5	4.5	3.9	3.1	1.3
SVN	0.6	0.6	0.8	0.9	1.3	2.8	7.0	6.0	5.2	4.7	4.1	2.9
SWE	0.5	0.9	1.3	1.4	1.6	3.0	5.6	5.0	4.2	4.0	3.7	2.6
SWZ	6.1	5.9	5.3	5.1	4.2	4.0	8.8	9.7	10.3	9.3	10.3	10.7
SYC	2.3	2.2	2.3	1.7	3.9	3.8	7.9	8.4	8.4	9.4	7.8	8.0
TCA	3.5	3.6	3.5	3.7	3.9	5.2	3.9	3.8	3.5	3.3	3.2	1.9
THA	0.8	0.6	0.3	0.4	0.6	1.6	7.2	7.2	7.1	6.8	6.5	5.4
TUR	8.6	10.4	11.6	12.5	14.9	19.1	6.4	5.4	4.7	4.7	3.0	-0.3
URY	8.4	8.2	8.0	8.2	7.8	8.4	6.6	7.5	7.6	6.3	6.8	6.5
USA	1.3	1.5	1.6	1.8	2.5	3.6	5.9	5.8	5.7	5.2	4.5	3.5
VGB	3.5	3.6	3.5	3.7	3.9	5.2	3.9	3.8	3.5	3.3	3.2	1.9
ZAF	5.6	5.4	5.0	4.7	4.4	4.7	7.7	8.2	8.7	9.3	9.8	9.8

Note: Long-term interest rates and inflation rates refer to the average of the 5-year prior. The average could refer to fewer numbers of years if data is missing. When no time series data is available, estimates are projected forward using the world growth rate in the respective indicator. Estimates of the real interest rate in the table include a 5% risk premium. In Scenario 2, EMTR indicators are not available for six countries (Angola, Argentina, the Democratic Republic of Congo, Liberia, Lithuania, and Türkiye) due to large inflation rates in the years of reference creating large negative real interest rates that are inconsistent with standard modelling assumptions.
Source: For the country-specific scenario, nominal interest and inflation rates are sourced from the OECD Economic Outlook, the IMF International Financial Statistics, the European Central Bank, through direct contact with delegates and from other public sources in a few instances.

7. 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[7]; Bureau of Economic Analysis, 2003[8]; Patry, 2007[9]; Li and Hall, 2020[10]) . The data collection for the tangible asset category is disaggregated into five subgroups (air, rail or water transport vehicles, computer hardware, equipment, industrial machinery, road transport vehicles) to better match variation in economic depreciation rates within this asset category. Table A.4 provides information on asset-specific parameters.

Table A.4. Economic Depreciation by Asset Category

Asset	Economic Depreciation
Non-residential Structures	0.0329
Air, Rail or Water Transport Vehicles (Tangible Asset)	0.0661
Computer Hardware (Tangible Asset)	0.3699
Equipment (Tangible Asset)	0.1546
Industrial Machinery (Tangible Asset)	0.1259
Road Transport Vehicles (Tangible Asset)	0.2014
Acquired Software	0.4033

Note: The tangible assets category consists of five subgroups (air, rail or water transport vehicles, computer hardware, equipment, industrial machinery, road transport vehicles) that are aggregated, using the unweighted average, to obtain a single set of ETR indicators for this category.
Source: Fraumeni, 1997; BEA, 2003; Patry, 2007; Li, 2012; Secretariat calculations.

8. Tax-related parameters are collected via the annual OECD Corporate ETR survey filled in by country delegates from the Working Party No 2 on Tax Policy and Statistics. Data for EU-28 countries in 2017 was collected by the Centre for European Economic Research (ZEW) at the request of the European Commission (EC) and has been validated by country delegates to ensure the consistency of the two approaches.

9. Some countries had an allowance for corporate equity[1] (ACE) in place in the reference period. In scenario 1, interest and inflation are constant across countries; in this case, it is assumed that notional interest deductions are equal to the nominal interest rate consistent with the modelling assumptions, i.e. 4.03%. For Liechtenstein the calculations also account for a 6% reduction of the equity stock applicable for the calculation of the ACE. Similarly, the relevant equity stock is reduced by 50% in Türkiye 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 2018, the ACE in Belgium was reformed to apply only to the incremental net accounting equity over a period of five years. The smoothing of the benefits of the provisions over a given number of years is modelled by the parameter N^{ACE} in equation (29) in Annex B. This parameter takes the value 1 for the rest of ACE cases.

10. Some ACEs apply only to new issues of equity, i.e., incremental, while others apply to the equity stock. The methodological updates enable a distinction in the modelling of both types of ACEs (Annex B). The ACE in Belgium, Cyprus, Portugal and Türkiye are modelled as incremental ACEs. In the case of Italy, the ACE provides a deduction based on the sum of net equity increases occurred after 1st January 2011. The ACE is modelled as applying on the stock of equity rather than on new issues of equity since for companies established after 2011, the entirety of the equity stock is considered as the base for the allowance.

11. In the country-specific scenario, ACEs correspond to the actual rates that have been legislated in the respective years (see Table A.5).

Table A.5 Allowances for Corporate Equity rates (%)

Country Code	Year	Scenario 1	Scenario 2
BEL	2017	4.03	0.237
BEL	2018	4.03	0.746
BEL	2019	4.03	0.726
BEL	2020	0	0
BEL	2021	0	0
BEL	2022	0	0
CYP	2017	3.22	5.191
CYP	2018	3.22	3.905
CYP	2019	3.22	3.905
CYP	2020	3.22	4.109
CYP	2021	3.22	4.288
CYP	2022	3.22	4.288
ITA	2017	4.03	1.6
ITA	2018	4.03	1.5
ITA	2019	4.03	1.3
ITA	2020	4.03	1.3
ITA	2021	4.03	1.3

[1] Allowances for corporate equity are also often referred to as notional interest deductions (NID). For brevity, this annex uses the term ACE.

Country Code	Year	Scenario 1	Scenario 2
ITA	2022	4.03	1.3
LIE	2017	3.7882	3.76
LIE	2018	3.7882	3.76
LIE	2019	3.7882	3.76
LIE	2020	3.7882	3.76
LIE	2021	3.7882	3.76
LIE	2022	3.7882	3.76
MLT	2017	0	0
MLT	2018	4.03	7.0025
MLT	2019	4.03	6.1375
MLT	2020	4.03	6.16
MLT	2021	4.03	6.3275
MLT	2022	4.03	8.2725
POL	2017	0	0
POL	2018	0	0
POL	2019	4.03	2.5
POL	2020	4.03	2.5
POL	2021	4.03	1.1
POL	2022	4.03	2.75
PRT	2017	4.03	7
PRT	2018	4.03	7
PRT	2019	4.03	7
PRT	2020	4.03	7
PRT	2021	4.03	7
PRT	2022	4.03	7
TUR	2017	2.015	8.53
TUR	2018	2.015	13.52
TUR	2019	2.015	6.01
TUR	2020	2.015	6.01
TUR	2021	2.015	12.185
TUR	2022	2.015	6.15

Note: The ACE for Türkiye and Liechtenstein reflect the adjusted rate.
Source: Secretariat.

12. 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 A.6 in Annex A 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. As opposed to expensing, when the asset is depreciated over time, the net present value of depreciation allowances is lower, due to the impact on inflation. The reduction in the value of the investment caused by inflation is therefore sensitive to the life of the asset. In order to compensate for this loss in value, some jurisdictions index depreciation allowances by inflation. This includes Chile, Colombia, Costa Rica, Iceland, Mexico, the Netherlands, Romania and Türkiye for years 2017-20; and for Argentina for 2018-20.

13. Estonia and Latvia from 2018 tax corporate profits only if they are distributed; retained profits are not taxed. Following (ZEW, 2015[7]), 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 and Latvia it is set to $(1-\tau_d)/(1-\tau)$, implying that the opportunity cost of retained earnings is reduced to 80% when the distribution system is in place, being the standard rate, τ, equal to 0% and the rate on distributions, τ_d, equal to 20%.

2. Asset Categories and Construction of Composite ETRs

14. In the OECD Corporate ETR survey, the four asset categories were defined as follows.

- Non-residential structures: (1) manufacturing plants, large engineering structures, office or commercial buildings.
- Tangible assets: (1) road transport vehicles, (2) air, rail or water transport vehicles, (3) computer hardware, (4) equipment and (5) industrial machinery.
- Acquired intangible assets: (1) acquired software.
- Inventories

15. The survey described the most common cost recovery methods, provided examples and asked respondents to provide information on the tax depreciation rules corresponding to a given asset group (e.g., computer hardware or manufacturing plants.

16. Using this information, ETRs are calculated separately for each asset and source of finance, i.e., debt and equity. Asset-specific ETRs are calculated by weighting debt to equity using a 35:65 split, as is common in the empirical literature (Egger et al., 2009[7]). ETRs for the tangible asset category, published in the CTS database, are then constructed as an unweighted average over the respective value for each of the five subgroups. The composite ETRs are then constructed as an unweighted average across the four asset categories.

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Annex A. Equations

Main Equations to calculate Effective Tax Rates

Effective Average Tax Rate	$$EATR = \frac{R^* - R}{Y^*}$$	(A.1)
Net income (Y^*)	$$Y^* = \sum_{s=0}^{\infty} \frac{p(1+\pi)^s(1-\delta)^{s-1}}{(1+i)^s} = \frac{p}{r+\delta}$$	(A.2)
Economic profit in the absence of taxation (R^*)	$$R^* = -1 + \sum_{s=0}^{\infty} \frac{(p+\delta)(1+\pi)^s(1-\delta)^{s-1}}{(1+i)^s} = \frac{p-r}{r+\delta}$$	(A.3)
Economic profit under taxation (retained earnings), R	$$R = R^{RE} + F^{DE} + F^{RE}_{ACE}$$	(A.4)
Economic profit under taxation, retained earnings (no financing terms), R^{RE}	$$R^{RE} = \sum_{s=d+1}^{\infty} \frac{(p+\delta)(1+\pi)^s(1-\delta)^{s-d-1}(1-\tau_{t+s})}{(1+i)^s} + A^* - 1 = \frac{(p+\delta)(1-\tau)}{(1+r)^d(r+\delta)} + A^* - 1 \;\; if \; \forall t \; \tau_t = \tau$$	(A.5)
Financing term (debt)	$$F^{DE} = \begin{cases} (1-\tau\varphi_{exp})(i - i(1-\tau))\frac{1}{(r+\delta)(1+\pi)} & Debt \\ 0 & Retained\ Earnings \end{cases}$$	(A.6)
Financing term (Allowance for corporate equity)	$$F^{RE}_{ACE} = \begin{cases} \hat{\imath}(\tau - \hat{\tau})\frac{1}{(r+\delta)(1+\pi)} & ACE - Equity\ Stock \\ \hat{\imath}(\tau - \hat{\tau})\frac{1}{(1+i)} & ACE - New\ Equity \end{cases}$$	(A.7)
Cost of capital	$$\tilde{p} = \frac{(1-A^*)(r+\delta)}{(1-\tau)} - \frac{F(r+\delta)}{(1-\tau)} - \delta$$	(A.8)
Effective Marginal Tax Rate (tax exclusive)[2]	$$EMTR - tax\ exclusive = \frac{\tilde{p} - r}{r}$$	(A.9)

Fiscal Depreciation: Estimates of capital allowances.

Declining balance method	$$A^{DB} = \frac{\tau\varphi}{1+i}\left[1 + \left(\frac{1-\varphi}{1+i}\right) + \left(\frac{1-\varphi}{1+i}\right)^2 + \left(\frac{1-\varphi}{1+i}\right)^3 + \cdots\right] = \frac{\tau\varphi}{\varphi+i}$$	(A.10)

[2] The tax inclusive version uses the cost of capital as the denominator of the fraction.

Straight-line method	$$A^{SL} = \tau\varphi\left[\left(\frac{1}{1+i}\right) + \left(\frac{1}{1+i}\right)^2 + \cdots + \left(\frac{1}{1+i}\right)^T\right] = \frac{\tau\varphi}{i}\left(1-(1+i)^{-\frac{1}{\varphi}}\right)$$	(A.11)
Declining balance method with a switch to straight-line	$$A^{DBSL} = \tau\left[\frac{\beta}{1+i}\left(1 + \frac{(1-\beta)}{(1+i)} + \frac{(1-\beta)^2}{(1+i)^2} + \cdots + \frac{(1-\beta)^{T^*-1}}{(1+i)^{T^*-1}}\right) + \frac{(1-\beta)^{T^*}}{(T-T^*)}\left(\frac{1}{(1+i)^{T^*+1}} + \cdots + \frac{1}{(1+i)^T}\right)\right]$$	(A.12)
Declining balance method with a switch to straight-line, half-year convention applies	$$A^{DBSL}_{HYC} = \tau\left[\frac{\beta}{1+i}\left(\frac{1}{2} + \frac{(1-\beta/2)}{(1+i)} + \frac{(1-\beta/2)(1-\beta)}{(1+i)^2} + \frac{(1-\beta/2)(1-\beta)^2}{(1+i)^3} + \cdots + \frac{(1-\beta/2)(1-\beta)^{T^*-2}}{(1+i)^{T^*-1}}\right) + \frac{(1-\beta/2)(1-\beta)^{T^*-1}}{(T-T^*)}\left(\frac{1}{(1+i)^{T^*+1}} + \cdots + \frac{1}{(1+i)^T} + \frac{1}{2}\frac{1}{(1+i)^{T+1}}\right)\right]$$	(A.13)

Note: When depreciation allowances are indexed by inflation, the net present value is calculated as above but using the real interest rate in (16)-(19) as the discount factor.

Inventory valuation

Economic profit under taxation, retained earnings (no financing terms), R^{RE}: Inventories	$$\boldsymbol{R_v^{RE}} = -(1-\boldsymbol{A}) + \frac{(p+\delta)(1-\bar{\tau})}{r+\delta} - \frac{\nu\tau\pi}{i-\pi}$$	(A.14)
Cost of capital: Inventories	$$\tilde{p}_v = \frac{(1-\boldsymbol{A})(r+\delta)}{(1-\tau)} + \frac{\nu\tau\pi(r+\delta)}{(i-\pi)(1-\tau)} - \frac{\boldsymbol{F}(r+\delta)}{(1-\tau)} - \delta$$	(A.15)

Note: Variable names are contained in Table 1. There are different methods available for inventory valuation. Jurisdictions may suggest a preferred inventory valuation method or employ a negative list or a positive list to determine the inventory valuation methods that firms can use. A key difference that sets inventory valuation methods apart and can be easily reflected in the modelling is whether it requires differences in the variation in the price of the assets. The variable ν takes the value of one when the inventory valuation method reflects the increase in the price level of inventories. First-in-first out methods or current price methods are modelled in this manner. Other inventory methods such as last-in-last-out or historical price methods would imply that no adjustment for inflation is required, hence ν in this model would take a value of zero. Other inventory methods instead require inventories to be valued at the average cost. These methods are approximated by assuming that inventories are adjusted by half the (a simple average between making a full inflation adjustment and no inflation adjustment).