Stata Commands for Computing Forward-Looking Effective Tax Rates on Investment[1]

Shafik Hebous, IMF, Washington, DC, USA, Shebous@imf.org

Andualem Mengistu, IMF, Washington, DC, USA, AMengistu2@imf.org

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Abstract. We present two commands – **etr** and **dietr** – to compute forward-looking effective tax rates proposed in Devereux and Griffith (2003) and Hebous and Mengistu (2024). The computation includes the option to consider the minimum corporate tax under the Pillar Two OECD-led agreement. The **etr** command calculates the *marginal* and *average* effective tax rates on a hypothetical investment, defined as the ratio of the net present value of the tax to that of the income stream. The command is flexible, allowing full user-based parameterization of macroeconomic, tax, and project-specific parameters. It returns the effective tax rates and the cost of capital as columns corresponding to integers of statutory tax rates, either using default values or a user-defined calibration. The **dietr** command calculates the effective tax rates and the cost of capital based on *specified variables* from an existing dataset—rather than calibrated parameters—, thereby enabling building cross-country databases.

Keywords: **etr**, **dietr**, forward-looking effective tax rates, net present value calculation, user cost of capital

1 Introduction

This paper briefly describes forward-looking effective tax rates (ETRs) on investment and presents the new Stata commands **etr** and **dietr**. The forward-looking ETR is ratio of the net present value of taxes to the net present value of the income stream. This calculation considers the statutory corporate income tax (CIT) as well as tax base provisions, such as depreciation allowances. For investments that yield economic rent (i.e., profit exceeding the normal return, defined as the opportunity cost of the investment), the measure is called the *average* effective tax rate (AETR). In the case of marginal investments that break even after the tax (i.e., yielding exactly the normal

1. The views expressed here are those of the authors and not necessarily those of the IMF, its Executive Board, or IMF management.

return), the measure is called the *marginal* effective tax rate (METR). The METR represents the wedge between the *user cost of capital* and the normal return, where user cost of capital is the pre-tax rate of return that equalizes the post-tax return to the normal return.

ETRs are commonly used to (i) evaluate tax policy reforms, (ii) compare countries' attractiveness—from a tax perspective, ceteris paribus—as potential investment locations, and (iii) control for confounding variables or serve as the main variable of interest in regression analyses. For these purposes, analysts value the flexibility of comparing effective rates under different scenarios or tailoring the computation of effective tax rates to a specific analysis. Existing publications and databases, however, typically lack such flexibility and are often based on a very specific set of assumptions.

Both Stata commands proposed here compute the AETRs, METRs, and the user cost of capital accommodating a wide range of tax designs based on the methodology of Devereux and Griffith (2003) and Hebous and Mengistu (2024). The **etr** command returns the METR, AETR, and the user cost of capital as columns corresponding to integers of statutory tax rates, using either default parameter values or a user-defined calibration. The **dietr** command, on the other hand, returns the METR, AETR, and the user cost of capital for *specified variables* in an existing dataset—rather than using calibrated parameters—, thereby enabling the creation of databases such as cross-country ETR panels.

Each command incorporates three tax systems, each with an array of options. A standard CIT is the common system in most countries and allows: (i) assets to depreciate for tax purposes over several years, (ii) interest expense deductions; and (iii) no allowances for the normal return. The CIT is inefficient as it yields a $METR > 0$. The literature identifies two alternative tax systems that ensure efficiency (resulting in a $METR = 0$): (i) the allowance for corporate equity (ACE), which retains the CIT features and offers an allowance for the normal return to equity (analogous to interest deductions); and (ii) the cash-flow tax, which provides immediate full expensing of the capital investment costs (instead of depreciation over time) and fully disallows interest deductions. The literature[2] established that—without frictions—the ACE and the cash-flow tax are equivalent in net present value terms.[3]

2 Framework

2.1 Average Effective Tax Rate (AETR)

Consider an investment of I units of capital in period zero ($I_0 = K_0$). The tax-depreciated capital in year t, denoted by K_t, is determined by the deprecation function

2. See, e.g., Mirrlees (2011) and Hebous and Mengistu (2024).
3. Other forms of cash-flow taxation that are equivalent to the one described here, and thus to the ACE, also exist. See, e.g., Meade (1978).

$\varphi(I)$.[4] Under a standard CIT:[5]

$$AETR = \tau\left[1 + \frac{\delta - \tilde{A}[r+\delta]}{p} - \frac{\alpha i}{p(1+\theta)}\right], \tag{1}$$

where τ is the statutory CIT rate, θ is inflation, p is real economic return net of economic depreciation δ, i is the nominal interest rate, and r is the real interest rate.[6], $0 \leq \alpha \leq 1$ is the degree of debt financing. If $\alpha = 0$ then the investment is fully equity-financed. The term $\tilde{A}$ is defined as:

$$\tilde{A} \equiv \left[\sum_{t=0}^{\infty} \frac{\varphi\left(K_t\right)}{(1+i)^t}\right] / I. \tag{2}$$

Equation 1 is sufficiently general to capture various aspects of a standard CIT by varying the values of its parameters. For example, accelerated deprecation can be modeled by increasing the depreciation rate φ. Additionally, a cash-flow tax system is equivalent to setting $\alpha = 0$ and $\varphi = 100\%$, which leads to $AETR^{\text{cft}} = \tau(1 - \frac{r}{p})$. The AETR under the ACE is equal to $AETR^{\text{cft}}$, although the mechanics behind the result differ.[7] However, Equation 1 does not account for certain tax designs, which are incorporated into our Stata commands, as briefly outlined below.

2.2 Marginal Effective Tax Rate (METR)

The METR is a special case of ETRs where the investment just breaks even. The METR is defined as the difference between the user cost of capital and the normal return, normalized by the cost of capital:[8]

$$METR \equiv \frac{\tilde{p} - r}{\tilde{p}}, \tag{3}$$

where $\tilde{p} = \frac{1}{1-\tau}\left[(r + \delta - \tau\tilde{A}(r+\delta)) - \alpha\tau\frac{i}{1+\theta}\right] - \delta$. In the absence of taxes, the marginal investment yields $p = r$. When the METR equals= 0, the marginal investment still yields $p = r$, and the investment remains viable despite the tax. In this sense, the tax system is considered efficient.

4. For example, straight-line depreciation over five years means that $\varphi = 20\%$ annually.
5. For full derivations of all equations and the tax systems behind the commands, see the online appendix in Hebous and Mengistu (2024).
6. Note that $(1+i) = (1+\theta)(1+r)$.
7. We model the ACE as an allowance for corporate capital that permits the deduction of the normal return on capital, regardless of the financing method. An equivalent alternative would be allowing interest deductions up to the normal return, in conjunction with a deemed notional return for equity.
8. See King and Fullerton (1984).

2.3 Tax Incentives

Refundable income tax credits (that directly lower the tax payment and are received in cash during loss periods) are modeled as a reduction in tax liability when the liability exceeds the credit amount. When the tax liability is lower than the credit, the excess credit is treated as income. The AETR in Equation 1 becomes:

$$AETR = \tau \left[1 + \frac{\delta - \tilde{A}[r+\delta]}{p} - \frac{\alpha i}{p(1+\theta)}\right] - \frac{NPV^{\text{credit}}(r+\delta)}{p}, \tag{4}$$

Equation 3 remains intact, but the cost of capital in the presence of refundable tax credits is given by:

$$\tilde{p} = \frac{1}{1-\tau}\left[(1-\tau\tilde{A})(r+\delta) - \alpha\tau\frac{i}{1+\theta} - NPV^{\text{credit}}(r+\delta)\right] - \delta, \tag{5}$$

where $NPV^{\text{credit}} = \sum_{t=0}^{\infty} \frac{RTC_t}{(1+i)^t}$, and RTC_t is the refundable tax credit amount in period t.

Non-refundable income tax credits are modeled as a reduction in tax liability when the liability exceeds the credit amount. When the tax liability is lower than the credit amount in a specific year, the excess credit is carried forward without interest. Since the timing of the carryovers and the amounts of credits given in a specific year affect the net present value of the tax at the end of the project, there is no closed-form expression for the AETR or METR. Consequently, the computation is done using a routine that computes the paid tax each year, accounting for the carry-forward of credits in the calculation of net present value of the *total* tax amount.

A temporary tax holiday reduces the statutory CIT rate to zero during the applicable years. Additionally, any costs incurred prior to the conclusion of the tax holiday, including asset depreciation, do not affect future tax liabilities in the post-holiday period. The AETR is then given by:

$$AETR = \tau \left[\left[1 + \frac{\delta}{p}\right]\left[\frac{1-\delta}{1+r}\right]^{holiday} - \frac{\tilde{A}^{holiday}[r+\delta]}{p} - \frac{\alpha i}{p(1+\theta)}\left[\frac{1-\delta}{1+r}\right]^{holiday}\right], \tag{6}$$

where *holiday* is the number of years during which the tax holiday applies.[9]

The METR changes as a result of changes in $\tilde{p}$. For example,

9. For instance, in a declining balance approach, $\tilde{A} = \frac{\phi(1+i)}{i+\phi}$, and when there is a tax holiday $\tilde{A} = \frac{\phi(1+i)}{i+\phi}(\frac{1-\phi}{1+i})^{holiday}$.

$$\tilde{p} = \frac{1}{1-\tau\left[\frac{1-\delta}{1+r}\right]^{holiday}}\left[r+\tau\delta\left[\frac{1-\delta}{1+r}\right]^{holiday} - \tau(r+\delta)\tilde{A}^{holiday} - \tau\frac{\alpha i}{(1+\theta)}\left[\frac{1-\delta}{1+r}\right]^{holiday}\right]. \tag{7}$$

2.4 Loss Offset

Equation 1 is based on the full loss offset assumption, under which the tax value of losses is fully refunded in cash (or equivalently carried forward with interest). This assumption is analytically convenient and has become standard in the workhorse model. It implies that only the net present values of the payoff and the tax at the end of the project matter, but not how they are realized in each year. As discussed in Hebous and Mengistu (2024), no closed form expression exists if we relax this full loss offset assumption to capture a more realistic setup, where losses are carried forward without interest. The computation of the the AETR allows for this scenario through a routine that checks the outcome each year: if there is a loss, it is carried forward without interest; if there is a strictly positive profit, the routine computes its net present value and that of the associated tax, ultimately obtaining the net present values of all yearly taxes and profits. As indicated in the introduction, the AETR is given by the ratio of the net present values of all paid taxes to that of the profit.

Equation 3 also assumes a full loss offset. Otherwise, as indicated above, the year-to-year realization of profits or losses matters. Similar to the AETR case, if the tax value of losses is not refunded but carried forward without interest, the METR is computed with an iterative routine. This routine finds the value of $\tilde{p}$ that makes the post-tax economic rent exactly zero—starting with an initial guess value of $\tilde{p}$, and continuing the search until it finds the value of $\tilde{p}$ that equates the net present value of the tax with that of the investment [10]

Pillar Two Minimum Corporate Tax

Equation 1 also changes when considering the minimum corporate tax under Pillar Two of the Inclusive Framework agreement. The AETR becomes:

$$AETR^{Pillar2} = AETR^{No\,minimum} + \frac{\sum_{t=1}^{\infty}\max(0,(15\%-\tau))\frac{\max(0,(\pi_t^c - SBIE_t))}{(1+i)^t}}{\frac{p}{r+\delta}}, \tag{8}$$

where $SBIE$ is the substance-based income inclusion (expressed as a percentage of capital), π_t^c is the so-called GloBE income (i.e., account profit), 15% is the minimum tax rate, and $AETR^{No\,minimum}$ is given by Equation 1. Accounting profit π_t^c allows for interest deductions and thus retains debt bias.

10. The algorithm starts with a plausible guess of the cost of capital, adjusts the cost of capital through iteration by increasing (decreasing) if economic rent is negative (positive).

Under Pillar Two's rules, multiple variants of Equation 8 exist depending on the types of tax credits and incentives involved, as detailed in Hebous and Mengistu (2024). The rules distinguish between two types of tax credits: qualified and non-qualified refundable tax credits. The key characteristic of the first type is that it must be refunded within four years. Table 1 shows the implications for the Pillar Two rate and the base of the minimum tax. Other incentives are broadly reflected by lowering the tax amount, which could result in a rate below the minimum rate. For example, a tax holiday triggers the full amount of the minimum tax.

Table 1: Top-up Rate and Base with Tax Credits

	No Credits	**QRTC**	**NQRTC**
Top-up rate	$15\% - \frac{\tau\pi_t^c}{\pi^c}$	$15\% - \frac{\tau\pi_t^c}{\pi^c+X_t}$	$15\% - \frac{\tau\pi_t^c - X_t}{\pi_t^c}$
Top-up base	$\pi_t^c - SBIE_t$	$\pi_t^c + X_t - SBIE_t$	$\pi_t^c - SBIE_t$

Note: (N)QRTC stands for a (Non)Qualified Refundable Tax Credit, where X represents the amount of the tax credit. SBIE refers to the Substance-Based Income Exclusion.

Accelerated depreciation or full expensing does not affect the Pillar Two rate, as these are considered 'temporary timing measures' under the minimum tax rules. As a result, they do not trigger a minimum tax on their own. Therefore, the 'no credit' column in Table 1 applies. In other words, π_t^c reflects the timing difference.

The default setting in our Stata commands treats the ACE as a qualified refundable tax credit, which is added to income (as outlined in Table 1). However, in practice, although a few countries have introduced the ACE, none refund it. Therefore, treating the ACE as a non-qualified refundable tax credit presents an important case. However, it raises a conceptual challenge in reconciling a non-refundable ACE with the assumption of full loss offset. Nonetheless, this case is technically feasible and remains an important reference scenario. Hebous and Mengistu (2024) model such a system and show that it diverges from the equivalence to a cash-flow tax even more than the 'refunded' ACE. The Stata commands will be updated soon to incorporate this case. A third—and probably the most realistic—scenario is to combine the ACE as a non-qualified refundable tax credit with an incomplete loss offset, in the form of carry-forward losses without refunds or interest. This case is included in the commands.

2.5 Personal Income Taxes (PITs)

The PIT affects the difference between the pre-tax and post-tax values of various sources of income, including interest, dividends, and capital gains. As a result, the AETR and METR of an investment, from the shareholder's perspective, depend on the source of finance for the investment. The AETR for a domestic investment, presented in equation 1, changes in the presence of PIT as follows:[11]

11. For a detailed discussion, see the online annex.

$$AETR = \frac{\frac{(p-r)}{r+\delta} - \gamma\left[\frac{(1+\theta)(p+\delta)(1-\tau)}{\rho-\theta+\delta(1+\theta)} + (\tau\tilde{A}-1) + \alpha\frac{\rho-(1-\tau)i}{\rho-\theta+\delta(1+\theta)} + \beta\frac{\gamma-1}{\gamma}\right]}{\frac{p}{r+\delta}}, \quad (9)$$

and the cost of capital is:

$$\tilde{p} = \frac{1}{[1+\theta][1-\tau]}\left[[\rho-\theta+\delta(1+\theta)][1+\beta(\frac{1-\gamma}{\gamma})-\tau\tilde{A}] - \alpha\tau i - \alpha(\rho-i)\right] - \delta, \quad (10)$$

where $\rho = \frac{(1-m^i)i}{(1-m^z)}$, $\gamma = \frac{(1-m^d)}{(1-m^z)}$, m^i is the tax rate on interest income, m^d is the tax rate on dividend income, and m^z is the tax rate on capital gains income. As before, α denotes the proportion of the investment financed by debt, while β signifies the portion financed by issuing new equity.

3 Installation of the etr and dietr Package

To install both the `etr` and `dietr` commands, type `ssc install etr`.

4 The etr Command

4.1 Syntax

The syntax of **etr** is:

etr, [*options*]

Running `etr` without setting any options gives the AETR, METR, and the user cost of capital under a standard CIT using preset default values.[12] The 'Results Window' in Stata displays the parameter values assumed in the calculation, which can be modified by the user using the following **options**:

- Macroeconomic parameters:
  - **inflation(real)** sets the inflation rate in decimal form. The default is 5%, expressed as 0.05.
  - **realint(real)** sets the real interest rate in decimal form. The default is 5%, implying a nominal interest rate of 10.25%. Real interest is expressed in decimal form (e.g., 0.05 if it is 5%)
- Tax system parameters:

12. A prerequisite is the installation of **esttab**, which can be done by typing 'ssc install estout' in the Stata command window.

- CIT
  - **system(string)** specifies ‘cft’ for a cash-flow tax system or ‘ace’ for the allowance for corporate equity system. The default is a ‘CIT’ system.
  - **depreciation(real)** is the depreciation rate for tax purposes in decimal form. The default is 25%. It is expressed in decimal form (for example, 0.25 if it is 25%).
  - **delta(real)** is the economic depreciation rate. The default is 25%. It is expressed in decimal form (e.g., 0.25 if it is 25%).
  - **deprtype(string)** allows for selecting a straight line depreciation method by specifying ‘sl’. If left empty or if ‘db’ is specified, the command uses the declining balance depreciation method.
  - **refund(string)** relaxes the full loss offset assumption by specifying ‘no’ (implying that losses are carried forward but there is no interest on the carryover amount and no cash refunds during loss periods). Otherwise, the default (or specifying ‘yes’) assumes a full loss offset (i.e., the project receives the tax value of losses in cash during loss periods, or equivalently, losses are carried forward with interest).
  - **holiday(real)** sets the number of years of a tax holiday (i.e., the number of years during which the CIT rate is zero). The default is zero (no tax holiday).
  - **minimumtax(string)** enables the Pillar Two minimum corporate tax by typing ‘yes’. Otherwise, the default (‘no’) assumes no minimum tax.
  - **minrate(real)** sets the Pillar Two minimum tax rate in decimal form. The default is 0.15.
- Personal income tax
  - **pitint(real)** is the tax rate on interest income at the individual level in the source country, in decimal format (e.g., 0.2 if the tax rate is 20%). The default is zero.
  - **pitdiv(real)** is the tax rate on dividend income at the individual level in the source country, in decimal format (e.g., 0.2 if the tax rate is 20%). The default is zero.
  - **pitcgain(real)** is the tax rate on capital gains income at the individual level in the source country, in decimal format (e.g., 0.2 if the tax rate is 20%). The default is zero.

- Project specific parameters:
  - **p(real)** is the profitability of the investment, expressed in decimal form (e.g., 0.2 if the profit is 20%). The default is 10%.
  - **debt(real)** is the proportion of the investment financed with debt, expressed in decimal form (e.g., 0.5 if 50% of the investment is financed through debt). The default is zero, meaning fully equity-financed.

- **`newequity(real)`** is the proportion of the investment financed through the issuance of new equity, expressed in decimal form (e.g., 0.5 if 50% of the investment is financed with new equity). The default is zero. The combined share of project financing through debt and new equity cannot exceed 100%.
- **`sbie(real)`** is the amount of the substance-based income exclusion (SBIE) as a percentage of the book value of total capital, expressed in decimal form (e.g., 1.5 if SBIE is 150% of the book value of capital), where 50% reflects payroll and 100% reflects tangible capital. If the user does not specify a value, the default is set to 1.5. Note that intangibles can be also modeled. For example, if SBIE is specified as 80%, this means the mix of tangible capital and payroll is 80% of the book value of total capital.
- **`qrtc(real)`** is the amount of the qualified refundable tax credit, expressed as a percentage of capital. The default is zero. It is expressed in decimal form (e.g., 0.01 if it is 1%).
- **`nqrtc(real)`** is the amount of the non-qualified refundable tax credit, expressed as a percentage of capital. The default is zero. It is expressed in decimal form (e.g., 0.01 if it is 1%).

4.2 Examples for Using etr

Example 1. Entering etr in the Command Window generates the AETR, METR, and the cost of capital as new variables, using the default values. The Results Window will display the values of the parameters used in the calculation, as shown in the snapshot below.

Example 2. To compute the AETR, METR, and the cost of capital under the Pillar Two minimum tax, including a non-qualified domestic tax credit of 10% of the investment amount, accelerated depreciation of 50%, an inflation rate of 2%, and a real interest rate of 3% (implying a nominal interest rate of 5.05%), type:

```
etr, inflation(0.02) realint(0.03) p(0.2) depreciation(0.50) delta(0.25)
sbie(1.8) nqrtc(0.01) minimumtax(yes)
```

To visualize the results, plot the outputs against the statutory tax rate:

```
twoway (line METR statutory) (line AETR statutory) (line coc statutory, yaxis(2)),
legend(pos(6)) ytitle("METR, AETR (%)") xtitle("Statutory CIT Rate")
```

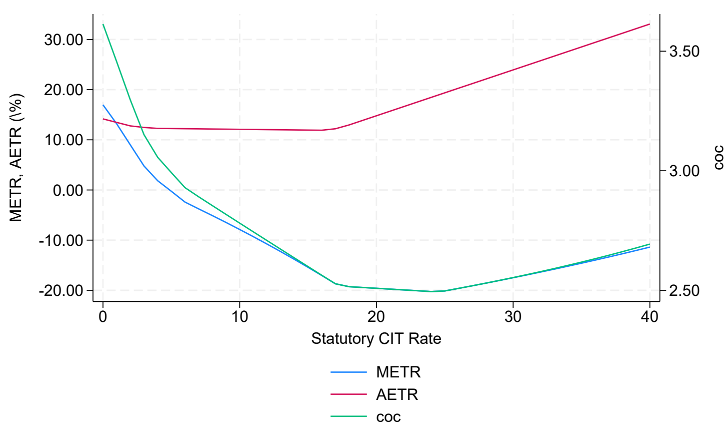
Example 3. Consider comparing two different tax reform scenarios in a country with a statutory CIT rate of 20% (baseline). Scenario 1 introduces immediate expensing and denies interest deductions. Scenario 2 lowers the statutory tax rate to 18%. In both scenarios, half of the investment is financed through debt.

```
etr, debt (0.5)
keep if statutory_tax_rate == 20 | statutory_tax_rate == 18
g Scenario = "Baseline" if statutory_tax_rate == 20
replace Scenario = "Scenario2" if statutory_tax_rate == 18
keep METR AETR Scenario
```

Figure 1: Displaying Parameterization in the Command Window after Running etr

```
. etr

                                  Parameters

Inflation(%)                               5

Nominal interest rate (%)              10.25

Tax depreciation (%)                      25

Economic depreciation (%)                 25

Share of debt finance(%)                   0

Share of new equity finance(%)             0

Profitability(%)                          10

Number of years of tax holiday             0

tax rate on interest income(%)             0

tax rate on dividend income(%)             0

tax rate on capital gains(%)               0

Depreciation method: Declining balance
Full loss offset: Yes
Pillar two minimum tax does not apply

.
```

Figure 2: ETRs and Non-Qualified Domestic Tax Credit under the Minimum Tax

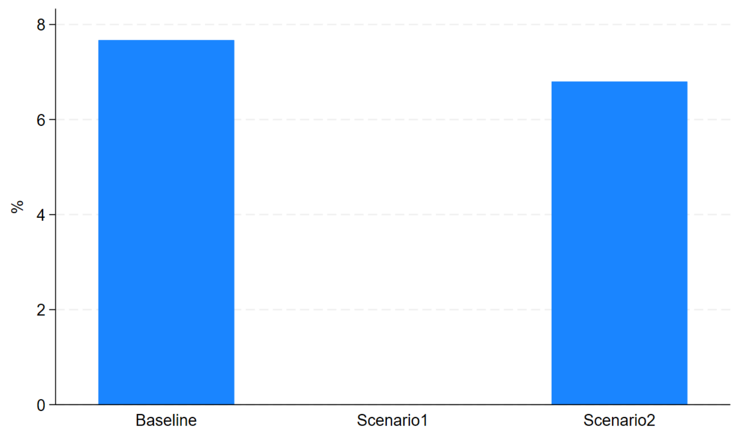


Note: The METR in this tax system is highest when the statutory tax rate is zero, as the top-up amount of the minimum tax reaches its maximum. The METR decreases as the statutory rate increases, until the point where the minimum tax no longer applies. The METR and the cost of capital become negative (i.e., subsidy) due to the combination of the tax credit and the full loss offset.

```
tempfile Baseline
save Baseline.dta, replace etr, depreciation(1)
keep if statutory_tax_rate == 20
g Scenario = "Scenario1"
```

```
keep METR AETR Scenario
append using Baseline.dta

graph bar (asis) METR, over(Scenario) ytitle(%)
```

Figure 3: METR under Alterative Hypothetical Reforms



Note: The METR is zero under full expensing (with no interest deductions), even when the statutory CIT rate is 20% (Scenario 1). This outperforms Scenario 2, which lowers the statutory CIT rate, if the objective is to reduce the METR.

5 The dietr Command

5.1 Syntax

The syntax of **dietr** is:

dietr, id(varname) taxrate(varname) inflation(varname) depreciation(varname) deprtype(varname) delta(varname) [*options*]

The command `dietr` requires specifying the following six variables: (i) a unique identifier, (ii) statutory CIT rate, (iii) inflation rate, (iv) depreciation rate for tax purposes, (v) depreciation type (either straight-line or declining balance), and (vi) the economic depreciation rate. In addition, there are: (i) eight optional variables that are set to default values unless specified otherwise by the user, and (ii) other parameters that can also be modified.

- Required variables:

  - **`id(varname)`** specifies the unit of analysis for the ETR (e.g., a country). This variable is particularly useful when there are multiple observations (e.g., at the firm level) for a specific ETR unit (e.g., within a country), as the **`id`** variable identifies the ETR unit (e.g., the country).
  - **`taxrate(real)`** specifies a variable as the statutory CIT rate; expressed in decimal format (e.g., 0.05 for 5%).
  - **`inflation(real)`** specifies a variable as inflation; expressed in decimal form (e.g., 0.05 for a 5%).
  - **`deprtype(string)`** specifies a variable as the depreciation system: 's' for straight-line or 'd' for declining balance.
  - **`depreciation(real)`** specifies a variable as the depreciation rate for tax purposes; expressed in decimal form (e.g., 0.05 for a 5%).
  - **`delta(real)`** specifies a variable as the economic depreciation rate; expressed in decimal form (e.g., 0.05 for a 5% rate).

  The user can assign any name to the tax rate, inflation, deprtype, depreciation, and delta variables in the dataset, as long as these variables are referenced correctly in the `dietr` command. For example, if the tax rate variable is named `xyz` in the dataset, it should be referenced in the `dietr` command as `dietr, taxrate(xyz)`.

- Optional variables:
  - **`system(string)`** specifies the variable that indicates the tax system: 'cft' for a cash-flow tax system or 'ace' for the allowance for corporate equity system. The default is the standard CIT ('cit').
  - **`realint(real)`** specifies the variable that indicates the real interest rate in decimal form (e.g., 0.05 for a 5% rate). The default value is 0.05.
  - **`debt(real)`** specifies the variable that indicates the proportion of investment financed with debt in decimal form (e.g., 0.5 for 50% debt financing). If not specified, the default is zero, i.e., fully equity financing.
  - **`newequity(real)`** specifies the variable that indicates the proportion of the investment financed through the issuance of new equity, in decimal form (e.g., 0.5 for 50% new equity financing). The default is zero. The combined share of project financing through debt and new equity cannot exceed 100%.
  - **`holiday(real)`** specifies the variable that indicates the number of years during which the project benefits from a statutory CIT rate of zero. The default is 0 years (i.e., no tax holiday).
  - Personal income tax
    - **`pitint(real)`** is the tax rate on interest income at the individual level in the source country, in decimal format (e.g., 0.2 if the tax rate is 20%). The default is zero.
    - **`pitdiv(real)`** is the tax rate on dividend income at the individual level in the source country, in decimal format (e.g., 0.2 if the tax rate is 20%). The default is zero.

  * **`pitcgain(real)`** is the tax rate on capital gains income at the individual level in the source country, in decimal format (e.g., 0.2 if the tax rate is 20%). The default is zero.

- Tax system parameters:
  - **`refund(string)`** specifies whether to relax the full loss offset assumption. Setting it to 'no' implies that losses are carried forward without interest and no cash refunds during loss periods. By default (or when set to yes), the system assumes a full loss offset, meaning the project receives the tax value of losses in cash during loss periods or losses are carried forward with interest.
  - **`minimumtax(string)`** enables the Pillar Two minimum corporate tax by typing 'yes'. Otherwise, the default ('no') assumes no minimum tax.
  - **`minrate(real)`** sets the Pillar Two minimum tax rate in decimal form. The default is 0.15.
- Project specific parameters:
  - **`p(real)`** is the profitability of the investment in decimal form (for example, 0.2 if profit is 20%). The default is 10%.
  - **`sbie(real)`** is the amount of the substance based income exclusion (SBIE) in the Pillar Two minimum tax rules. If the user does not specify a value, the default sets the sum of tangibles and payrolls to 150% of the book value of tangibles. Alternatively, the user can specify another value for this sum, not below 100% of tangibles. The SBIE is always 5% of the default or the user-calibrated value.
  - **`qrtc(real)`** is the amount of qualified refundable tax credit as a percentage of the book value of capital. The default is set to zero.
  - **`nqrtc(real)`** is the amount of non-qualified refundable tax credit as a percentage of the book value of capital. The default is zero.

5.2 Examples for Using dietr

To illustrate the use of the `dietr` command, the following examples use the same demo data file:

```
use "dietr_database.dta", clear
```

Example 4. To generate ETRs under different tax systems—CIT, ACE, and cash-flow tax—using only the required variables and default parameters, and to display the comparison in a chart, run the following syntax:

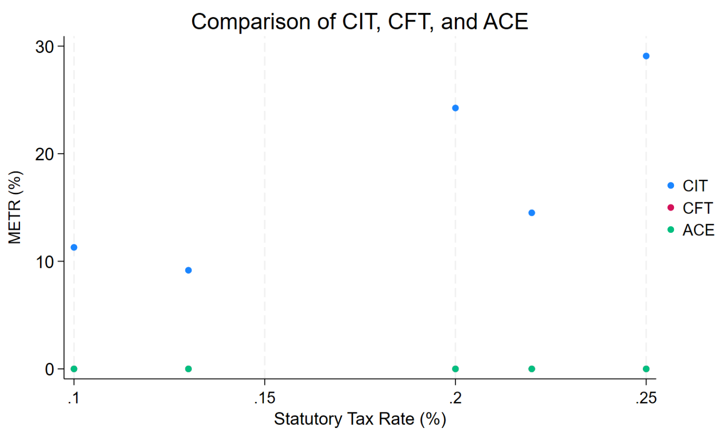
```
dietr , id(x) taxrate(z) inflation(a) deprtype(b) /// depreciation(c)
delta(k)
```

```
dietr , id(x) taxrate(z) inflation(a) deprtype(b) /// depreciation(c)
delta(k) system(cft)
```

```
dietr , id(x) taxrate(z) inflation(a) deprtype(b) /// depreciation(c)
delta(k) system(ace)
```

```
twoway (scatter METR_CIT z, lcolor(blue) lpattern(solid)) /// (scat-
ter METR_CFT z, lcolor(red) lpattern(dash)) /// (scatter METR_ACE
z, lcolor(green) lpattern(dot)), /// ytitle("METR (%)") ylabel(,
angle(0) nogrid labsize(medium) format(%9.0f)) /// xtitle("Statutory
Tax Rate (%)", size(medium)) /// title("Comparison of CIT, CFT, and
ACE") /// legend(order(1 "CIT" 2 "CFT" 3 "ACE") position(3))
```

Figure 4: Building an ETR Database for Different Tax Systems



Example 5. To compare the ETRs with and without the Pillar Two minimum tax:

```
dietr , id(x) taxrate(z) inflation(a) deprtype(b) depreciation(c)
delta(k)
```

```
rename (coc_cit METR_CIT AETR_CIT) (coc_cit_n METR_CIT_n AETR_CIT_n)
```

```
tempfile pretopup
```

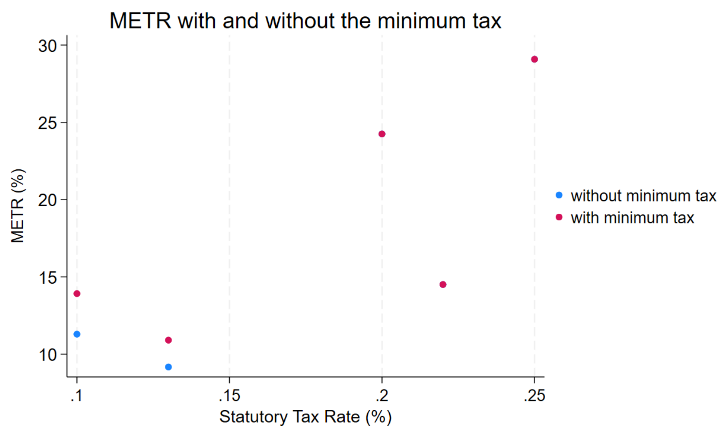
```
save `pretopup',replace
```

```
dietr , id(x) taxrate(z) inflation(a) deprtype(b) depreciation(c)
delta(k) minimumtax(yes)
```

```
merge 1:1 x using `pretopup'
```

```
twoway (scatter METR_CIT_n z, lcolor(blue) lpattern(solid)) (scat-
ter METR_CIT z, lcolor(red) lpattern(dash)), ytitle("METR (%)") yla-
bel(, angle(0) nogrid labsize(medium) format(%9.0f)) xtitle("Statutory
Tax Rate (%)", size(medium)) title("METR with and without a min-
imum tax") legend(order(1 "without minimum tax" 2 "with minimum tax")
position(3))
```

Figure 5: Building an ETR Database in the presence of the Pillar Two Minimum Tax



6 Practical Hints

- The METR cannot become negative without a full loss offset or some forms of cash refunds.

- The ETRs for a fully equity-financed investment under the standard CIT are the same as those for a debt- or equity-financed investment under the Comprehensive Business Income Tax (CBIT) discussed by the U.S. Department of the Treasury in 1992, which denies interest deductions.

- The default setting in the commands treats the ACE as a qualified refundable tax credit when combined with the Pillar Two minimum tax. To treat the ACE as a non-qualified refundable tax credit, use the following command: `etr, minimumtax(yes) refund(no) system(ace)`. An updated version will provide the option to consider the ACE as a non-qualified refundable tax credit while assuming full loss offset.

- Without a full loss offset, the ACE and cash-flow tax are not equivalent.

- Under the Pillar Two minimum tax, the ACE and cash-flow tax are not equivalent, and the AETR, METR, and cost of capital under the cash-flow tax cannot exceed those under the ACE.

- The AETR, METR, and cost of capital are identical for both the ACE and cash-flow tax systems, except when the Pillar Two rules apply and/or when there is no full loss offset. However, the yearly profiles of payoffs and tax revenues differ, as shown in the auxiliary output file. These profiles are equivalent *in terms of net present value* under the conditions of a full loss offset and no Pillar Two minimum tax.

- Making the ACE refundable lowers the METR, AETR, and cost of capital (compared to a non-refundable ACE) under the Pillar Two minimum tax. However, as shown by Hebous and Mensigstu (2024), a refundable ACE remains nonequivalent to the cash-flow tax under Pillar Two.
- In the default setting, the sum of tangibles and payrolls is assumed to be 150% of the book value of tangibles, implying that the SBIE is 5% $\times$ 150% = 7.5% of tangibles. If the user chooses a value below 100% in the option sbie(real), then implicitly there is a share of intangibles (which is not part of the SBIE) that makes the sum of payrolls and tangibles below 100% of the *total* book value of capital.

References

Devereux, M., and Griffith, R. (2003). Evaluating Tax Policy for Location Decisions. *International Tax and Public Finance*, 10, 107-126.

Hebous, S. and Mengistu, A. (2024). Forward-Looking Effective Tax Rates under a Global Minimum Corporate Tax. Oxford Center for Business Taxation Working Paper 2024-10.

King, M., and Fullerton, D. (1984). The Theoretical Framework. In M. King and D. Fullerton (Eds.), *The Taxation of Income from Capital* (pp. 7-30). National Bureau of Economic Research.

Meade Committee. (1978). The Structure and Reform of Direct Taxation. In J. Meade (Ed.), London, George Allen.

Mirrlees Review. (2011). Tax by Design. In S. Adam, T. Besley, R. Blundell, S. Bond, R. Chote, M. Gammie, P. Johnson, J. Mirrlees, G. Myles, and J. Poterba (Eds.), Mirrlees Review.