World Bank Global METR Database

June 2022

Contents

World Bank Global METR Database[1]

Abstract

To compare tax burden on investment across countries, a database of METR on investment in four main asset types – Equipment, Building, Land and Inventory was prepared for 95 countries. The database is freely accessible through an open-source platform https://github.com/Revenue-Academy/METR. It will be updated every year to expand the coverage and update the tax parameters such as corporate and personal income tax rate, tax depreciation rates, and investment related allowances and deductions. A python based interactive tool has also been developed, which allows calculation of METR for a specific country based on user inputs. The tool has a user-friendly graphical user interface and will allow policymakers to simulate the impact of changes in underlying parameters on the METR.

Introduction

1. **The impact of corporate tax system on investment behavior is of particular interest to the policymakers. All things being equal, taxes lower business profits and may disincentivize fresh investments by pushing the post-tax returns below the minimum rate needed to satisfy the investors.** Since investment is believed to be an important driver for economic growth, most countries have adopted tax policies that create incentives for business investment. However, such incentives vary from one country to the other and together with the corporate rates provide an important basis for comparison of tax systems across countries.

2. **Due to the tax incentives that are available in a particular country, the effective tax rate (ETR) on investments that firms face can be very different from the statutory tax rate.** Some of these incentives include investment allowances, additional or accelerated depreciation, interest expense deductibility and other deductions that lower the business profit. Design of tax incentives is an important policy consideration to influence the ETR of business firms based on size, sector, location, or other factors.

Measures of tax burden on investment

3. **Traditional measures of ETR include backward-looking measures such as Average Tax Rate (ATR) and forward-looking measures such as Marginal Effective Tax Rates[2] (METR) and Average Effective Tax Rates[3] (AETR).** ATR is based on tax burden in proportion to the accounting profit, which represents the return on cumulative levels of investment, both past as well as present. On the other hand, METR and AETR measure the impact of tax system on future cash flows and profitability of an additional investment made in the present.

---

[1] This report was prepared by Rajiv Kumar under the guidance of Sebastian James. Contact: rkumar40@worldbank.org

[2] King, M.A., Fullerton, D., 1984. The Taxation of Income from Capital. University of Chicago Press, Chicago.

[3] Devereux, M. and Griffith, R., 1998. The taxation of discrete investment choices (No. W98/16). IFS working papers.

4. **The analysis of the METRs on capital helps assess how taxes can affect the rate of return from capital investment** (See Annex 3, 4, 5 for a detailed theoretical background of the METR). The METR measures the wedge between the before-tax rate of return and the after-tax rate of return on marginal investments. The marginal investment is the last 'piece' of investment made by a profit maximizing firm. This means that the return on the marginal investment would be just equal to the opportunity cost of that investment (which is some combination of investing in the bond and stock market).

METR as a measure of tax burden on investment

5. **The METR combines a wide range of effects of the tax system.** For example, elements of the tax system can also interact with macroeconomic variables and impact the METR on capital. For example, the ability to deduct interest payments on borrowed funds in the calculation of a corporation's taxable income lowers the effective cost of investments especially when there is inflation. This is because the nominal interest rate includes an inflation component which increases the size of tax deductions. Conversely, inflation can raise the effective tax rate on inventories under first-in-first-out inventory accounting. This occurs because the cost of "old" inventory reported on a company's income statement will be less than the item's current sales value which reflects the impact of inflation, and this artificially raises a company's taxable income. Similarly, the depreciation rate in the income tax code can impact the METR. When this rate exceeds the "true" rate at which an asset wears out (the rate of economic depreciation), the investor receives, in effect, a tax concession. Tax holidays and other special incentives can also be considered in the calculation of METR rates.

6. **It is important to emphasize, some limitations of the methodology.** METR calculations capture only the effects of the formal tax rules. Generally absent are considerations of tax administration, tax evasion and the informal economy. Payroll taxes and excise taxes on fuel are also omitted from consideration since, arguably, their amounts are unaffected by marginal increases in the capital stock. METR analysis depends on some simplifying assumptions and abstracts from certain nuances of the tax code that cannot be readily captured in the calculations. Thus, the METR figures should be interpreted as a tool for understanding the incentive effects of the business tax system in a country, rather than as precise values.

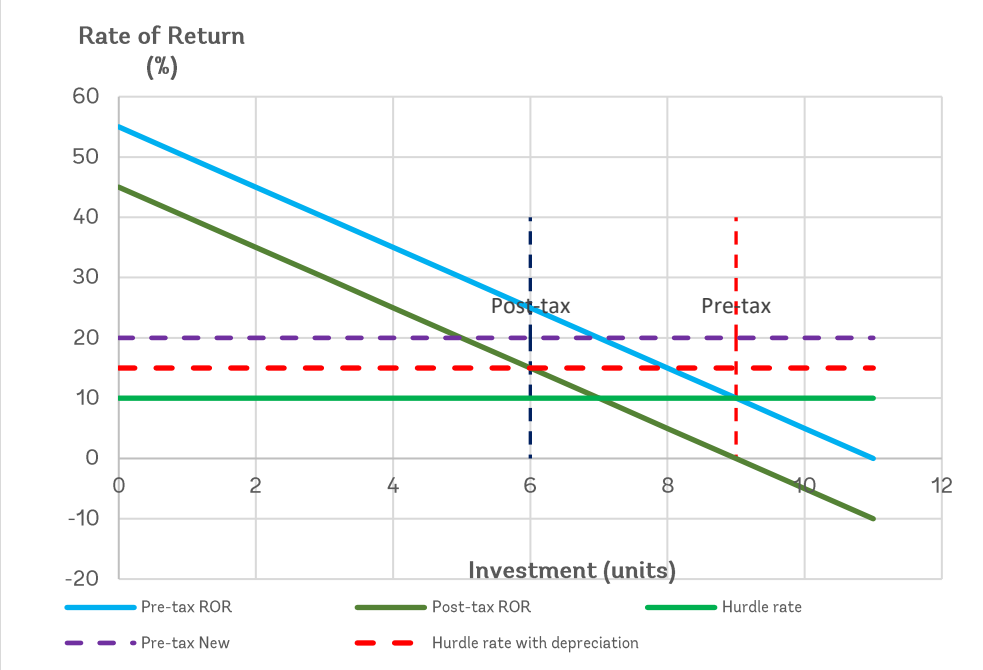
7. **In the case of investments that generate above-normal after-tax returns (i.e. inframarginal investments), the Average Effective Tax Rate (AETR) is more appropriate.** This is because investments generating above-normal returns are, by definition, profitable, and therefore not likely to be deterred by the tax system unless the tax rates are egregiously high. For highly profitable investments however, the corporate tax rate is more relevant than the METR. Annex 3 shows the mathematical derivation of the METR and the fact that the AETR, which is the effective tax rate on any investment, is a weighted average of the METR and the statutory tax rate, with the weights being the ratio of the return on investment from the marginal investment and the return from that project. This means that for marginal investments, the ratio would give the METR the weight of 1 and the statutory rate a weight of 0. For highly profitable investment the statutory tax rate would have a weight of 1 while the METR a negligible weight. For investments that give returns in between, the AETR is the relevant measure.

8. **In a highly competitive world economy, most investments have little economic rents and thus are likely to be sensitive to the METR (rather than AETR, which is relevant when there are**

economic rents to extract). In principle, it is possible to design a tax system that yields positive tax revenues while generating an METR equal to zero, implying that all viable investments would be undertaken. Such a system would collect tax revenues only from the investments enjoying above-normal returns with the marginal investment generating zero tax. It is also possible for the METR to be negative. This would imply that the tax system subsidizes implicitly investments that would otherwise not be undertaken. Hence the METR is very useful in determining the impact of the tax system on real investment decisions of taxpayers. To illustrate, Box 1 provides a simplified example of how the tax system can distort investment decisions of potential investors.

Box 1: An illustrative example of METR

A simple example of an METR calculation may be helpful. Consider a farmer who uses tractors to work on his farm. Say the farmer could earn after-tax return of 10% on his investment in the capital market. This is his 'hurdle rate' of return which means that any alternative investment that does not give him less than this much return would not be undertaken. Now suppose the first tractor he invests in to use in his farm gives him a return of 55%. If he is not cash constrained or unable to borrow funds, he could then then buy a second tractor and a third and so on. By the law of diminishing marginal returns on capital, every additional capital (tractor) invested would give him less and less of return. This implies that the second tractor would give him say 45% of return on investment, the third 40%, the fourth to 35% and so on. Eventually there are so many tractors in the farm that say his return on the eighth tractor is 15% and the ninth tractor goes down to 10%. At this point additional investment in the form of tractors would give less than 10% returns and the farmer stops at nine tractors. The ninth tractor is now the marginal investment (when we neglect depreciation i.e. wear and tear).



Now suppose we include the effect of wear and tear and say it is 5% annually. Ignoring the corporation income tax for the moment (we are assuming that the farm is incorporated), the tractor must generate an annual rate of return of at least 15 % to be worth acquiring - i.e., 5 % to compensate for the wear and tear plus 10 % to compensate for the fact that the farmer could have earned this amount by investing its money in the capital market instead of buying the tractor. If, in this example, the return on the eighth tractor is exactly 15 %, then the eighth tractor is the marginal investment (The farmer would not invest in the ninth tractor as it is a losing investment). If the return exceeds 15%, the tractor is earning above-normal returns. If the tractor earns less than 15%, it is not a viable investment for the farmer.

What is the effect of a corporation income tax on the investment decision of the farm? Assume the corporate tax rate is 40%. In order for a tractor to be a viable investment, it must earn such a return that after taxes should give at least 15% which is the hurdle rate of return after wear-and-tear/depreciation we calculated above. This means a return of C, such that (100 – 40)% x C

= 15%. The before-tax required rate of return is therefore C = 15%/ (1-0.4) = 25%. In this example, therefore the farmer would not invest in the eighth tractor as after taxes the return of investment would drop to below 15% which after depreciation (which is 5%) would be below what he could get from the market (which is 10%). However, his sixth tractor is a viable investment as it gives him 25% which is exactly equal to the minimum of 15% required after taxes and depreciation. Hence after taxes, the farmer would only invest up to six tractors in his farm. Further issues such as the taxation of dividends, sales tax on equipment can also be incorporated along with the corporate tax in the calculation of an investor's required rate of return.

The METR in this simple example is given by the ratio of the difference in the rate of return on the marginal investment before taxes and after taxes (the tax wedge) to the rate of return on the marginal investment before taxes. In other words, what percentage of the returns of the marginal investments is given up compensating for taxes. In this example, the METR is equal to (25-15%)/25% or 40%, which is just the corporate tax rate. In the real world we need to incorporate the different tax provisions such as taxation of dividends, tax on equipment which increases the tax burden on investments raises the METR. On the other hand, deductibility of interest (as against equity), accelerated depreciation, etc, lowers the METR. Hence the METR reflects the impact of the entire tax system on the marginal investment. It is possible that when the tax system in effect does not raise the before-tax required rate of return of investors because of the various beneficial tax provisions, therefore C = 15%, and so the METR could equal 0.

9. **It should be noted that the METR methodology used only focuses on the impact of the tax system on fixed capital.** Hence taxes that do not depend on physical capital such as labor taxes and tax incentives such as the learnership allowance granted to encourage skill development of worker do not affect the METR on capital. Further, some sectors by their nature depend much more on labor than on capital. Hence a tax incentive that lowers METR on physical capital would encourage more investment in the physical assets and would likely benefit the manufacturing sector more than the services sector. In such a case a decision may be made between a broader reform that lowers corporate tax rates for all rather than an approach that reduces the cost of physical capital.

10. **Lower METRs for the same amount of investment in general results in lower tax revenue in present value terms.** However, a lower METR implies more investment that can lead to higher growth. Hence the revenue impact is not necessarily lower. As mentioned above, a zero METR does not mean zero taxes. This only means that for the marginal investment, the returns on investment before and after taxes are exactly equal. However, investments made before the marginal investment all earn more than the hurdle rate of return and hence provide positive returns above the hurdle rate. Annex 3 presents the methodology on how the METR is calculated.

11. **METR analysis can be a useful tool for policy makers to make informed-based decisions.** It may be used in policy simulations to estimate the effect of changes in tax parameters on the cost of capital and labor, and the incentive to invest and produce. It can be also useful to analyze whether the tax system is creating distortions across sectors and types of finance.

World Bank METR database

12. To compare tax burden on investment across countries, a database of METR on investment in four main asset types – Equipment, Building, Land and Inventory was prepared for 95 countries. Together these form the main assets, which attract business investments.

Data and Methodology

13. Data related to economic and tax parameters for 95 countries was collected and compiled into a database. The parameters covered by the database are summarized in the table below.

Table 1: Economic and Tax parameters used in METR calculation

Economic parameters	Tax parameters
inflation International interest rate Debt to Asset ratio Economic depreciation rate - Equipment, Building Capital investment weights - Equipment, Building, Land and Inventory	Investment allowance - Equipment, Building Depreciation rate – Equipment, Building Inventory accounting – LIFO / FIFO Sales tax rate on capital inputs Transfer tax rate on capital assets Land transfer tax rate Financial transfer tax rate Dividend payout ratio Dividend distribution tax rate Dividend tax rate Personal Income Tax (PIT) rate on interest income PIT rate on capital gains Property tax rate Asset tax rate

14. Presently, there are 95 countries covered by the database with the following regional distribution.

Table 2: Regional distribution of countries covered by METR database

Region name	No of countries
East Asia & Pacific	13
Eastern Europe & Central Asia	18
Latin America & the Caribbean	17
Middle East & North Africa	10
North America	2
South Asia	3
Sub-Saharan Africa	15
Western Europe	17
Total	95

15. A python-based model was developed to calculate METR for each country in the database. The model is based on methodology discussed in Annex 3. For simplicity and to isolate the impact of tax system on investment, the following parameters have been assumed to be the same for all countries-

a. international interest rate (1%)
b. debt to asset ratio (40%)
c. dividend payout ratio (50%)
d. economic depreciation (Equipment 21%, Buildings 9%) and
e. capital investment weights (Equipment 64%, Buildings 36%)

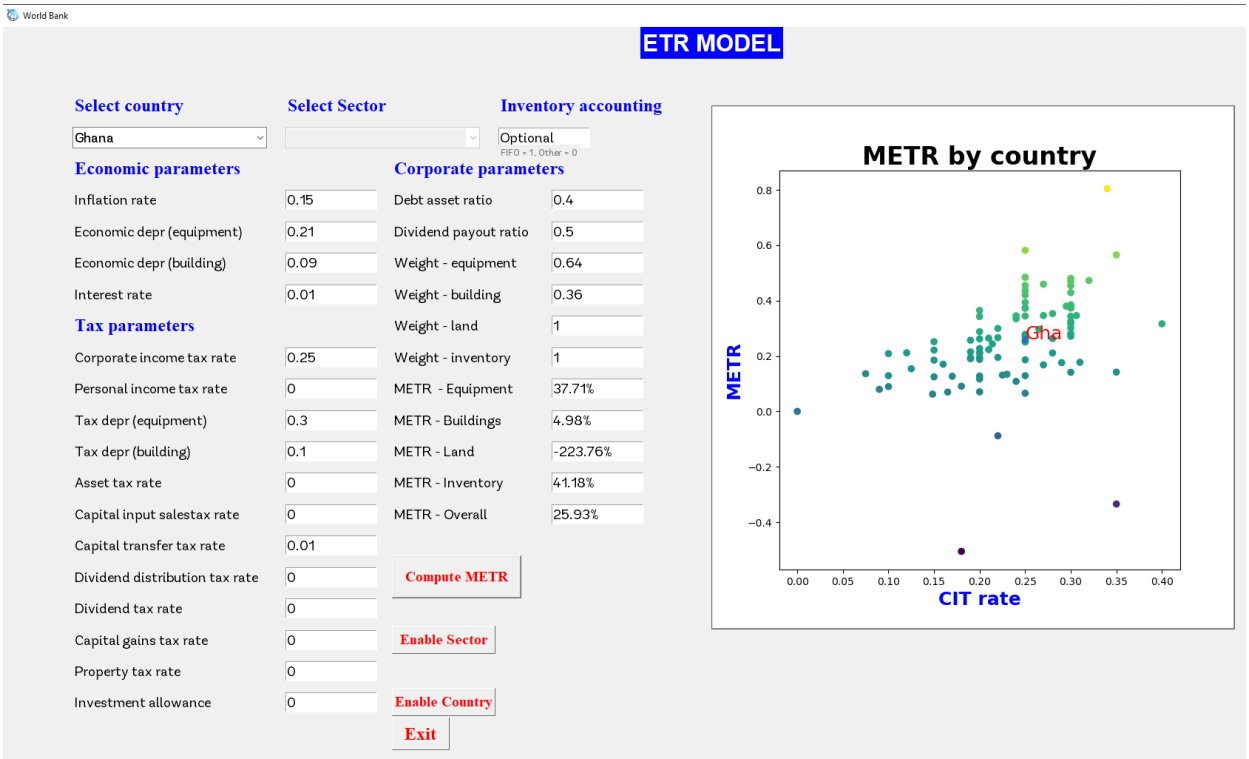
16. The differences in METR of different assets across countries are, therefore, due to-

a. Inflation rate
b. Corporate income tax (CIT) rate,
c. Tax depreciation rate

d. Domestic PIT rate on interest rate and capital gains
e. Inventory valuation method (LIFO / FIFO[4])
f. Sales tax on capital inputs
g. Asset tax rate
h. Property tax rate

The model has a user-friendly graphical user interface, which allows visualization of how a country compares with rest of the countries in terms of METR for an asset.

Figure 1: METR Model Interactive Tool - Graphical User Interface

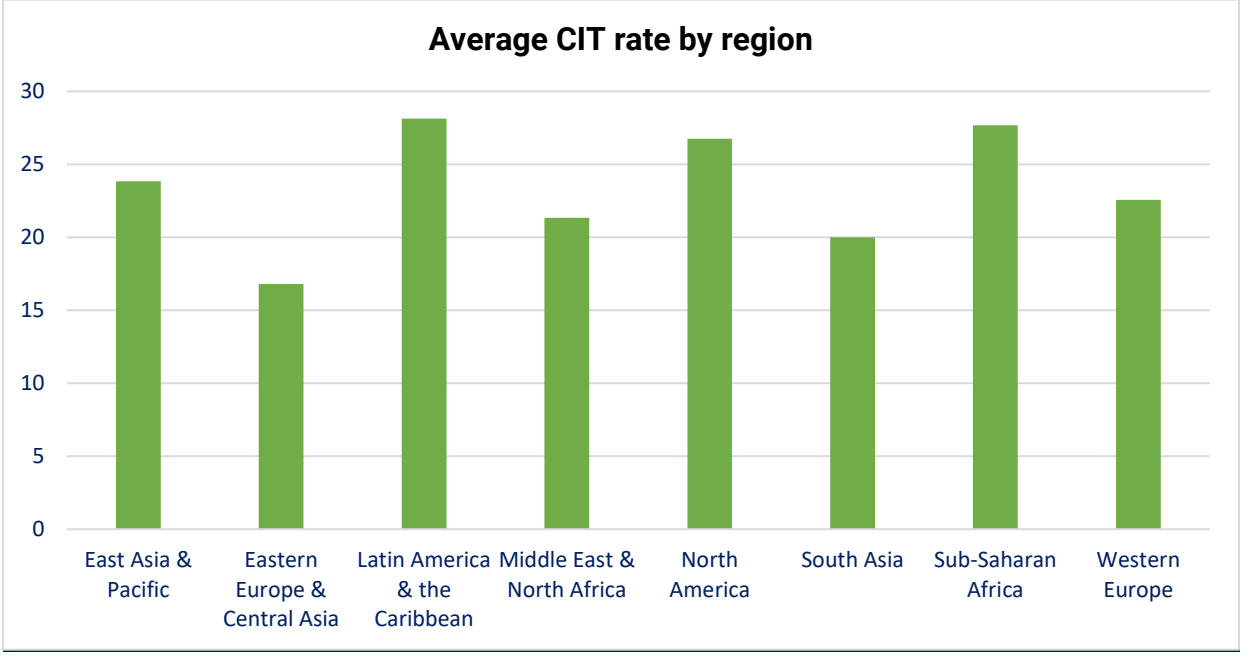


17. The average corporate income tax rate by region is shown below (also refer Annex 2). These rates are based on data in public domain[5]. It may be noted that some of the countries have changed their CIT rate post-2020 (such as Turkey, which increased its rate from 22% in 2020 to 25% in 2021; and Bangladesh, which reduced its rate from 32.5% in 2020 to 30% in 2021), which may affect the regional averages. Further, some countries (such as Argentina) have progressive CIT rates. Similarly, in some countries (such as Australia and India) CIT rates depend on the size of the corporates (as indicated by turnover). In such cases, the maximum CIT rate has been used for the purposes of computing METR.

[4] LIFO stands for Last In First Out and FIFO stands for First In First Out

[5] *https://home.kpmg/it/it/home/services/tax/tax-tools-and-resources/tax-rates-online/corporate-tax-rates-table.html*

Figure 2: Average CIT rate by region



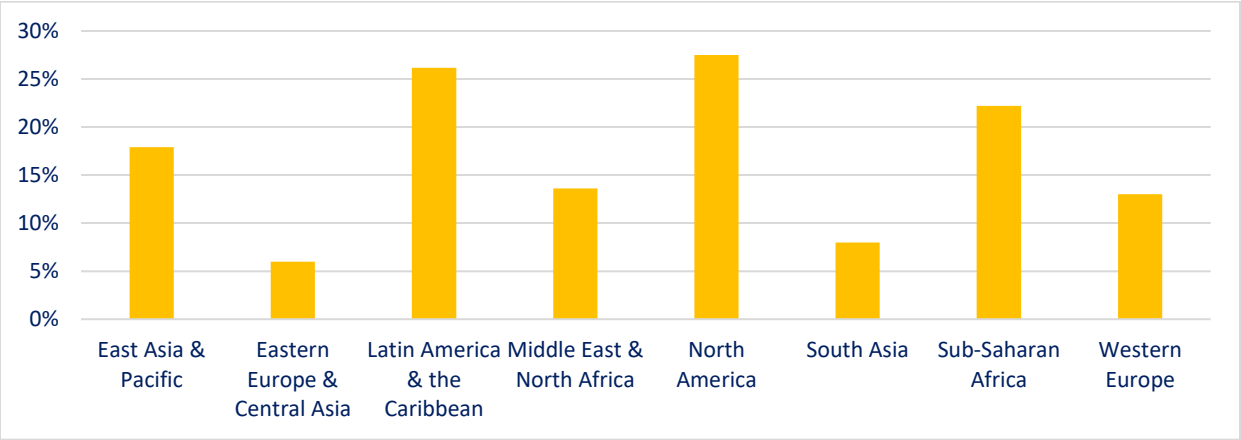
Results

18. METR on investment in depreciable assets i.e. equipment and buildings was calculated for each country and then aggregated by capital weights (refer Annex 1). A higher METR is indicative of higher tax burden on investment and vice versa. It may be noted that in some cases METR may even be negative. This may be due to reasons like generous tax depreciation (higher than economic depreciation) which acts as a subsidy to businesses, or high inflation rate which lowers the cost of financing. Inflation also affects effective taxes through historical cost depreciation and FIFO inventory accounting[6].

19. The following table summarizes the METR by region for Equipment. It may be seen that countries in EECA and South Asian regions (with lower CIT rates) have relatively lower METR whereas countries in LAC and North America (with higher CIT rates) have higher METR. METR of countries in North America (USA, Canada) is high also due to sales tax on capital inputs, which raises the cost of financing. Moreover, in EECA region, average tax depreciation for equipment is 26% which is higher than the economic depreciation of 21% and therefore acts as a subsidy. Similarly, in South Asian region the average tax depreciation for equipment is 29% and in MENA region it is 26%, which results in a lower METR. On the contrary, average tax depreciation for equipment in LAC is 19% which is lower than the economic depreciation.

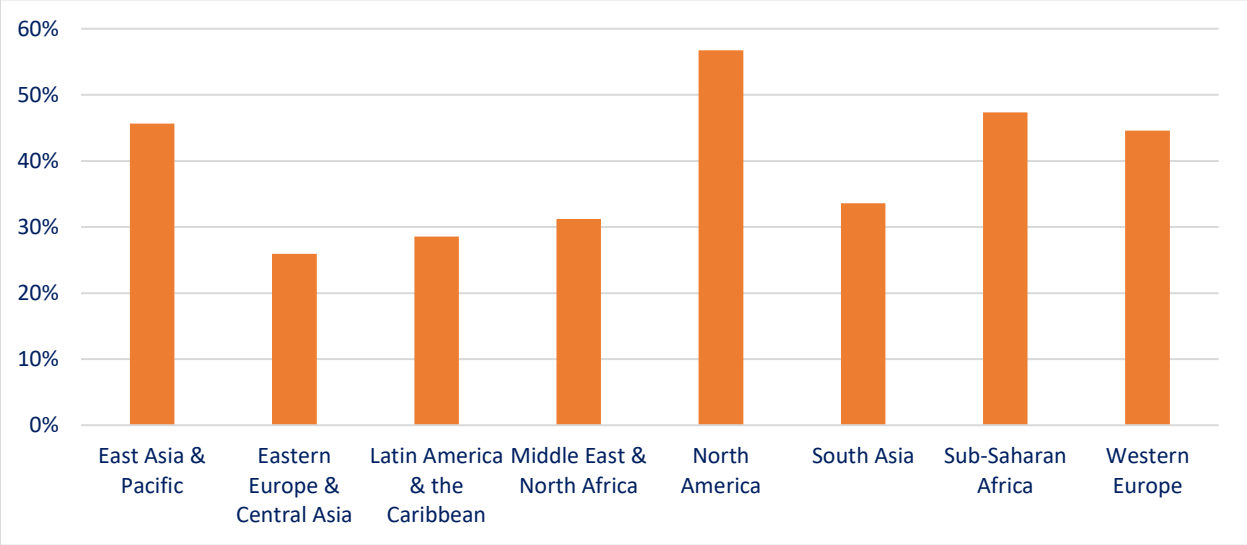
[6] *Fullerton, D., 1984. Which effective tax rate?. National tax journal, 37(1), pp.23-41.*

Figure 3: Average METR (Equipment) by region



20. The following table summarizes the METR by region for Buildings. It may be noted that METR for buildings is in general higher than equipment. This is because the tax depreciation for buildings is not as generous as equipment and is lower than economic depreciation rate. EECA and MENA regions have relatively lower METR for investment in buildings. However, North America has a high METR due to a combination of high CIT rate and sales tax on capital inputs. In EECA, LAC and MENA, tax depreciation rate for building is relatively more generous, which explains low METR in these regions.

Figure 4: Average METR (Buildings) by region



21. The following table summarizes the METR by region for investment in land. It may be noted that METR for land is negative in all regions except in Western Europe where it is almost nil. Negative METR suggests that tax system encourages investment in land whereas nil METR suggests that the system is neutral towards investment in land. It may be noted that METR for land is sensitive to tax on transfer of land (such as stamp duty on registration) and property taxes. However, for the purpose of this study, both taxes were assumed to be nil. In future, data related to tax on transfer of land and property tax will be updated in the database.

Figure 5: Average METR (Land) by region

22. The following table summarizes the METR by region for investment in inventories. It may be noted that METR for inventory is quite sensitive to inflation rate. High inflation rate exaggerates profitability and hence the return on investment as old inventory purchased at low price is sold for a higher price. METR for investment in inventory is also sensitive to inventory valuation method followed by a country. Countries following FIFO method will have a higher METR as compared to those that follow LIFO. Most countries in LAC, and a few countries in Western Europe and EECA follow LIFO method, which is why METR in these regions is relatively low.

Figure 6: Average METR (inventory) by region

Conclusion and way forward

23. World Bank METR database provides a useful knowledge tool to policymakers for comparing the tax burden on investment in capital assets. It is available in an open-source platform (https://github.com/Revenue-Academy/METR) and can be freely accessed. Comparison can be made with other countries including those that are within the same region or in their neighborhood. Interactive tool allows policy simulations and the impact of changes in underlying economic or tax parameters on the METR.

24. The METR database will be updated annually reflect the changes in economic and tax parameters by country as well as to expand the coverage by including more countries. Further, the database will also be updated by incorporating data related to tax holidays and other tax incentives.

****

Annex 1: METR by country

Country	Region	Equipment	Buildings	Overall	Land	Inventory
Argentina	LAC	66%	-193%	-27%	-118%	-118%
Australia	EAP	36%	61%	45%	-9%	26%
Austria	W Europe	53%	55%	54%	-7%	21%
Bangladesh	SA	25%	27%	26%	-150%	29%
Belgium	W Europe	18%	36%	25%	8%	8%
Bolivia	LAC	50%	58%	53%	-50%	25%
Botswana	SSA	33%	54%	41%	-39%	22%
Brazil	LAC	85%	77%	83%	-1275%	38%
Bulgaria	EECA	6%	22%	12%	2%	7%
Canada	NA	21%	54%	33%	-8%	22%
Chad	SSA	68%	63%	66%	-3150%	39%
Chile	LAC	18%	40%	26%	-29%	-29%
China	EAP	51%	41%	47%	-7%	21%
Colombia	LAC	58%	59%	59%	-193%	-193%
Costa Rica	LAC	53%	67%	58%	-9%	-9%
Croatia	EECA	7%	21%	12%	12%	12%
Czech Republic	EECA	21%	42%	28%	4%	14%
Denmark	W Europe	22%	36%	27%	5%	16%
Dominican Republic	LAC	47%	43%	46%	-29%	-29%
Ecuador	LAC	45%	45%	45%	-7%	-7%
Egypt	MENA	38%	20%	31%	-225%	40%
Estonia	EECA	21%	18%	20%	5%	5%
Ethiopia	SSA	60%	53%	57%	-319%	41%
Fiji	EAP	37%	41%	39%	-18%	18%
Finland	W Europe	14%	23%	17%	5%	15%
France	W Europe	23%	54%	34%	7%	21%
Georgia	EECA	27%	28%	27%	-21%	15%
Germany	W Europe	44%	57%	49%	8%	8%
Ghana	SSA	38%	5%	26%	-225%	41%
Greece	EECA	6%	28%	14%	16%	16%
Guyana	LAC	25%	67%	40%	12%	32%
Hong Kong	EAP	-11%	40%	7%	-13%	15%
Hungary	EECA	1%	24%	9%	2%	6%
Iceland	W Europe	17%	48%	28%	-5%	17%
India	SA	32%	57%	41%	-150%	32%
Indonesia	EAP	58%	51%	55%	-88%	27%
Iran	MENA	70%	22%	53%	-194%	43%
Ireland	W Europe	15%	29%	20%	8%	8%
Israel	MENA	9%	31%	17%	15%	15%
Italy	W Europe	35%	56%	43%	6%	6%
Jamaica	LAC	60%	55%	58%	-88%	27%
Japan	EAP	33%	64%	44%	8%	24%
Jordan	MENA	24%	43%	31%	-5%	17%
Kazakhstan	EECA	36%	25%	32%	-186%	26%
Kenya	SSA	44%	64%	51%	-1650%	36%
Korea S.	SA	29%	51%	37%	6%	6%

Kuwait	MENA	27%	37%	31%	-12%	14%
Latvia	EECA	7%	18%	11%	5%	15%
Lesotho	SSA	48%	51%	49%	-88%	27%
Luxembourg	W Europe	27%	45%	34%	6%	19%
Madagascar	SSA	49%	43%	47%	-122%	25%
Malaysia	EAP	40%	54%	45%	-7%	20%
Mauritius	SSA	10%	33%	18%	-12%	14%
Mexico	LAC	60%	56%	58%	-75%	-75%
Moldova	EECA	30%	32%	31%	18%	13%
Morocco	MENA	20%	35%	25%	8%	24%
Netherlands	W Europe	27%	51%	36%	6%	19%
New Zealand	EAP	26%	35%	30%	7%	21%
Nigeria	SSA	54%	27%	45%	-225%	44%
Norway	W Europe	30%	49%	37%	-20%	20%
Pakistan	SA	0%	0%	0%	0%	0%
Panama	LAC	23%	32%	27%	6%	6%
Paraguay	LAC	26%	32%	28%	-13%	10%
Peru	LAC	47%	54%	49%	-34%	27%
Philippines	EAP	41%	47%	43%	-35%	28%
Poland	EECA	16%	42%	25%	4%	4%
Portugal	W Europe	24%	52%	34%	5%	16%
Qatar	MENA	17%	22%	19%	-2%	8%
Romania	EECA	14%	37%	22%	4%	4%
Russia	EECA	44%	50%	46%	-186%	26%
Rwanda	SSA	51%	60%	54%	-75%	30%
Saudi Arabia	MENA	24%	39%	29%	-5%	17%
Serbia	EECA	30%	40%	34%	-4%	12%
Sierra Leone	SSA	34%	30%	33%	-319%	41%
Singapore	EAP	9%	29%	16%	11%	11%
Slovak Republic	EECA	28%	35%	31%	5%	16%
Slovenia	EECA	20%	37%	26%	4%	14%
South Africa	SSA	44%	55%	48%	-120%	30%
Spain	W Europe	18%	57%	32%	6%	19%
Sweden	W Europe	25%	46%	32%	5%	16%
Switzerland	W Europe	5%	15%	8%	9%	9%
Tanzania	SSA	47%	57%	50%	-150%	32%
Thailand	EAP	22%	33%	26%	5%	15%
Trinidad and Tobago	LAC	40%	37%	39%	-35%	28%
Tunisia	MENA	48%	51%	49%	-88%	27%
Turkey	MENA	4%	12%	7%	-2338%	31%
Uganda	SSA	39%	57%	46%	-150%	32%
Ukraine	EECA	-2%	-48%	-19%	-225%	38%
United Kingdom	W Europe	25%	49%	33%	4%	14%
United States	NA	42%	59%	48%	-8%	23%
Uruguay	LAC	69%	57%	65%	-650%	-650%
Uzbekistan	EECA	23%	17%	21%	-38%	11%
Venezuela	LAC	-101%	-101%	-101%	-101%	-101%
Vietnam	EAP	27%	50%	36%	-18%	18%
Zambia	SSA	23%	59%	36%	-220%	46%

Annex 2: Tax parameters by country

Country	Region	CIT rate[7]	Tax Depreciation	
			Buildings	**Equipment**
Argentina	Latin America & the Caribbean	35%	4%	12%
Australia	East Asia & Pacific	30%	3%	24%
Austria	Western Europe	25%	3%	11%
Bangladesh	South Asia	25%	12%	37%
Belgium	Western Europe	29%	7%	33%
Bolivia	Latin America & the Caribbean	25%	3%	17%
Botswana	Sub-Saharan Africa	22%	3%	25%
Brazil	Latin America & the Caribbean	34%	4%	12%
Bulgaria	Eastern Europe & Central Asia	10%	4%	30%
Canada	North America	27%	4%	55%
Chad	Sub-Saharan Africa	35%	5%	16%
Chile	Latin America & the Caribbean	27%	8%	40%
China	East Asia & Pacific	25%	7%	15%
Colombia	Latin America & the Caribbean	32%	5%	19%
Costa Rica	Latin America & the Caribbean	30%	2%	14%
Croatia	Eastern Europe & Central Asia	18%	5%	30%
Czech Republic	Eastern Europe & Central Asia	19%	3%	21%
Denmark	Western Europe	22%	5%	23%
Dominican Republic	Latin America & the Caribbean	27%	7%	18%
Ecuador	Latin America & the Caribbean	25%	5%	15%
Egypt	Middle East & North Africa	23%	5%	27%
Estonia	Eastern Europe & Central Asia	20%	10%	22%
Ethiopia	Sub-Saharan Africa	30%	5%	21%
Fiji	East Asia & Pacific	20%	5%	18%
Finland	Western Europe	20%	8%	29%
France	Western Europe	28%	3%	27%
Georgia	Eastern Europe & Central Asia	15%	7%	22%
Germany	Western Europe	30%	3%	14%
Ghana	Sub-Saharan Africa	25%	10%	30%
Greece	Eastern Europe & Central Asia	24%	5%	39%
Guyana	Latin America & the Caribbean	40%	3%	35%
Hong Kong SAR, China	East Asia & Pacific	17%	4%	93%
Hungary	Eastern Europe & Central Asia	9%	3%	48%
Iceland	Western Europe	20%	3%	31%
India	South Asia	30%	5%	35%
Indonesia	East Asia & Pacific	25%	5%	14%
Iran	Middle East & North Africa	25%	5%	10%
Ireland	Western Europe	13%	2%	12%
Israel	Middle East & North Africa	23%	4%	30%
Italy	Western Europe	24%	2%	15%
Jamaica	Latin America & the Caribbean	25%	4%	13%
Japan	East Asia & Pacific	31%	2%	21%
Jordan	Middle East & North Africa	20%	4%	24%
Kazakhstan	Eastern Europe & Central Asia	20%	10%	26%
Kenya	Sub-Saharan Africa	30%	3%	29%
Korea, Republic of	South Asia	25%	3%	20%
Kuwait	Middle East & North Africa	15%	4%	20%
Latvia	Eastern Europe & Central Asia	20%	10%	41%

[7] https://home.kpmg/it/it/home/services/tax/tax-tools-and-resources/tax-rates-online/corporate-tax-rates-table.html

Lesotho	Sub-Saharan Africa	25%	5%	20%
Luxembourg	Western Europe	25%	4%	21%
Madagascar	Sub-Saharan Africa	20%	5%	17%
Malaysia	East Asia & Pacific	24%	3%	17%
Mauritius	Sub-Saharan Africa	15%	5%	38%
Mexico	Latin America & the Caribbean	30%	5%	15%
Moldova	Eastern Europe & Central Asia	12%	5%	20%
Morocco	Middle East & North Africa	31%	8%	33%
Netherlands	Western Europe	25%	3%	21%
New Zealand	East Asia & Pacific	28%	7%	24%
Nigeria	Sub-Saharan Africa	30%	10%	25%
Norway	Western Europe	22%	4%	25%
Pakistan	South Asia	0%	10%	25%
Panama	Latin America & the Caribbean	25%	7%	24%
Paraguay	Latin America & the Caribbean	10%	3%	16%
Peru	Latin America & the Caribbean	30%	5%	20%
Philippines	East Asia & Pacific	30%	7%	24%
Poland	Eastern Europe & Central Asia	19%	3%	26%
Portugal	Western Europe	21%	2%	20%
Qatar	Middle East & North Africa	10%	5%	19%
Romania	Eastern Europe & Central Asia	16%	3%	25%
Russia	Eastern Europe & Central Asia	20%	3%	21%
Rwanda	Sub-Saharan Africa	30%	4%	20%
Saudi Arabia	Middle East & North Africa	20%	5%	24%
Serbia	Eastern Europe & Central Asia	15%	3%	15%
Sierra Leone	Sub-Saharan Africa	30%	11%	37%
Singapore	East Asia & Pacific	17%	3%	25%
Slovakia	Eastern Europe & Central Asia	21%	5%	17%
Slovenia	Eastern Europe & Central Asia	19%	4%	22%
South Africa	Sub-Saharan Africa	28%	5%	25%
Spain	Western Europe	25%	2%	29%
Sweden	Western Europe	21%	3%	20%
Switzerland	Western Europe	15%	6%	32%
Tanzania	Sub-Saharan Africa	30%	5%	25%
Thailand	East Asia & Pacific	20%	5%	21%
Trinidad and Tobago	Latin America & the Caribbean	30%	10%	25%
Tunisia	Middle East & North Africa	25%	5%	20%
Turkey	Middle East & North Africa	22%	13%	49%
Uganda	Sub-Saharan Africa	30%	5%	30%
Ukraine	Eastern Europe & Central Asia	18%	8%	37%
United Kingdom	Western Europe	19%	2%	18%
United States	North America	27%	4%	55%
Uruguay	Latin America & the Caribbean	25%	3%	10%
Uzbekistan	Eastern Europe & Central Asia	8%	5%	19%
Venezuela	Latin America & the Caribbean	34%	7%	24%
Vietnam	East Asia & Pacific	20%	3%	25%
Zambia	Sub-Saharan Africa	35%	5%	47%

ANNEX 3: The Theory of METR and AETR

If A Corporate Firm investing $1 in a real asset and

- it depreciates at the exponential rate of δ
- The firm's discount rate is ρ
- *The net rate of return before tax is* r
- *The corporate tax rate is* u

1) $r + \delta$ is the profit maximizing return on a unit investment which is got by using the profit maximization condition, i.e. Profit = F(K) − rK- δK, and hence $\frac{\partial Profit}{\partial K} = 0$, implies F'(K) = $(r + \delta)$, i.e. the return from a unit investment = $r + \delta$.
2) The value of the investment that depreciates exponentially at the rate δ at time t is given by $e^{-(\delta)t}$ [evaluating $\lim_{\Delta t \to 0}(1 - \delta \Delta t)^{(\frac{t}{\Delta t})}$ where the expression in brackets is the value of the investment remaining at time t i.e. after t time periods = $\left(\frac{t}{\Delta t}\right)$].
3) Exponential discounting in continuous time gives $e^{-(\delta)t}$.

Putting 1), 2) and 3) together, we have a unit investment that returns $r + \delta$. However, this investment loses value at the exponential rate of δ (i.e. its value at time t will be $e^{-(\delta)t}$.Hence the return from the investment at any point t for a duration of dt is given by
$(r + \delta)e^{-(\delta)t}\, dt.$

If u is the corporate tax rate, the tax paid on this return is equal to
$u(r + \delta)e^{-(\delta)t}\, dt.$

The present value of this return discounted at an exponential rate of ρ is given by
$u(r + \delta)e^{-(\delta)t}\, e^{-(\rho)t} dt.$

With taxes however the investment will benefit from a depreciation or capital allowance deductions. Putting these together, the Net Present Value of the Corporate Tax (NPVT) collected over the lifetime of the asset is given by

$$NPVT = \int_0^{\infty} u(r + \delta)e^{-(\rho+\delta)t}\, dt \; - uZ$$
$$= \frac{u(r + \delta)}{\rho + \delta} - uZ$$

where uZ is the present value of future reduction in tax due to all the deductions from the corporate tax base associated with the investment (i.e. the capital or depreciation allowances).

The expression Z can be calculated easily both in discrete as well as continuous time.
In continuous time and under exponential discounting, If the tax system allow depreciates at the exponential rate of ϕ
The Present Value of the future reduction in tax due to all the deductions is given by

$$uZ = u\int_0^{\infty} \phi e^{-(\rho+\phi)t}\, dt \;=\; \frac{u\phi}{\rho+\phi}$$

In discrete time, consider a $1 capital expenditure with initial investment allowance at the rate θ and a declining balance depreciation on the balance at the rate ϕ
Flow of deductions in discrete time

Year	Deduction	Undepreciated Capital Cost
1	θ+(1-θ) ϕ	(1-θ)(1-ϕ)
2	δ(1-θ)(1-ϕ)	(1-θ)(1-ϕ)(1-ϕ)= (1-θ)(1-ϕ)^2
3	ϕ(1-θ)(1-ϕ)^2	(1-θ)(1-ϕ)^3
4	. . .	. . .

The *present discounted value* of the allowance and the depreciation deductions on the $1 expenditure is:

$$Z = \theta + (1-\theta)\{\phi + \phi\,(1-\phi)/(1+\rho) + \phi\,(1-\phi)^2/(1+\rho)^2 + \ldots\}$$

$$Z = \theta + (1-\theta)\,\phi\,/(\rho+\phi)$$

When θ=0, the value of uZ is the same as the expression in the case of continuous discounting, i.e.

$$uZ = \frac{u\phi}{\rho+\phi}$$

We have the expression to compute the Net Present Value of the taxes paid. In order to calculate the Effective tax rate we need to have an expression of the income. The income is calculated in the manner similar to the discussion above except that the income accruing to the investor is net of depreciation (while the tax is paid on the entire return).
The investment will generate a flow of pre-tax income which is given by

$$NPV = \int_0^{\infty} re^{-(\rho+\delta)t}\, dt \;=\; \frac{r}{\rho+\delta}$$

The forward-looking measure of the Average Effective Tax Rate is given by

$$AETR^f = \frac{NPVT}{NPV}$$

$$= \frac{(u-uZ)(\rho+\delta) + u(r-\rho)}{r}$$

One can verify that when the tax depreciation is equal to the economic depreciation, i.e. $\phi = \delta$, $AETR^f = u$ the corporate tax rate, and when $\phi \neq \delta$ the AETR will deviate from the statutory rate
AETR may be calculated for any value of the pre-tax rate of return '*r*'. Of particular interest is the tax on the marginal investment project (with a net-of-tax value equal to zero).

The marginal investment can be understood as follows. Ignoring taxes, all investments that earn a rate of return in excess of a minimum required hurdle rate of return will be undertaken. Investments that earn more than the hurdle rate of return are said to earn *economic profits*. The very last investment project undertaken just breaks even in the sense that it earns the hurdle rate of return exactly is called the *marginal* investment. Gross of tax and depreciation, the present value of the return from an extra unit of investment is given by,

$$PVG = \frac{r+\delta}{\rho+\delta}$$

(this is because $(r+\delta)$ is the profit maximizing return on investment which is got by using the profit maximization condition, i.e when Profit = F(K) − rK- δK, hence F'(K) = $(r+\delta)$ as above). By the definition of the Marginal Investment,

$$PVG - NPVT - 1 = 0$$

return less expenses [i.e. tax (NPVT) plus investment ($1)] = 0

Hence,

$$\frac{(1-u)(r+\delta)}{(\rho+\delta)} = 1 - uZ$$

Hence, the required before tax rate of return on the Marginal Investment is given by

$$\hat{r} = \frac{(1-uZ)(\rho+\delta)}{(1-u)} - \delta$$

This expression is also known as the User Cost of Capital and can be derived by maximizing the Value of a firm Jorgenson (1963) and Hall and Jorgenson (1967). Sticking this return $\hat{r}$ into the definition of effective tax rate for r we used earlier

$$AETR^f = \frac{NPVT}{NPV}$$
$$= \frac{(u-uZ)(\rho+\delta) + u(r-\rho)}{r}$$

We obtain,

$$METR^f = \frac{(u-uZ)(\rho+\delta)}{(1-u)\hat{r}}$$

And in another form,

$$\boldsymbol{METR^f = \frac{\hat{r} - \rho}{\hat{r}}}$$

Which implies that the $METR^f$ is the difference between the before-tax and after-tax rate of return measured relative to the before tax return. Consider the case when the tax system allows investments to be expensed fully,

i.e. $\phi \rightarrow \infty$, hence Z=1, substituting into the expression for METR

$$METR^f = \frac{(u-uZ)(\rho+\delta)}{(1-u)\hat{r}}$$

Gives $METR^f$ = 0

Which implies that under a cash flow tax when investment is completely expensed, the METR = 0.

Substituting ,

$$METR^f = \frac{(u-uZ)(\rho+\delta)}{(1-u)\hat{r}}$$

into the expression for

$$AETR^f = \frac{(u-uZ)(\rho+\delta) + u(r-\rho)}{r}$$

Gives,

$$AETR^f = \left(\frac{\hat{r}}{r}\right) METR^f + \left(1 - \frac{\hat{r}}{r}\right) u$$

Which is an intuitive expression that indicates the relative importance of these two measures

For the marginal investment project where $\hat{r} = r$, we have the

$AETR^f = METR^f$, but for projects with very high rates of returns, $\hat{r} \gg r$, the $AETR^f$ approaches the corporate tax rate.

ANNEX 4: METRs for Capital and Labor

Based on the foundation developed in ANNEX 1, the METRs can be calculated for different kinds of capital (Land, Building, Equipment and Inventory) using different kinds of financing (debt and equity) and also including other factors of production including Labor.

From Annex 1 we have

$$\boldsymbol{METR^f = \frac{\hat{r} - \rho}{\hat{r}}}$$

Where $\hat{r}$ is the required before tax is rate of return on the Marginal Investment (Gross-of-tax rate of return on Capital) and ρ is the firm's discount rate which is taken to be net-of-tax rate of return on capital for the owners of the firm given by the expression

$$\rho = \beta i+(1-\beta)e - \pi$$

where i is the interest rate on debt and e is the rate of return on equity, β is the proportion of the investment financed by debt and π is the inflation rate.

The required rate of return for owner of capital is different from the cost of financing for the firm because firms are allowed to deduct interest payments that are financed by debt. Hence,

$$\hat{r} = \frac{(1 - uZ)(\rho_f + \delta)}{(1 - u)} - \delta$$

where ρ_f = βi(1-u)+(1-β)e − π , reflecting that the cost of debt will now be lower as it is deductible and hence reduces the corporate tax payable.

Gross of Tax Rate of Return on Capital

The Gross of tax rate of return on capital is given by

$$\hat{r} = (1 + t_c)\,(1 - ITC)\frac{(1 - uZ)(\rho_f + \delta)}{(1 - u)(1 - t_p - t_s)} - \delta$$

Where t_c the tax on capital inputs such as a tax on transfer of property, import duty on capital equipment, etc. t_p is the property tax rate and t_s is a tax on gross receipts such as a sales tax and ITC is the Income Tax Credit rate which is the percentage of capital invested that is allowed to be deducted out of the tax paid.

Z is the present value of the depreciation benefits which is equal to $\frac{\phi}{\rho+\phi}$ where ϕ is the depreciation rate for the capital for tax purposes (as shown in Annex 1). In the case of straight-line depreciation Z is calculated using the present value of equal parts of the capital being allowed to depreciate as follows:-

$Z = \sum_{i=1}^{\frac{1}{\phi}} \left(\frac{\phi}{(1+\rho)^i}\right)$, hence if ϕ=5% straight line, then the summation is carried for 20 years with 5% of the capital being allowed depreciated each year for tax purposes.

Gross of Tax Rate of Return on Inventory

For Inventory the method of accounting for it affects the gross rate of return. If inventory is depreciated by the FIFO (First In First Out) accounting method, then the value of sale out of the inventory is higher because of inflation during the intervening years and there is essentially a tax on inflation that is borne by the firm. In such a case the Gross of tax rate of return on inventory is given by

$$\hat{r} = \frac{(\rho_f + u\pi\zeta)}{(1-u)(1-t_p-t_s)}$$

Where ζ=1 if the FIFO accounting is used and Where ζ=0 if LIFO (Last In First Out) method is used.

Gross of Tax Rate of Return on Land

For Land which does not depreciate but bears taxes such as the property tax and the land transfer tax, the Gross of tax rate of return is given by

$$\hat{r} = (1+t_c)\frac{\rho_f}{(1-u)(1-t_p-t_s)}$$

METR on Labor

For the Marginal cost of labor we assume that the firm bears the taxes on labor such as the payroll taxes, social security contributions, etc. that it pays to the government. In such a case the Marginal cost of labor is the taxes borne on the incremental labor which is the tax burden on the average wage of a worker.

Composite METR on the Costs of Production

Based on Makenzie, Mintz and Scharf (1997), the overall METR on production assuming a Cobb-Doublas production function is given by the expression,

$$\hat{r} = \left[(1+METR_l)^{\delta l}(1+METR_k)^{\delta k}\right] - 1$$

Where $METR_l$ is the METR for Labor, $METR_k$ is the METR on Capital, and δl and δk are the factor shares of Labor and Capital respectively.

ANNEX 5: METRs during Tax Holidays

As per Mintz (1989) (Tax Holidays and Investment), gross pre-tax required rate of return or the user cost of capital are as follows –

Suppose tax holiday starts from t*. Assuming that tax depreciation allowances are not deferred until end of tax holidays,

Investments made during Holiday period (t < t*)

$$F_t' = \frac{(\partial + r)(1 - A_t)}{1 - u_0} + \frac{(u_1 - u_0)(1 + r) \propto}{1 - u_0} \left(\frac{1-\propto}{1+i}\right)^{t* - t}$$

Where,

$F_t' = Gross\ pre - tax\ required\ rate\ of\ return$

∂ = economic depreciation

r = cost of financing

A_t (NPV of tax depreciation) $A_t = u_0 + Z(u_1 - u_0)\left(\frac{1-\propto}{1+i}\right)^{t* - t}$ for t < t*

$Z = \frac{(1+i)\propto}{i+\propto}$

U_1 = Corporate tax rate during tax holiday

U_0 = Corporate tax rate after holiday

$\propto$ = tax depreciation rate

i = discount rate such that (1+r) = (1+i)/(1+pi)

pi = inflation rate

Investments made at end of Holiday period (t = t*)

$$F_{t*}' = \frac{(\partial + r)(1 - A)}{1 - u_1} + \frac{(u_1 - u_0)(1 + r) \propto}{1 - u_1}$$

A = $u_1 Z$

Investments made after end of Holiday period (t > t*)

$$F_{t*}' = \frac{(\partial + r)(1 - A)}{1 - u_1}$$