METR Modeling

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What is a METR?

- METR=marginal effective tax rate.
- Commonly employed to assess possible tax distortions to investment; savings; employment.
- METR for investment in physical capital (machinery, equipment, buildings, inventories) derived from a model of a profit-maximizing firm, producing under competitive market conditions.
- A forward-looking, parameter-based tax burden summary statistic, routinely used to assess tax distortions to domestic investment.
- Seminal work by Jorgenson (1963), King and Fullerton (1984).

Possible METR dimensions

- Classes of assets:
  - machinery, buildings, inventories
- Classes of industries:
  - manufacturing, non-manufacturing, other
- Sources of finance:
  - retained earnings, new equity, debt
- Forms of ownership:
  - households, tax-exempt institutions
  - Resident (domestic investment), non-resident (FDI)

Illustration of METR closed/local economy, no tax

R_n=MRRS =marginal required rate of return on domestic savings (debt + equity financing) =marginal cost of domestic funds

R_g=MPK-δ=(ΔY/ΔK)-δ =marginal product of capital, net of economic depreciation

METR=$(R_g-R_n)/R_g$=0

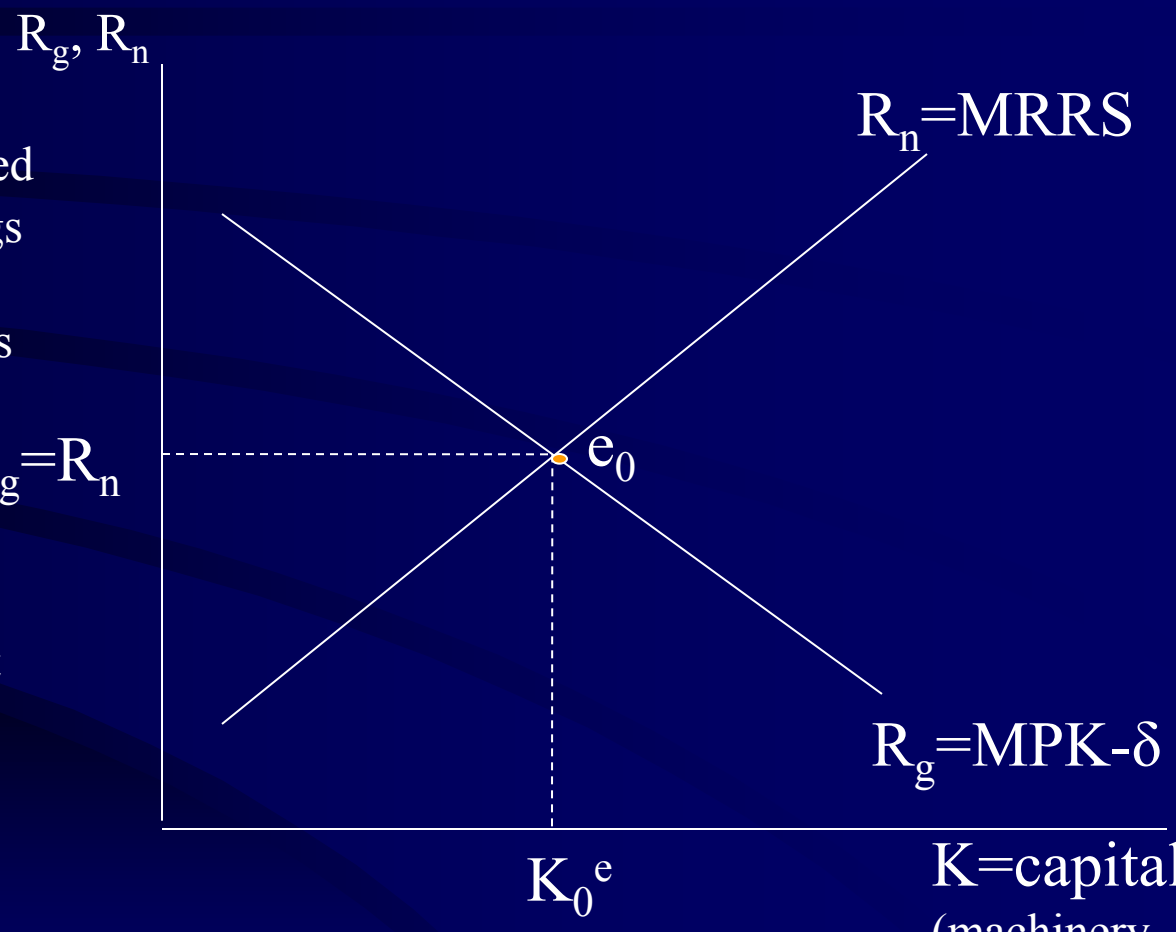
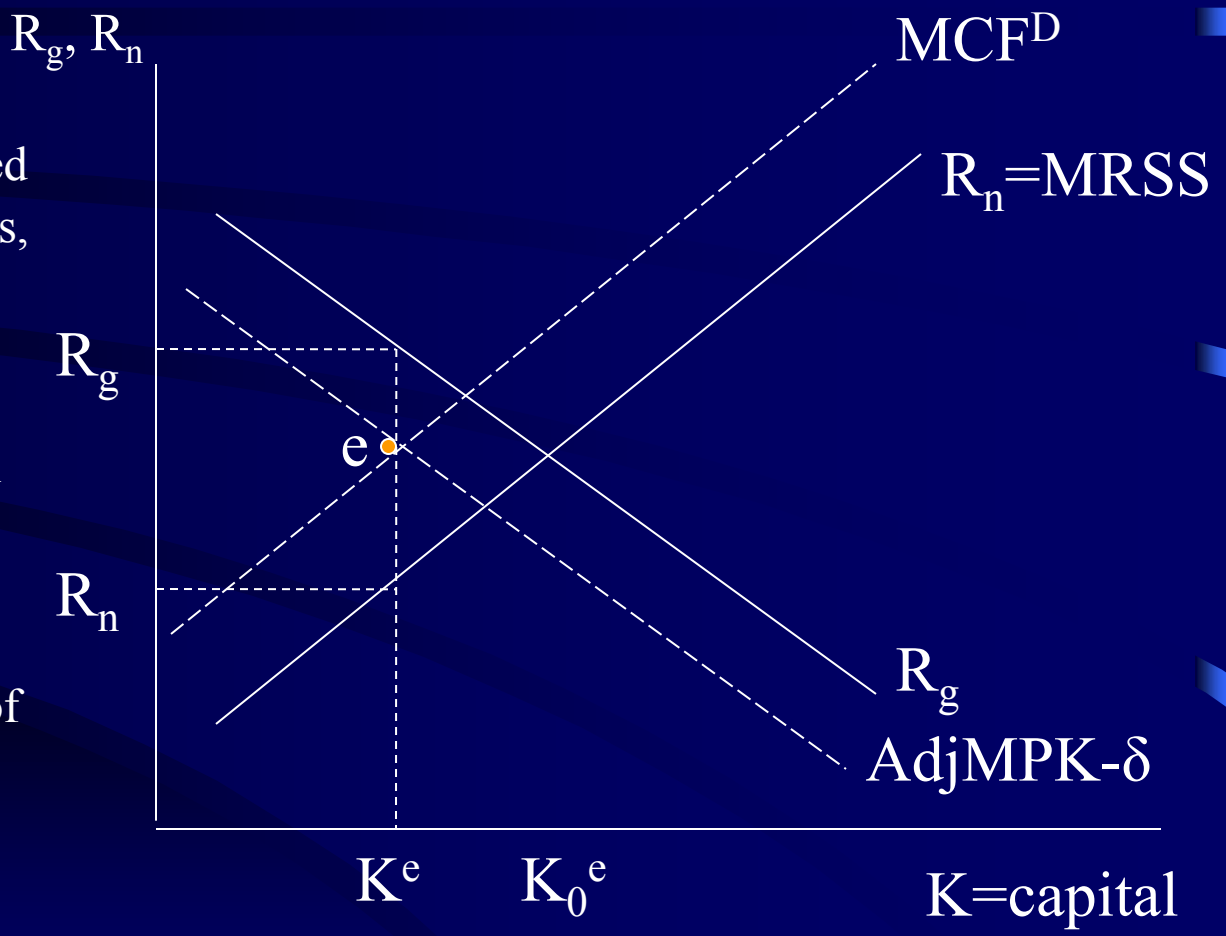


Illustration of METR closed/local economy, with tax

R_n=MRRS =marginal required rate of return on domestic savings, net of personal income tax

MCF^D =marginal cost of domestic funds at corporate level

AdjMPK-δ=tax adjusted marginal product of capital, net of economic depreciation

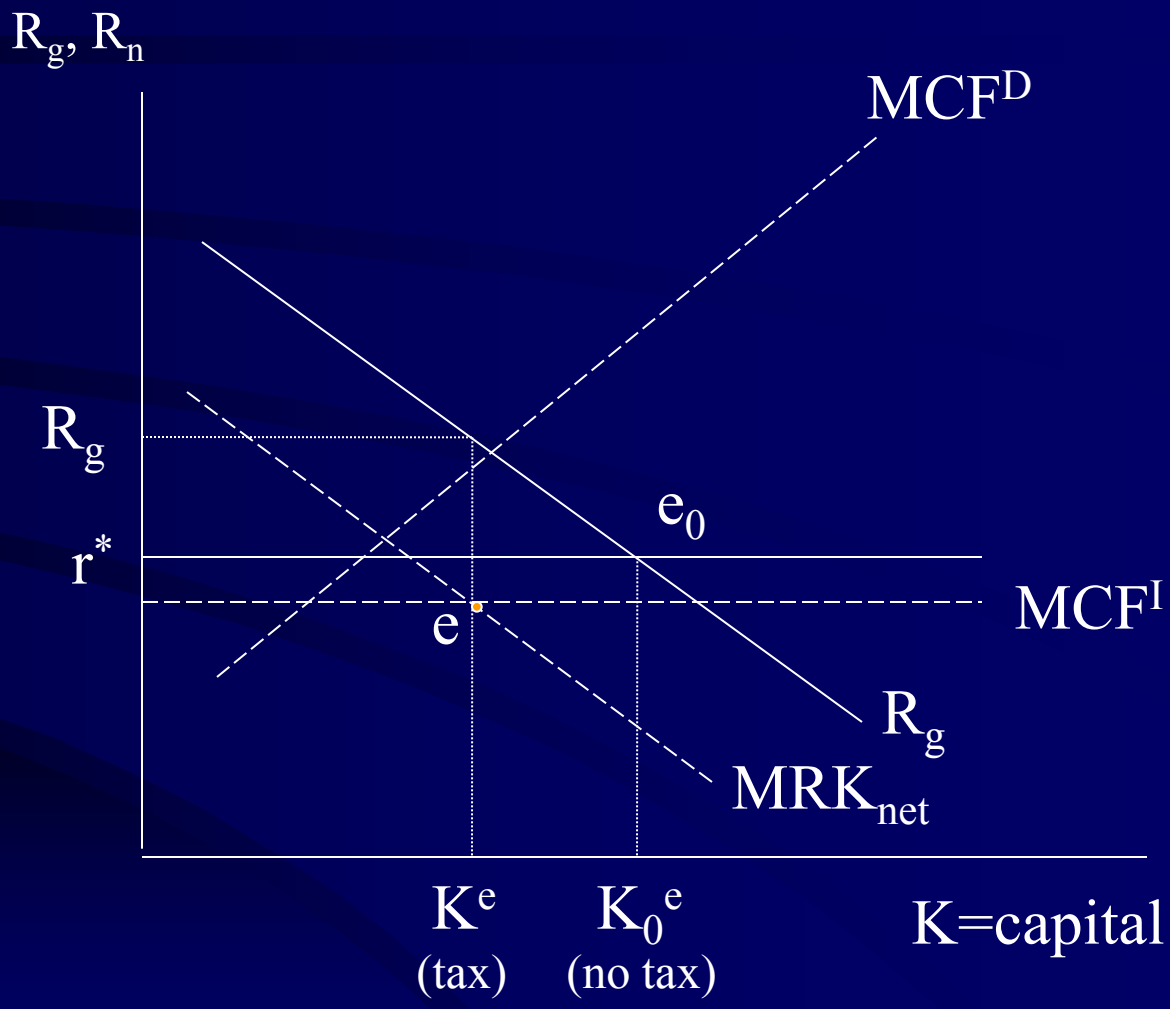


METR=$(R_g–R_n)/R_g$ >0 (tax distortion discouraging investment)

Illustration of Corporate METR (open economy)

$METR_C=(R_g-r^*)/R_g>0$

$METR_C$ typically used to assess tax distortion to investment (open economy assumption applied widely)



Corporate METR

- $METR_C=(R_g-r^*)/R_g$

  where

  - R_g=marginal product of capital, net of economic depreciation (profit maximizing rate),
  - r^*=required rate of return on (debt + equity) finance, net of corporate tax (exogenous – set in global capital market).

- If $METR_C > 0$, tax distortion ↓ investment.
- If $METR_C < 0$, tax distortion ↑ investment.
- If $METR_C = 0$, tax neutrality (no effect).
- Need to measure $R_g=(\Delta Y/\Delta K)-\delta$ to solve for $METR_C$ – based on assumption of profit maximization.

Consider a simple CIT system

- Statutory corporate income tax (CIT) levied at a single rate denoted by u (e.g. u=0.25).
- Interest expense is tax deductible; cost of equity is not tax deductible.
- Declining-balance tax depreciation at rate α (single capital type for illustrative purposes) – let z measure present discounted value (PV) of depreciation allowances, per currency unit of capital.
- Investment tax credit, at rate ψ, per currency unit.
- Effective purchase price of one currency unit of capital = (1-A) where $A=\psi+z$.

Solving for R_g and $METR_C$

- After-tax marginal benefit (MB) of investment:

  $MPK(1-u)=(\Delta Y/\Delta K)(1-u)$

- After-tax marginal cost (MC) of investment:

  $(R_f+\delta)(1-A)$ where $R_f=\beta i^*(1-u)+(1-\beta)\rho^*$

- Profit maximizing investment condition (MB=MC):

  $MPK(1-u)=(R_f+\delta)(1-A)$

- Solving for R_g

  $R_g=MPK_n=MPK-\delta=(R_f+\delta)(1-A)/(1-u)-\delta$

- Solving for $METR_C$

  $METR_C=(R_g-r^*)/R_g$

  with $R_g=(\beta i^*(1-u)+(1-\beta)\rho^*+\delta)(1-A)/(1-u)-\delta$

  and $r^*=\beta i^*+(1-\beta)\rho^*$

Assessing impact of tax incentives

Increase in tax parameter	*Transmission mechanism*	*Impact on Rg and METR©*	*Impact on investment*
Corporate tax rate (u)	decreases net return on business profits	increases	decreases
	decreases cost of debt finance	decreases	increases
	increases value of capital cost allowance	decreases	increases
Capital cost allowance rate (α)	decreases effective cost of physical capital	decreases	increases
Investment tax credit rate (ψ)	decreases effective cost of physical capital	decreases	increases

METR analysis of efficiency effects of cash-flow tax of corporate profits

Main features of cash flow tax:

- immediate expensing of capital costs
- no deduction for interest expense

$A=u$, so that $(1-A)=(1-u)$

$R_f=r^*= \beta i^*+(1-\beta)\rho^*$

Solve for R_g:

$R_g=(R_f+\delta)(1-A)/(1-u)-\delta$

$=(r^*+\delta)(1-u)/(1-u)-\delta=r^*$

$METR_C=(R_g-r^*)/R_g =0$ (tax neutrality)

METR analysis of efficiency effects true economic depreciation and tax deduction for cost of finance (debt+ equity)

With true economic depreciation of capital costs $\alpha=\delta$

$(1-A)=(1-u\delta/(R_f+\delta))=(R_f+\delta(1-u))/(R_f+\delta)$

With deduction for interest and marginal return on equity

$R_f= \beta i^*(1-u)+(1-\beta)\rho^*(1-u)$

Solve for R_g:

$R_g=(R_f+\delta)(1-A)/(1-u)-\delta =R_f/(1-u)+\delta-\delta =R_f/(1-u)$

$R_f=\beta i^*+(1-\beta)\rho^*=r^*$

$METR_C=(R_g-r^*)/R_g =0$ (tax neutrality)