

# INTRODUCTION:

# TAX/ TRADE POLICY MODEL

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# Basic Concepts:

## What *is* a CGE Model?

A “Computable General Equilibrium” (CGE) model:

- is an economic model that combines the following:
  - **firms** (factories, companies) that attempt to maximize profits and minimize costs
  - **households** who maximize “welfare” (consumption) by choosing consumption goods according to price
  - **markets**: where *prices adjust* until supply and demand is equal



## *Basic Concepts:*

# WHEN IS A CGE MODEL USED?

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- Use Examples:
  - Trade Policy: Free Trade Agreements for U.A.E.
  - Climate Change : Effect of a tax on CO<sub>2</sub>.
  - Tax Reform: VAT, Income Tax, Corporate Tax simultaneously in Mongolia. ( also done for Jamaica, Vietnam, USA, etc..)
  - Labor markets: formal & informal work in Bulgaria

# WHY ARE CGE MODELS POPULAR?

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## Strengths:

- Combines economic theory + detailed data
- Optimization:
  - Households respond to price changes
  - Firms respond when markets shift
- Provides “evidence” :
  - Benefits and costs can be quantified
  - Trade-offs between policies can be quantified

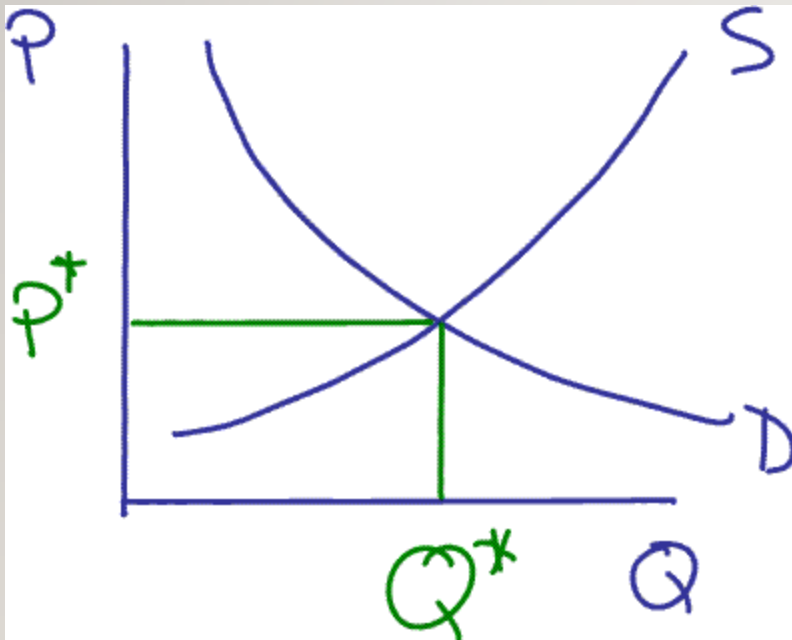
# UNDERSTANDING CGE :

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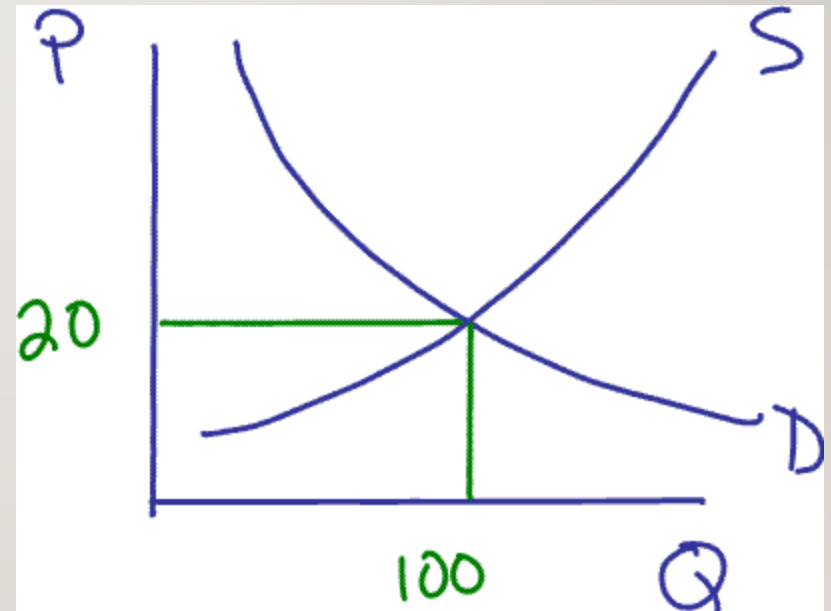
- No Econometrics:
  - CGE Models are “Calibrated” to the National Accounts. No time-series, or panel-data is used.
  - CGE Dataset:
    - One year of full national accounting information (input-output, institutional transfers, taxes, trade, etc..)
- Main Theory :
  - Optimization
  - Demand and supply functions
  - Elasticities of substitution

# Example

Partial Equilibrium = Theory & Data



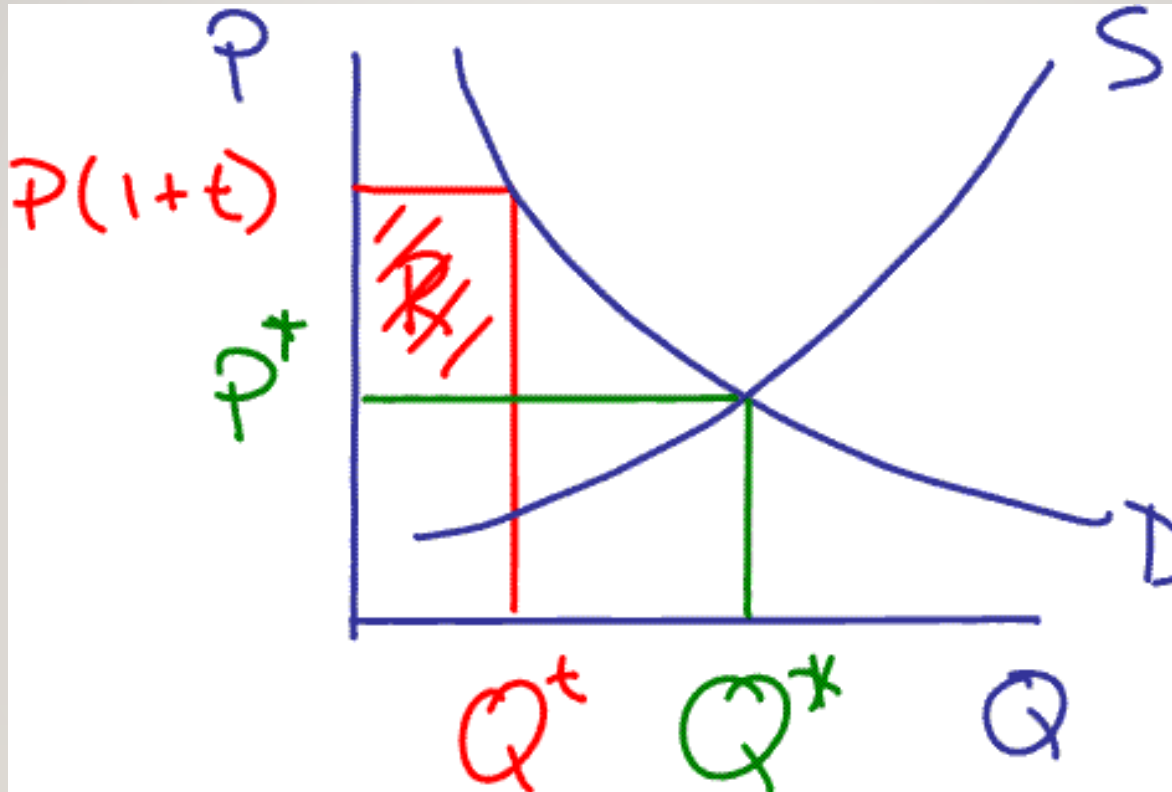
**Theory Only**



**Theory with: *numbers***

# Example

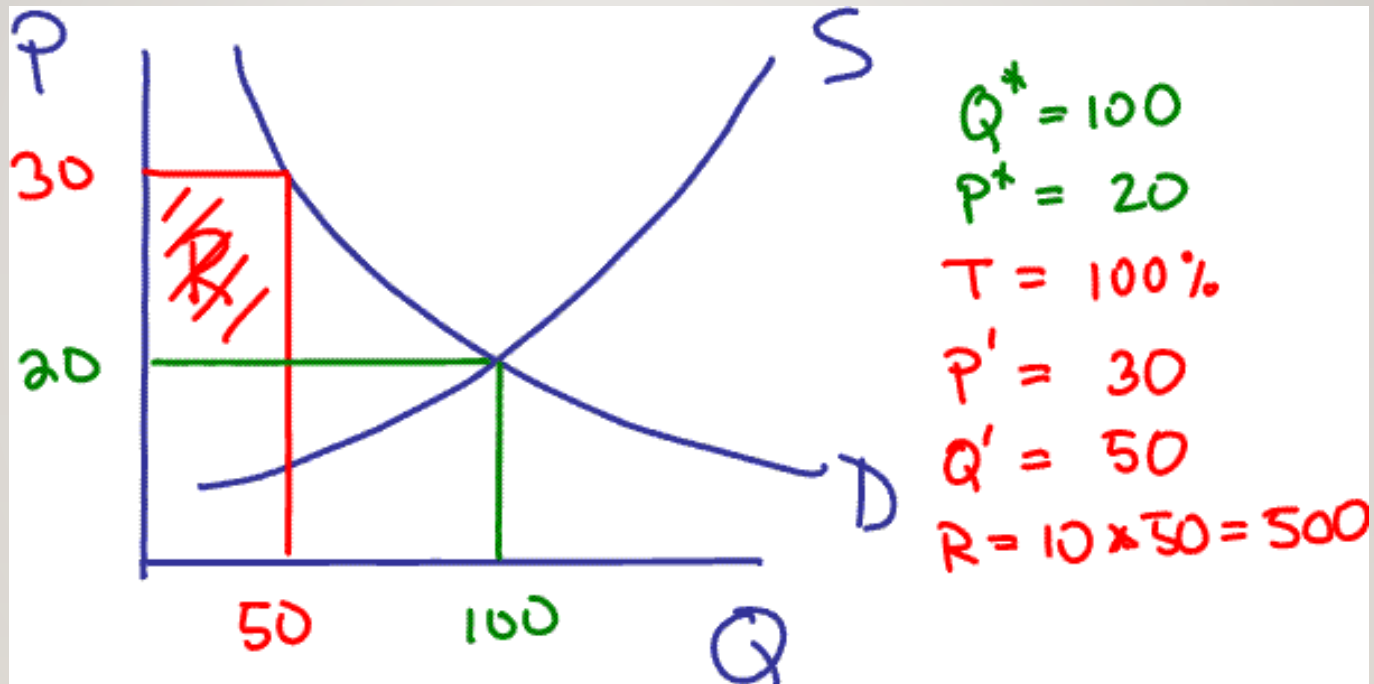
## Partial Equilibrium: Theory Only



**Theoretical Effect of a Tax**

## Example

Actual Impact using Numbers:



**Effect of a Tax: With numbers**

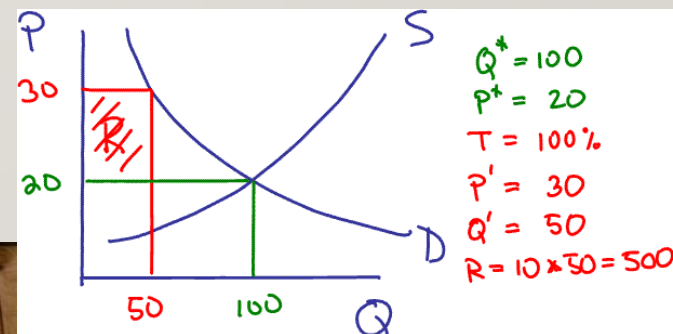


# Numerical Results:

Using the previous *Partial Equilibrium* model, we can say:

Effect of a 100% tax:

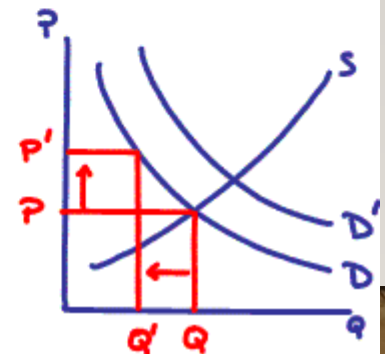
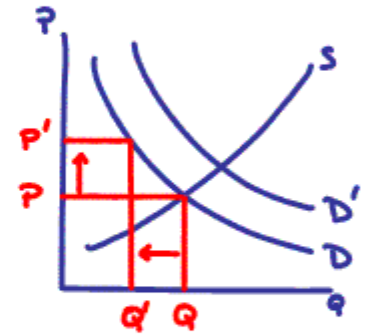
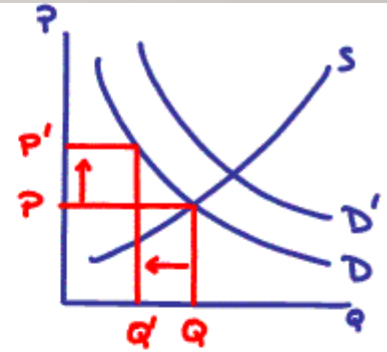
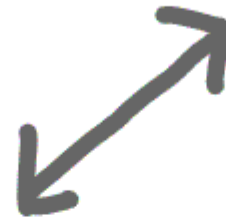
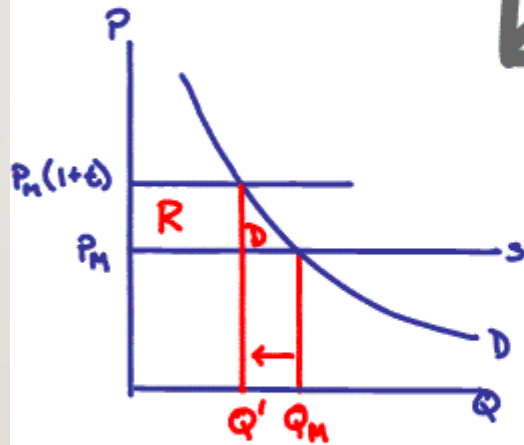
- Output Declines:
  - \$2,000 to \$1,000 (50% decline)
- Consumer prices rise:
  - \$20/each to \$30/each (50% increase)
- Tax Revenues = \$500



# General Equilibrium: All markets interacting

General Equilibrium:

- Multiple markets
- Multiple households
- Multiple firms



# TYPICAL OUTPUTS (TAX):

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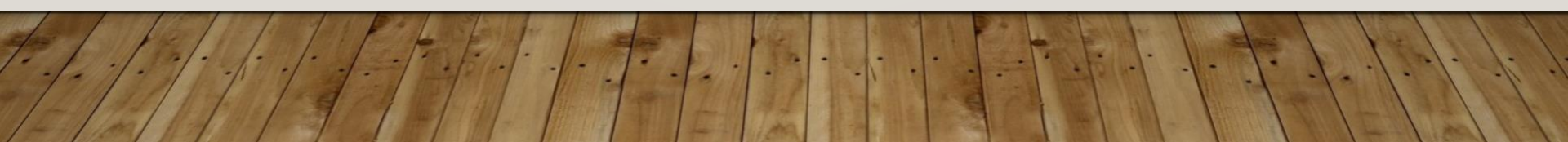
## For Tax Policy:

- Tax Revenues, Tax Interaction Effects, Cost of Funds
- Prices & Inflation
- Sector-Level Effects
- Wages, Return to Capital, Foreign Exchange
- Income changes ( real and nominal ), welfare
- GDP, Exports, Imports, etc.

# TYPICAL OUTPUTS (TRADE):

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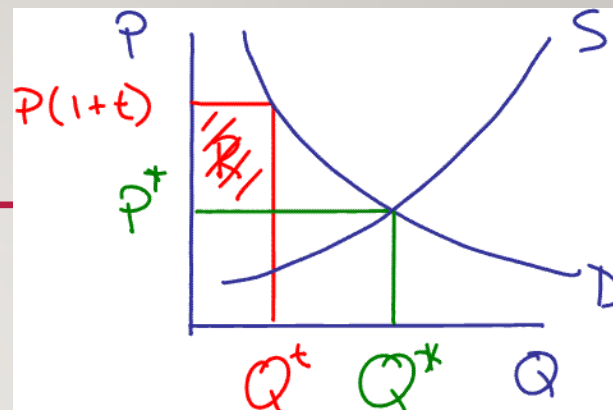
## For Trade Policy:

- Import values
  - Export values
  - Balance of Trade
  - FX Values, Tariff Revenues
  - Income changes ( real and nominal ), welfare
  - GDP, CPI, wages, return to capital, etc.
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# TAXATION: COST OF FUNDS

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Cost of Funds:



$$MCF = \Delta I / \nabla REV$$

Change in Income ÷ Change in Tax Revenues

Best Case Scenario:  $MCF = 1.0$  ( A Lump-Sum Tax )

Normally,  $MCF = \{ -1.8 \text{ up to } -6.0 \}$

$MCF > 1.0$  Reflects the Deadweight Loss caused by the tax.

# DATASETS: SOCIAL ACCOUNT MATRIX

The Social Accounting Matrix (“SAM”)

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Markets	Production Sectors			Consumers
	X	Y	W	
PX	100		-100	
PY		100	-100	
PW			200	-200
PL	-40	-60		100
PK	-60	-40		100

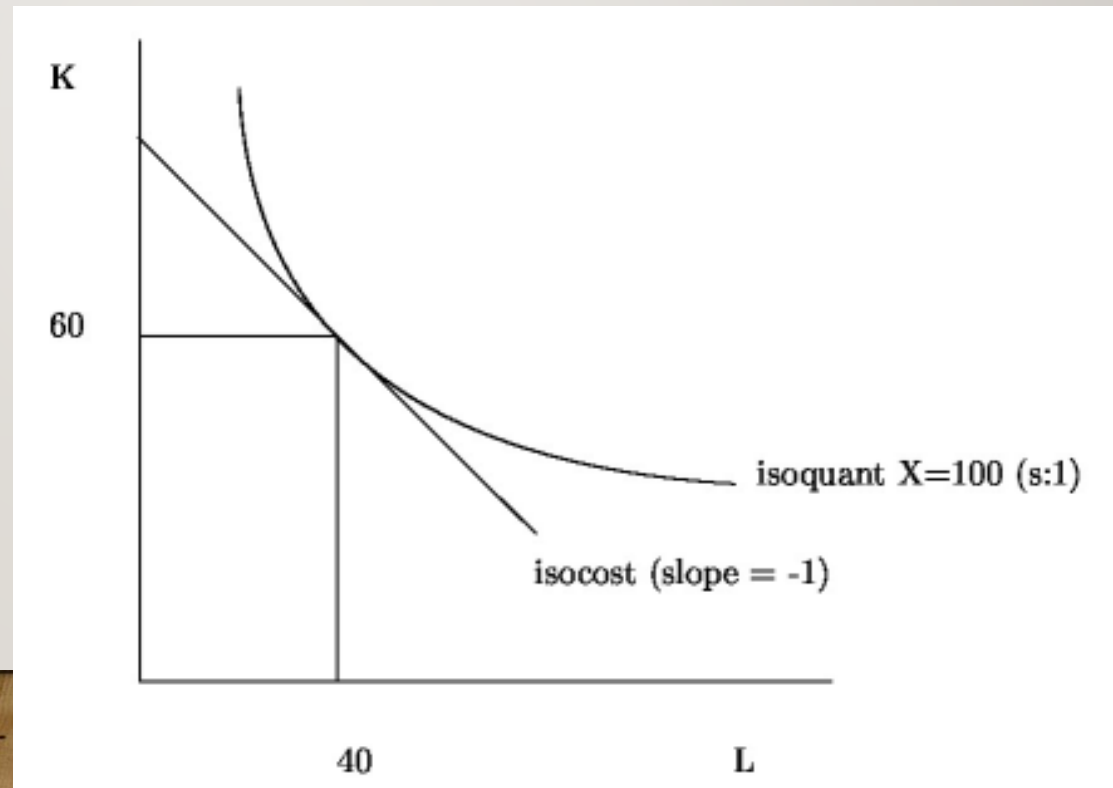
# PRODUCTION FUNCTIONS

Function for XSector: Calibrated to the Data ( 60 / 40 )

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$$X_i = L_i^{0.4} K_i^{0.6}$$

arkets		Productio X	Y
PX		100	
PY			100
PW			
PL		-40	-60
PK		-60	-40

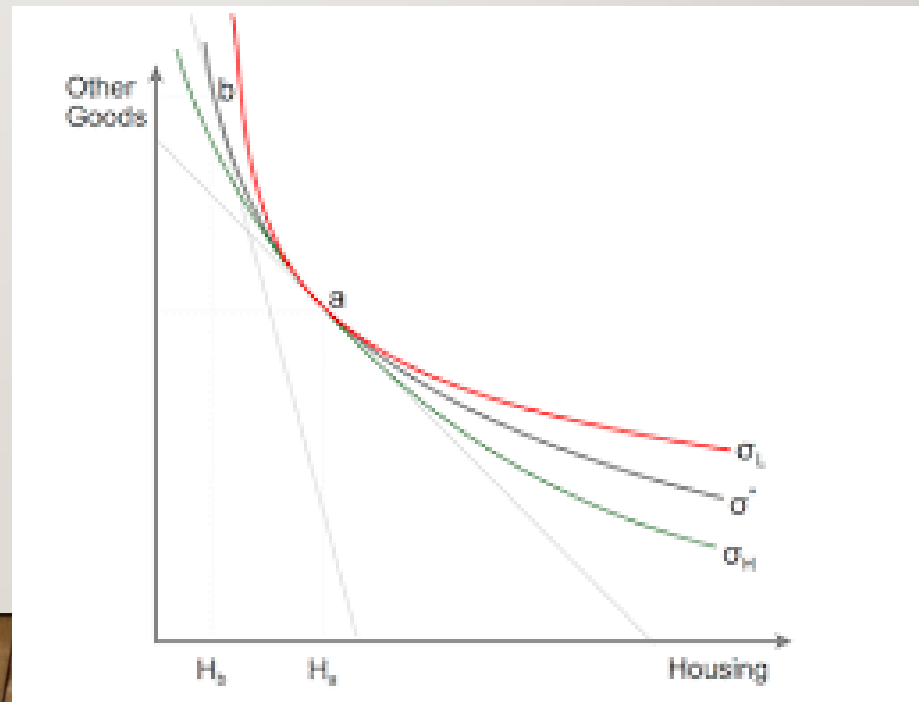


# PRODUCTION FUNCTIONS

Elasticity of Substitution between K and L: Chosen according to Local Knowledge

$$X_i = L_i^{0.4} K_i^{0.6}$$

arkets		Productio X	Y
PX		100	
PY			100
PW			
PL		-40	-60
PK		-60	-40





# EXAMPLE: 50% TAX ON X

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## Exercise:

- Build a 2 x 2 x 2 CGE Model
- Apply a 50% Tax on the X-Sector
- Answer the Tax Questions.

# “Actual” POLICY MODEL

## Example Social Account Matrix:

- 52 Production Sectors ( production functions )
- 9 Factors of Production:
- 2 Household Types
- 1 Government Agent
- 6 Policy Variables

Sectors and commodities			
Label	Description	Label	Description
wht	Wheat	opf	Meat fish and dairy products
maz	Maize	prc	Processed cereals
pdr	Paddy rice	rcf	Processed coffee
sor	Sorghum	pct	Processed tea
pot	Irish potatoes	sgr	Bakery processed sugar
spt	Sweet potatoes	bev	Traditional beverages
cas	Cassava	sda	Modern beverages
ort	Other roots	tbc	Tobacco
pul	Pulses	tex	Textile and clothing
veg	Other vegables	ppr	Wood paper and printing
ban	Bananas	chm	Chemicals
frt	Other fruits	nmm	Non-metalic minerals
osd	Oil seed	frn	Furniture and other manufactured products
cof	Coffee	ele	Electricity gas and water
tea	Green tea	con	Construction
pyr	Pyrethium	trd	Wholesale and retail trade
xcr	Other export crops	htl	Hotels and restaurants
cow	Bovine cattle, live	trn	Transports
shp	Sheep and goats live	com	Communication
pic	Swine live	fin	Finance and insurance
chk	Poultry live	rel	Real estate
mlk	Raw milk	bus	Business services
egg	Eggs	rpr	Repair
lvs	Other livestock products	pub	Public administration
frs	Forestry	edu	Education
fsh	Fishing	hlt	Health
min	Mining	osr	Other personal services

The Social Accounting Matrix ("SAM")

Markets	Production Sectors			Consumers CONS
	X	Y	W	
FX	100		-100	
FY		100	-100	
FW			200	-200
FL	-40	-60		100
FK	-60	-40		100

# Actual TAX POLICY MODEL

## Real World - Social Account Matrix:

- 52 Production Sectors (production functions)
- 9 Factors of Production:
- 2 Household Types
- Government Agent
- 6 Policy Variables

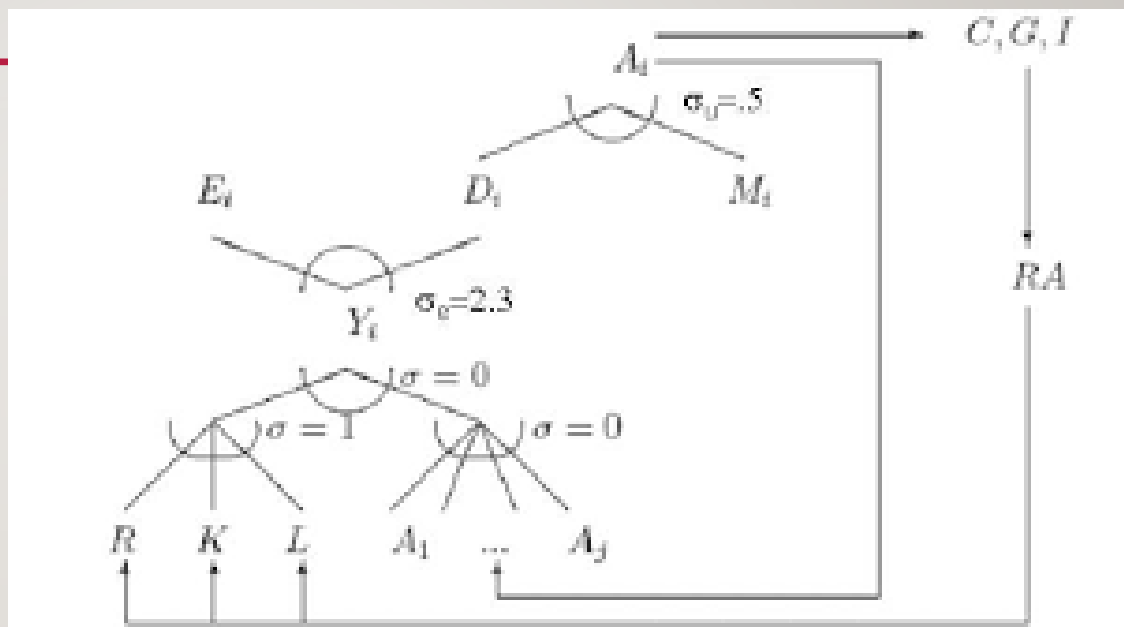
Labor Types			
lab-ag	Agriculture Labor	lab-us	Unskilled Labor
lab-ls	Low Skilled Labor	lab-hs	High Skilled Labor
Capital Types			
Ind	Crop Lands	cap-na	Non-Agriculture Capital
liv	Livestock	cap-ss	Sector Specific Capital
cap-ag	Agriculture-specific capital		
Tax types			
VAT	Value Added Taxes	TL	Taxes on Labor by Type
DT	Direct Taxes	TK	Taxes on Capital by Type
TM	Import Tariffs	FEE	Fees and other charges
Household Types			
hhd-rur	Rural Households	hhd-urb	Urban Households

The Social Accounting Matrix ("SAM")

Markets	Production Sectors			Consumers CONS
	X	Y	W	
FX	100		-100	
FY		100	-100	
FW			200	-200
FL	-40	-60		100
FK	-60	-40		100

# Real World TAX POLICY MODEL

## Production Structure:

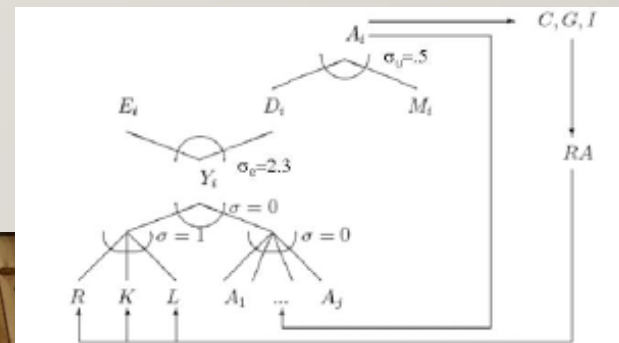


- Inputs:  $A_1 \dots A_j$ , Labor ( $L$ ), Capital ( $K$ ), Land ( $R$ )
- Outputs  $\rightarrow$  Domestic Markets ( $D$ ), Export Markets ( $E$ )
- Goods come from  $D$ =Domestic, or  $M$ =Imports
- Goods  $\rightarrow$  Industry ( $I$ ), Consumers ( $C$ ), or Govt. ( $G$ ).

# EXAMPLE CODE

Example of the Computer Code for this Production Function:

```
$prod:y(i)$y0(i)          s:0  t:0.5  va:2.0  sl(va):2.0  sk(va):2.0
  o:px                    q:x0(i)
  o:pd(i)                  q:d0(i)
  i:pa(j)                   q:id0(j,i)
  i:pl(lab)                 q:ld0(i,lab)          a:govt t:tl(lab)  sl:
  i:pk("lnd")               q:kd0(i,"lnd")       a:govt t:tk("lnd")
  i:pk("cap-ss")            q:kd0(i,"cap-ss")  a:govt t:tk("cap-ss")
  i:pk(capL)                q:kd0(i,capL)       a:govt t:tk(capL)  sk:
```



# THANK YOU

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