

# GHG Regulation

# 3 Approaches

- Direct Regulation
- Cap and Trade
- Fee

# Economy Wide Model

- Find the effect on the total CA economy of these three types of measures
- Use EDRAM, a general equilibrium model of CA
- What is EDRAM?

# Model History

- California State Senate Bill 1837 in 1994
- Evaluate Tax Bills Over \$10 million
- Adopted by CAL EPA/ARB
  - SIP (2000 report)
  - Petroleum Reduction Strategies (joint with CEC)
  - Current SIP
- Continuous use for last 8 years

# DRAM

- Captures all the fundamental economic relationships among consumers, producers and government.
- Computable
  - done numerically
  - over 1100 equations
- General Equilibrium
  - Prices adjust to clear markets
    - in factors, labor and capital
    - in goods and services
  - Conserves Money
  - Conserves goods, services, and factors

# Industrial Sectors

- Group like industries together
  - e.g. Agriculture sector represents all agricultural firms in CA.
    - output value = value of all crops in CA
    - labor demand = total value of labor used in ag.
- Data
  - national data Bureau of Economic Analysis
  - state employment data

# Households & Gov't

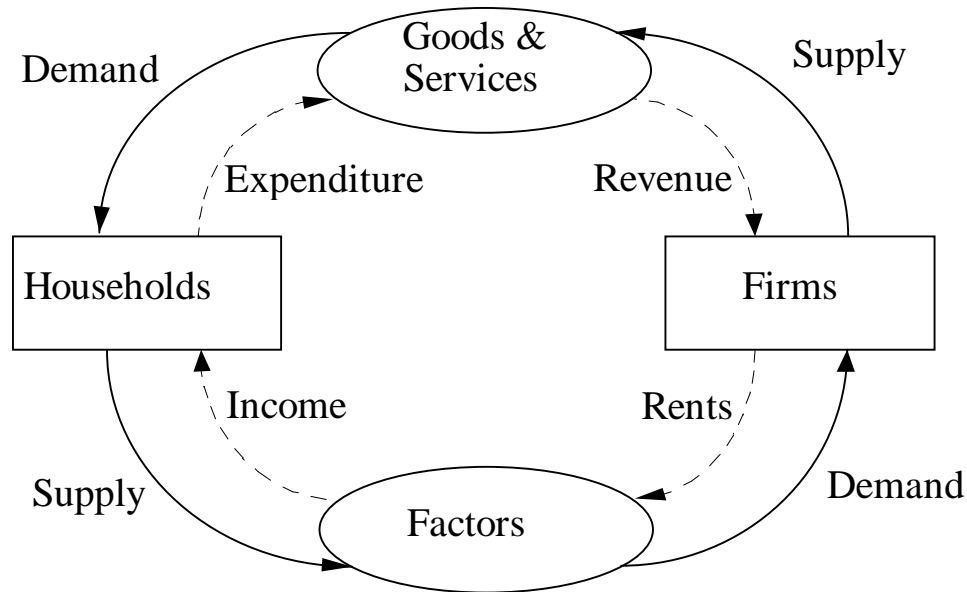
- 7 categories of HH
  - one for each marginal tax rate
  - traces income and expenditure for each
- Gov't
  - 7 federal, 27 state, and 11 local sectors
  - keeps program areas and tax types separate

# Where is Petroleum?

- Refining
- Crude Production
- Import and Export
  - Crude
  - Refined
- Intermediate good purchased by
  - Transportation
  - Other sectors
- Purchased by consumers
- Significant direct tax revenue
- Engines are needed to use petroleum



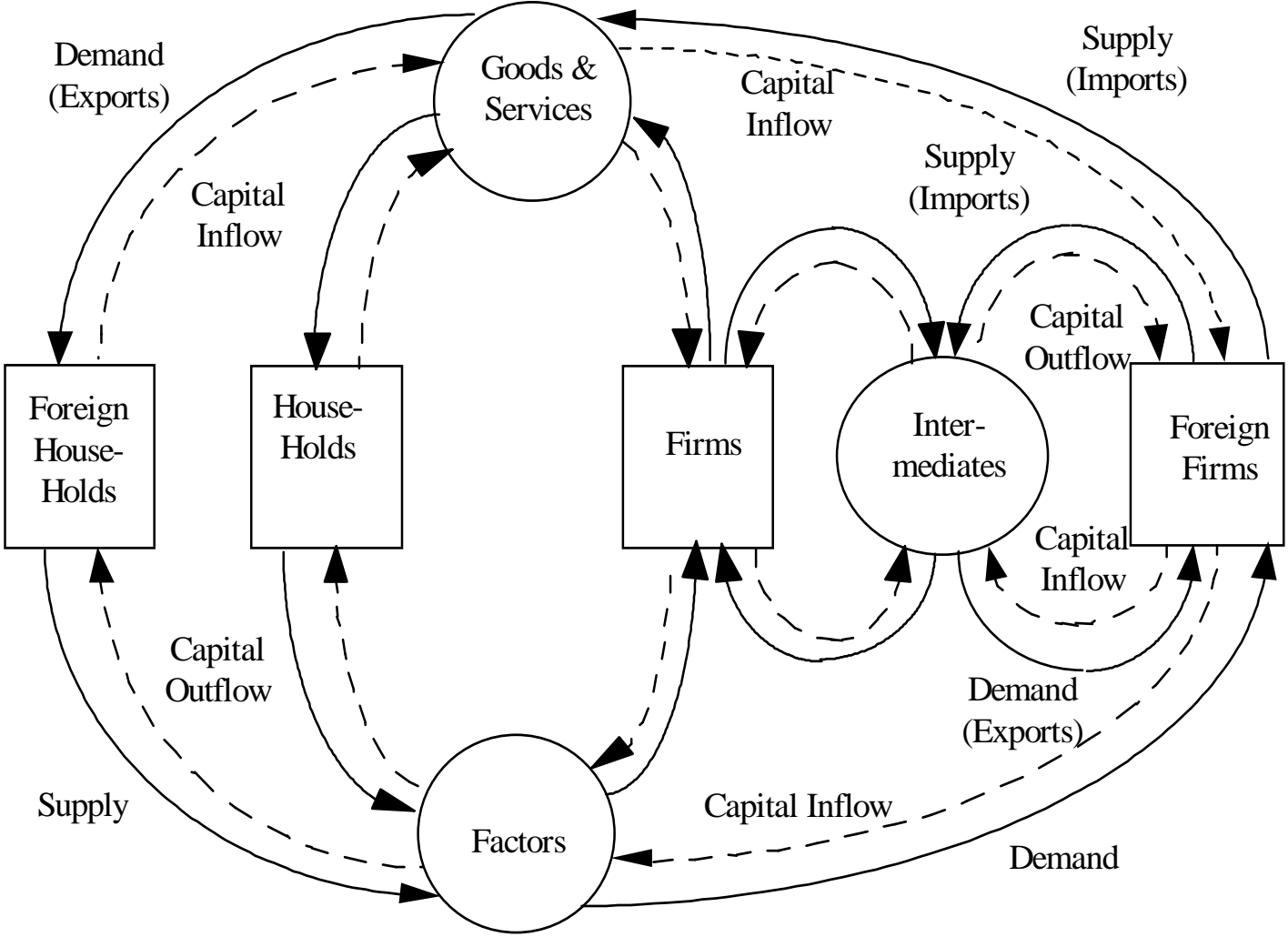
# Goods and Services



many different  
goods and  
services and  
many types of  
firms

Two Factors:  
Capital and Labor

# Trade and Intermediates



# Production

- Output is made from
  - Value added
    - which is made from capital and labor
  - and Intermediate Goods
- Producers Maximize Profits

# Consumers

- Maximize their happiness by buying
  - goods and services
- Their income comes from
  - labor
  - capital
  - transfers (e.g. social security)
- They pay taxes

# Gov't and Trade

- Government has taxes as income
- Gov't buys goods and services
- Gov't makes transfer payments

# Trade

- When domestic prices increase relative to world prices, imports go up and exports go down.

# State Level Model

- (1) Regional CGE models do not require that regional savings equal regional investment.
- (2) Regional economies trade a larger share of their output.
- (3) Regional economies face larger and more volatile migration flows than nations.
- (4) Regional economies have no control over monetary policy.
- (5) In regional models, local, state and federal taxes are interdependent through deductibility.
- (6) There is less state specific data than there is national data.
- (7) the California CGE differs from a national CGE in that California faces a long run balanced-budget requirement.

# Investment and Migration

- Immigration and emigration respond to economic conditions.
- Investment and disinvestment respond to the rate of return.
- Model is equilibrium—takes 3-5 years to fully adjust to policy changes.



# Back to 3 Types of Measures

# Carbon Tracking

- Track CO<sub>2</sub>e at the level of primary energy within CA.
- Calculate the carbon intensity (MMTCO<sub>2</sub>e per billion dollars of purchases) for
  - Refineries, the natural gas, and in-State electricity.
  - Imported natural gas, refinery products, and electricity.

# Direct Regulation

- Develop a “conservation supply curve”
  - List of regulations
  - Ordered by cost by ton CO<sub>2</sub>e saved
  - Go down the list until you get the savings you need.

# Economy Wide Effects

- Example: Fuel
  - Now: Fuel is made with oil (and other things)
  - Alternative: Use less oil but more agricultural outputs (e.g. corn) and more processing (e.g. services of the chemical industry)
  - Made Up Example
    - 10 billion less in oil purchased
    - 5 billion more chemical industry services
    - 5 billion more agricultural outputs

# Technological Change

- The changes from the conservation supply curve are applied as changes in technology.
- Every barrel of fuel is now made with less crude and more agriculture and chemical industry.
- Therefore price of fuel must change. Uneconomic techniques raise the price.
- Model follows through consequences of raised prices. Consumers demand less, less exported, more imported and so on.

# Model

- EDRAM takes the change in technology to make gas and finds the changes in relevant variables
  - Incomes (including income of low earners)
  - Employment
  - Population
  - And so on.
  - Carbon (changes in prices give further effects than just the technologies themselves)

# Fee

- We track carbon.
- We charge a fee on the “carbon purchases” by the prime sectors (oilref, gas and elect distributors and importers)
- For any fee level...

## ...for any fee level

- Find the measures from our conservation supply curve that would pay for themselves and apply them
- Run model and tabulate carbon.
- Choose the fee level that achieves the desired reduction.



# Where does the fee go?

- Used to reduce other tax (double dividend)
  - PIT, Sales, Bank and Corp are big ones
  - Remitted lump sum
  - Could easily be targeted to certain income groups
    - E.g. a tax credit for those earning below \$10K
- Used for increased expenditures
  - Across the board
  - For specific carbon reduction measures

# Cap and Trade

- Nearly same as a fee!
  - Choose a cap.
  - Raise the fee until the cap is met.
- But Who Gets the Money?
- Examples
  - Auction. It could go to the general or a special fund. Just like a fee.
  - Grandfathered. It goes to the firms.

# Consequences

- If the value of the quotas is transferred to the firms, there is no reason to believe that anything like all of it will be spent in CA
  - Is much like a federal excise tax on CO<sub>2</sub>e
  - In general, quota rents transferred outside CA are quite deleterious to CA income.

# Conclusion

- Cap and Trade, Fee, and Direct all make use of technologies from the conservation supply curve.
  - Cap and Trade and Fee only use those measures below the carbon value.
- Cap and Trade and Fee require a “sink” for the value created by the carbon cap or by the tax
  - “sinks” outside CA are costly