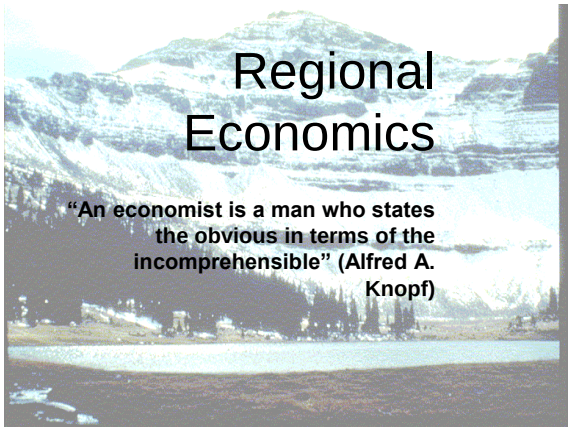
IMPLAN

The Economy as a Web

1



Regional Economics

- Objectives of this Unit:
  - State the obvious…. There are consumers, there are producers, they interact. There are natural resources involved.
  - Highlight what makes this branch of economics different from other, perhaps more familiar, specializations.

3

Regional Economics

- Different from Efficiency Analysis
  - System of complex interactions
  - A Web - disturb one area, impacts felt elsewhere
- Why should we be interested in it?
  - Decisions that influence jobs and income of fundamental interest to many people
  - Scoping, interest groups
  - Remind legislators that we count

4

Regional Economics

- Clear objective:
  - Describe the “ripple” effects on a regional economy of government policies and management actions.

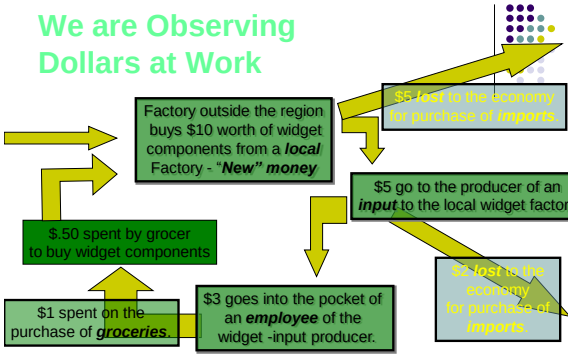
5

Regional Economics

- What do we mean by “ripple” effects?
  - System of complex interactions
  - Different scales
  - Flows between geographically separated systems
  - A Web - disturb one area, impacts felt elsewhere

6

We are Observing Dollars at Work



Dollars at Work

- The longer the dollar remains in the economy, the larger the ripple effect (the "Multiplier" effect)
  - Scale
  - Structure
  - Trade
  - Policy
  - Custom
  - History
  - Perception

Dollars at Work

- Historically, many policies geared toward delaying the "leakage" of money from an economy as long as possible.
  - Boeing
- Classic problem of urban centers, rural areas with a poorly developed economic base, and developing nations.
  - Mexico

Dollars at Work: Units of Measure

- Descriptive Analysis:
  - Structure: #, type, class
  - Export Base
  - Level of interrelatedness: multipliers
  - Contribution analysis: Share of the whole
  - Leakage: flow of money
- Impact Analysis:
  - Total economic response to a change
  - Rate of impact: response coefficients

10

Dollars at Work: Types of Impacts

- Who: Direct, Indirect, and Induced
  - For example, let's say a Forest invests in range improvement. The Forest Service is the consumer.
  - Direct effects are felt by the producers of materials and services purchased by the FS
  - Indirect effects are felt by the producers of materials used by the direct industries to provide goods and services to the FS

11

Dollars at Work: Types of Impacts

- Who: Direct, Indirect, and Induced (continued)
  - Induced effects occur when employees of the directly and indirectly affected industries spend the wages they receive in the process of providing goods and services to the FS Range Program.
- What: Sales ("Output"), Employment, Income

12

Example Questions

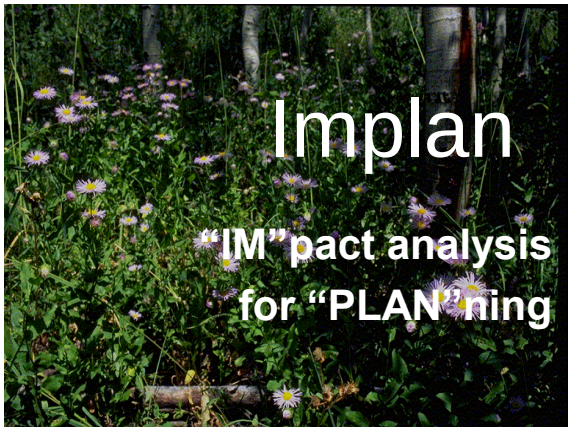
- SMALL SCALE (community, county, multi-county):
  - "How much does the local community depend on commodity production off of the National Forest?"
  - "How much does the local community depend on the National Forest to attract tourists?"
  - "How much do Forest Service employees spend in the communities in which they live?"
  - "How dependent is the local economy on National Forest Program expenditures?"

13

Regional Economic Analysis Systems

- Input-Output models:
  - RIMS II (Bureau of Economic Analysis)
    - State and county level
    - User provided multipliers only
  - REMI
  - IMPLAN
    - Zip code level
    - Structure and data editable
    - Descriptive information in addition to multipliers
- Computable General Equilibrium models
  - GAMS

14



Objectives of this Unit:

- History of Regional Economic analysis in the Forest Service
- Overview of the software and data system developed and used by the Forest Service

16

History

- Regulatory triggers
- Spectrum/Forplan incorporated project level analysis (cost/benefit, present net worth, etc.) but prior to 1980, nothing available for regional analysis.

17

History

- IMPLAN developed by the Forest Service to look at the “big picture” - regional economics.
- Software:
  - Built on well accepted theory -”Input-Output” (I-O)
  - I-O developed by Wassily Leontief for which he won the Nobel Prize in economics.

18

History

- Data:
  - Periodic collection of regional economic data for entire Forest Service would have been prohibitively expensive.
  - “Non-survey” data derived from published sources. Methodology original but founded on well accepted ideas.
  - Time lag, ie; most recent data available currently is 2004 (2003 is the latest data set purchased by the FS).

19

History

- Some of the principal uses of IMPLAN:
  - Forest planning; Project level analysis, Contributions to economic systems, Monitoring
  - Policy analysis (ie spotted owl, Chief’s roads policy)
  - RPA/SPRA assessments (minerals, recreation, timber, range, etc.)
  - Resource accounting
    - TSPIRS (Timber Sale Program Information Reporting System)
    - ARR (All Resources Reporting)

20

History

- IMPLAN used extensively outside of the Forest Service by:
  - Other Federal agencies
  - State and local governments
  - Researchers
  - Consultants
- Also used internationally

21

History

- IMPLAN now privatized:
  - Minnesota IMPLAN Group
  - Data sales
  - Software development and maintenance
- We purchase annual site license for software and data
  - Copyright issues
  - Stringent FOIA repercussions.
- www.implan.com

22

Why Use Implan?

- Example: Ski area EIS
  - Basic Statistics on the Local Economy
    - Broad ranking of industries in order of # employees (Chamber of Commerce)
    - Population trends (Consultant study)
    - Housing unit types (Board of Realtors)
    - Employment/unemployment rate (State Dept of Labor)
    - Median household income (State Dept of Labor)
    - Retail sales (State Dept of Revenue)
    - Tax base (County records)
    - Public services(County records)

23

Why Use Implan?

- Example: Ski area EIS
  - Basic Statistics on the Local Economy
    - *Detailed ranking of industries in order of # employees*
    - *Population trends*
    - Housing unit types (Board of Realtors)
    - *Employment rate*
    - Unemployment rate (State Dept of Labor)
    - *Median household income for 3 income brackets*
    - *Retail sales*
    - *Tax base*
    - Public services*(County records)*

24

Why Use Implan?

- Example: Ski Area EIS
  - *PLUS!*
    - *Economic ties to other businesses in the area*
    - *Ripple effects through the economy of:*
      - *wages spent in the area*
      - *government spending in the area*
      - *changes in policy*
      - *changes in the structure of the economy*
      - *leakage of money from the region*
      - *transfer payments*

25

Why Use Implan?

- Saves Time
- Saves Money
- Quantitative support for Qualitative Analyses
- ***IT'S FUN!!!!!***

26

Example Applications

- **Program Expenditures**
  - Question: What effect do non-salary expenditures and employee wage spending have on the area's economy?
  - Data:
    - County data (from IMPLAN)
    - Budget object code data by program by forest (from NFC)
    - Personal consumption expenditure data (from IMPLAN)
  - Initial Change: Expenditures for local materials and services

27

Example Applications

- **"Stemming-From" Effects**
  - Question: What impacts on local economies result from the provision of outputs and services from the national forests?
  - This is different from Program Expenditures. Here looking at FS as a producer of inputs to the local economy.
  - Outputs most commonly assumed to be of interest to locals are timber, recreation, minerals, grazing, protection, and soil, water, and air.

28

Example Applications

- **"Stemming-From" Effects (cont.):**
  - Data:
    - County data (from Implan)
    - Timber: TSPIRS harvest information, mill flow data.
    - Recreation: Visitor expenditure profiles, visitation estimates.
    - Minerals: Patented vs non-patented claims, extraction volume, industry expenditure profile.

29

Example Applications

- **"Stemming-From" Effects (cont.):**
  - Data (continued):
    - Grazing: Number of permits, Head Months, non-government management expenditures.
    - Protection: Fire really messy because so much interagency cooperation.
  - Initial Change:
    - Change in demand for a national forest commodity.
    - Change in forest use or policy that affects demand.

30

Example Applications

- **Grants-In-Aid (payments to states):**
  - PILT and FS contributions
  - Timber/Recreation 25% Fund payments and payments under Secure Rural Schools:
    - Question: What economic impacts do Grants-In-Aid payments have on local economies?
    - Data: County data (from Implan), amount of payments to states, information on how each state divvies up the money (how much to schools and how much to roads).

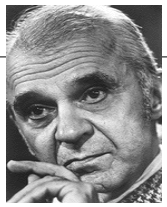
31

Example Applications

- **Grants-In-Aid (payments to states) cont:**
  - Timber/Recreation 25% fund payments (cont):
    - Initial Change: demand for output from the State and Local Govt (education) sector, and roads construction sector.
  - Minerals: Leasable, locatable, reserved
    - State by state variations in distributions

32

Input-Output Models



33

Input-Output Models

"The Royal Swedish Academy of Sciences has awarded the 1973 year's Prize in Economic Science in Memory of Alfred Nobel to

Professor **Wassily Leontief**

for the development of the input-output method and for its application to important economic problems.

Professor Leontief is the sole and unchallenged creator of the input-output technique. This important innovation has given to economic sciences an empirically-useful method to highlight the general interdependence in the production system of a society. In particular, the method provides tools for a systematic analysis of the complicated interindustry transactions in an economy."

34

Input-Output Models

- Objectives of this Unit:
  - Cover the theory – build an understanding of the modeling mechanics
  - Highlight the pros and cons – understand the advantages and pitfalls of using this type of model

35

Input-Output Models

- Elements:
  - Buyers of products and services
  - Sellers of products and services
  - Employment
  - Income

36

Input-Output Models

Transactions Table

	Purchasing Industries				
Producers	Agric	Manuf	Services	Final Demand	Output
Agriculture	10	6	2	20	38
Manufact.	4	4	3	26	37
Services	6	2	1	35	44
Labor	18	25	38	0	81
Total Outlay	38	37	44	81	200

37

Input-Output Models

Direct Requirements Table: (A)

	Purchasing Industries		
Producers	Agriculture	Manufacturing	Services
Agriculture	0.26	0.16	0.05
Manufacturing	0.11	0.11	0.07
Services	0.16	0.05	0.02
Primary Inputs	0.47	0.68	0.86
Total Outlay	1.00	1.00	1.00

38

Input-Output Models

Total Requirements Table: $(I-A)^{-1}$

	Purchasing Industries		
Producers	Agriculture	Manufacturing	Services
Agriculture	1.45	0.27	0.09
Manufacturing	0.20	1.16	0.09
Services	0.26	0.11	1.04
Output Multiplier	1.91	1.54	1.22

39

Input-Output Models

- Predictive Model : $X = (I-A)^{-1} Y$
  - X : Output - what we want to predict
  - $(I-A)^{-1}$: Multipliers
  - Y : Final demand - changes in final demand drive production in the economy up or down
- **"Ripple effects" through the economy are captured**
- **Question: This is an awfully simple model - why do we need Implan?**

40

Input-Output Models

Suppose a foreign country would like to purchase $1 more from the agriculture sector. The ripple effect can be traced using the table of Direct Requirements (A).

<u>Round 1</u>: For agriculture to sell $1 to a foreign country, agriculture buys from:

- **Agriculture $0.278 worth of goods**
- **Manufacturing $0.111 worth of goods**
- **Services $0.167 worth of goods**

41

Input-Output Models

<u>Round 2</u>: For agriculture to sell $0.278 worth of goods to agriculture, agriculture buys from:

- **Agriculture $0.077 ($0.278 x .278)**
- **Manufacturing $0.031 ($0.278 x .111)**
- **Services $0.046 ($0.278 x .167)**

…<u>and</u>, for manufacturing to sell $0.111 worth of goods to agriculture, manufacturing buys:

- **Agriculture $0.018 ($0.111 x 0.162)**
- **Manufacturing $0.012 ($0.111 x 0.108)**
- **Services $0.060 ($0.111 x 0.054)**

42

Input-Output Models

…and, so on, and so on…. ad infinitum

After 2 Rounds, Agriculture has produced for:

Export……..	$1.000
Agriculture (1st round)…… …..	$0.270
Agriculture (2nd round)……..	$0.077
Manufacturing (2nd rnd)…….	$0.018
Services (2nd rnd)…….	$0.008
For a 2nd Round total output multiplier of……..	$1.373

43

Input-Output Models

- Followed through all rounds (matrix inversion), this amounts to $1.91 (Type I output multiplier).
- These calculations are further complicated when the effect of wage spending in the economy is included (Type II or III multiplier).
- In addition to the output multipliers, income and employment multipliers must be calculated.

44

Input-Output Models

- Conclusion?

USE IMPLAN!

45

Input-Output Models

- Modeling Objectives
  - Generate regionalized direct coefficients.
  - Account for imports, exports and cross-hauling (leakages).
  - Apply final demand changes.
- Results
  - Snapshot of regional economy.
  - Estimate of impacts on regional economy.

46

Input-Output Models

- Simplifying Assumptions
  - Each industry produces one commodity (or product “bundle”)
  - Industries produce commodities using fixed recipes (production functions) - there is no substitution of ingredients and an increase in ingredients leads to an increase in gross output.
  - Resources (including labor) are unlimited.

47

Input-Output Models

- Simplifying Assumptions (cont)
  - There is no time dimension/seasonality - all changes are assumed to be average annual changes. This assumption implies the following:
    - There is no new technology
    - Trade relationships are static
    - There are no relative price changes except for commodity specific price inflation and deflation
    - There are no structural changes

48

Input-Output Models

- Simplifying Assumptions (cont)
  - Corrections for industry size, technology, or trade relations must be made by the user - ie;
    - Before building the model: Changes in trading patterns, industries present in the model, etc. can be made before estimating the multipliers
    - After building the model: Data on the temporal distribution of sales can be entered as separate alternatives to obtain an approximation of the effects over time.

49

Input-Output Models

- Keep in mind:
  - Snapshot in time
  - Static
  - Shock modeling/Short term impacts
  - Precision / accuracy
  - Not a statistical model: i.e. no error term, no confidence intervals
  - Price change effects imputed

50

Input-Output Models

- SAM : Social Accounting Matrix
  - Conventional I-O matrix plus inter- institutional transfers
  - Examples: dividend payments, income taxes, welfare payments, social security payments, compensation from work outside the region, live outside region where employed.

51

Input-Output Models

- Multipliers (for derivations, see Chapter 15 in the User's Guide)
  - Direct effects
  - Indirect effects
  - Induced effects
- Type I : Direct and indirect effects
- Type II and III: Direct, indirect, and induced effects.

52

Input-Output Models

- Output Multipliers
- Income Multipliers
- Employment Multipliers
- Response Coefficients : Defined, or scaled, per unit effects - ie; employment response per 1000 visitor days

53

Impact Analysis:

54

The Nobel Peace Prize for 2006

"The Norwegian Nobel Committee has decided to award the Nobel Peace Prize for 2006, divided into two equal parts, to **Muhammad Yunus** and **Grameen Bank** for their efforts to create economic and social development from below. Lasting peace can not be achieved unless large population groups find ways in which to break out of poverty. Micro-credit is one such means. Development from below also serves to advance democracy and human rights."

55

Impact Analysis:

Objectives for this Unit:

- Understand the terminology used in impact analysis
- Recognize the ways impact analysis can be misused

56

What Information Do We Need?

- An IMPLAN model requires:
  - Study area data from MIG
  - Any needed changes to the underlying economic structure
    - Technology
    - Missing sectors
    - Adjustments to trade factors such as RPCs
    - Etc.

57

What Information Do We Need?

- Information about a Final Demand Change
  - Remember $X=(I-A)^{-1}Y$
  - Y (Final Demand) is the only way we have to shock the model
  - Remember, the total value of an industry's output (TIO) includes local sales to processors (intermediate demand) plus sales to Final Demand.

58

What Information Do We Need?

- What is Final Demand?
  - Sales to anyone outside of the Study Area
  - Sales to inventory
  - Sales to households inside or outside the Study Area
  - Sales to any person, industry, or government inside or outside of the Study Area who will not be further processing the goods or services in any way.

59

What Information Do We Need?

- Examples of Final Demand
  - Sale of logs by local loggers to sawmills outside of the Study Area.
  - Local expenditures by recreationists.
  - Sale of cattle grazed on the National Forest to buyers outside of the Study Area.
  - 25% Fund returns spent by local governments for roads and schools.

60

Estimating Final Demand Changes

- **WHO** is involved in the transaction?
  - Final consumer? Local factory? Grocery store?
- **WHAT** is being transacted?
  - Traditional I-O, money. “Green” I-O, money and flows of resources.
- **WHERE** does the transaction occur?
  - Outside the area? Export demand? Hither and Yon?
- **WHEN** did the transaction occur?
  - All comparisons made on a base year.

61

Why is this important?

- Provide clarity to the analysis
- Ensure compatibility of the question with the model
- Improve the relationship between the policy question and the model’s answer

62

What is being transacted?

- Money or physical quantity?
  - All impacts must ultimately be monetized
  - Conversion of physical transactions to a monetary basis
    - For marketed products, this is easy
    - For non-market products, such as a recreation experience, a proxy must be found, i.e. recreation expenditures

63

How does the transaction take place?

- Is the purchase made from trade industries like retail and wholesale trade?
  - If so, the "purchaser price" transaction must be bridged back to the producers.
- Is the purchase made directly from the producer of the product?
  - If so, the "producer price" transaction is put directly into IMPLAN

64

How does the transaction take place?

- Producer Price Transactions
  - All transactions utilized by IMPLAN must ultimately be expressed in "producer prices"
  - Producer prices are the expression of product demand placed directly upon the producer of the good or service

65

How does the transaction take place?

- Purchaser Price Transactions
  - Purchaser prices have trade, transportation and insurance markups (margins) included with the product charge in the transaction amount
  - The margins and the product price must be "unbundled" and allocated to the individual producers to arrive at producer prices

66

How does the transaction take place?

- "Unbundling" Purchaser Prices
  - If a transaction is given in purchaser prices, we must "bridge" the expenditures back to the producers of goods and services.
  - For example, a person buying an auto from a dealership is really purchasing an auto plus trucking, insurance, wholesale, and retail services
  - The recreation and wildlife-related expenditure data provided on the PAG website has already been bridged for you.

67

Where does the transaction take place?

- IMPLAN models are spatial economic models - estimates relate to a specific geographic area.
- Changes in the final demand for products must, in fact, be incident upon producers in that economy either directly or indirectly.
- The location of expenditures is particularly important

68

Where does the transaction take place?

- Location of Recreation Spending
  - Consider the impact of ski trip spending on Summit County (location of the ski area):
  - "I spent $25 for gas during my ski trip. I bought it while I was in Breckenridge."
  - "I spent $25 for gas for my ski trip. I filled up before I left Boulder."
  - The two situations have very different effects on the Summit County economy.

69

Where does the transaction take place?

- Local Purchase Coefficients
  - Using a model for Larimer County, and final demand changes representing "people spending money in Colorado", LPCs could be used to indicate what portion was spent in Larimer County
  - Or… you could simply reduce the amount spent locally by hand for the same effect.

70

When did the transaction take place?

- All changes in demand must be expressed in the same relative prices as used in the accounting period (base year) of the model
- IMPLAN provides a "look-up" table of price adjusters (inflators and deflators) to adjust commodity transactions to the base year. You put in data, tell IMPLAN what year they're in, and IMPLAN automatically adjusts them.

71

Pieces of an Impact Analysis

- Event: What money was spent on.
  - Value (transaction): Expenditure.
  - Employment: The direct employment can be entered. Value is derived from this based on the Output per Worker ratio for that industry in the model.

72

Pieces continued….

- Group (Activity): Logical grouping of Events.
- Project (Scenario): Logical grouping of Groups.

73

Example:

- Events:
  - Purchase Groceries (Purchaser price)
  - Purchase Equipment (Purchaser price)
  - Purchase Gas (Purchaser price)
- Group:
  - Hikers (purchasing groceries, equipment, etc)
  - Boaters "
  - Hunters "
- Project: Recreation

74