

An Input-Output Model of the US Economy (year 2009)

Introduction

An input-output model represents the interdependencies between different sectors of the economy. Wassily Leontief developed input-output models using matrix theory. His work was recognized with the Nobel Prize in Economic Sciences in 1973. See page 1 and section 2.6 of the textbook to learn more about Input-Output modeling and analysis. In the year 2009 the US economy was divided into 67 sectors. Here we exclude two sectors (“Scrap, used and secondhand goods” and “Noncomparable imports and rest-of-the-world adjustment”) and concentrate on the rest. The Input-Output table can be downloaded from U.S. Department of Commerce (Bureau of Economic Analysis [1]) <http://www.bea.gov/itable/index.cfm> . Below is a portion of the table

Name	Farms	Forestry & fishing	Oil & gas extraction
Farms	36764.1	180.8	0
Forestry & fishing	19734.7	5320.1	0
Oil & gas extraction	0	0	10470.9
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Total input (in millions of dollars)	195085.5	13322.4	43011.7

Reading the table is not difficult. For instance, in the year 2009, the Farms sector spent a total of 195085.5 million dollars for producing various items such as wheat, rice, etc. These inputs were divided among all other sectors including Farms. In other words, Farms sector consumed 36764.1 million dollars of its own output, 19734.7 million dollars of Forestry & fishing output, 0 dollar of oil & gas extraction, etc. Note that sector Oil & gas extraction sector does not include petroleum products which is considered as a separate sector (see # 24 of the list of sectors at the end of this document). To learn more about the input-output tables see [2].

Main question

Using the matrix theory, linear algebra and Matlab computations, we would like to answer the following question: “What production levels are needed to keep an economy going and to supply demands from outside the economy?”

Project Procedure

1. Download the excel files IO2009 and IO65x65 from the Blackboard folder “IOdata2009”. IO65x65 is the excel file containing the Input-Output table without the last two sectors (i.e. “Scrap, used and secondhand goods” and “Noncomparable imports and rest-of-the-world adjustment”).
2. Import IO65x65 to Matlab and rename the generated 65 by 65 matrix to “T”
3. Form the consumption Matrix C of the US economy. To do so (i) generate a row vector S containing the sum of each column of the table. In the command window enter **S= sum(T);** (ii) divide the table T by vector S. In the command window enter **C = T*inv(diag(S));**
4. Using matrix C provide a few examples to describe relationships between the (see the description of matrix A, example 1 in [3])
5. Check if C has any negative or zero entry: You may enter **[rowN , colN] = find(C<0)** , which returns the row and column indices of the negative entries in the matrix C. Similarly, enter **[row,col] = find(C == 0)** to find the zero entries.
6. Explain if there is any meaning for negative or zero entries of C matrix.
7. Check if the sum of each column of C is less than 1 (you may enter **SC = sum(C)**). Is it possible to have a sum greater than 1? Why?
8. Compute the matrix I-C by entering **IC = eye(size(C)) – C**
9. Compute the inverse of I - C and provide an interpretation of its entries. Hint: entries of the inverse matrix can be used to predict how production will have to change when demand changes.
10. Assuming a closed economy (i.e. $d = 0$), compute and analyze the total output X and internal consumption CX. Hint: enter **“X = linsolve(IC,zeros(length(C),1))”** Hint: see equation 4 page 133 of the textbook.

11. Are you sure about your computations? Form the augmented matrix " $\mathbf{M} = [\mathbf{I}\mathbf{C}, \mathbf{zeros}(\text{length}(\mathbf{C}),1)]$ " of the system $(\mathbf{I}-\mathbf{C})\mathbf{X}=0$ and apply the command " $\mathbf{rref}(\mathbf{M})$ ". What would be the total output \mathbf{X} ?
12. Assuming the final demand " d ", provided in the excel file d2009 in the Blackboard, compute find the production level \mathbf{X} that will satisfy this demand. Hint: see example 2 page 133 of the textbook.
13. Write a short essay (less than 150 words) of the objectives and main outcomes and include it in the supplementary documents.

Instructions for slide preparation

- (a) It is strongly recommended to read section 2.6 of the textbook before starting the project
- (b) Each team is required to prepare around 5-10 PowerPoint slides.
- (c) The contents of the presentation may include Introduction, Objectives, The Input-Output Model, Analysis of the Model, Concluding Remarks, Limitations and Future Work.
- (d) The first slide must contain the name and ID of each participant. Also include the specific works (e.g essay writing, coding, analytical solutions) done by each participant.
- (e) Supplementary slides (e.g. Matlab codes, essay, further explanations, references) should
- (f) Please send your presentation to baniyaghoubm@umkc.edu before midnight Oct. 30, 2012. Also a print of the file should be given to me on Nov. 1.

Collegiality and Group Work

The groups in this class are meant to imitate real-world research groups. Each group should meet at least once a week. Each group member should (1) maintain a friendly environment for the entire group; (2) facilitate collaboration and problem solving; (3) provide a vision of the main objectives and ensure discussions lead to conclusions and decisions; (4) motivate and inspire other group members; (5) contribute to the group by sharing his/her knowledge, expertise and viewpoints; (6) participate in all meetings and discussions; (7) have productive suggestions to enhance quality of the work.

Useful links

http://en.wikipedia.org/wiki/Input-output_model
<http://home.business.utah.edu/bebrpsp/URPL5020/IO>
http://www.bea.gov/glossary/glossary_a.htm (full glossary)
<http://www.encyclopedia.com/doc/1G2-3045000577.html>

References

[1] U.S. Department of Commerce - Bureau of Economic Analysis
<http://www.bea.gov/itable/index.cfm>

[2] Input–Output Analysis (International Encyclopedia of the Social Sciences)
<http://www.encyclopedia.com/doc/1G2-3045000577.html>

[3] Iris Jensen (2001) The Leontief Open Production Model or Input-Output Analysis
<http://online.redwoods.cc.ca.us/instruct/darnold/laproj/fall2001/iris/lapaper.pdf>

List of 2009 U.S. Economy Sectors

1. Farms
2. Forestry, fishing, and related activities
3. Oil and gas extraction
4. Mining, except oil and gas
5. Support activities for mining
6. Utilities
7. Construction
8. Wood products
9. Nonmetallic mineral products
10. Primary metals
11. Fabricated metal products
12. Machinery
13. Computer and electronic products
14. Electrical equipment, appliances, and components
15. Motor vehicles, bodies and trailers, and parts
16. Other transportation equipment
17. Furniture and related products
18. Miscellaneous manufacturing
19. Food and beverage and tobacco products
20. Textile mills and textile product mills
21. Apparel and leather and allied products
22. Paper products
23. Printing and related support activities
24. Petroleum and coal products
25. Chemical products

26. Plastics and rubber products
27. Wholesale trade
28. Retail trade
29. Air transportation
30. Rail transportation
31. Water transportation
32. Truck transportation
33. Transit and ground passenger transportation
34. Pipeline transportation
35. Other transportation and support activities
36. Warehousing and storage
37. Publishing industries (includes software)
38. Motion picture and sound recording industries
39. Broadcasting and telecommunications
40. Information and data processing services
41. Federal Reserve banks, credit intermediation, and related activities
42. Securities, commodity contracts, and investments
43. Insurance carriers and related activities
44. Funds, trusts, and other financial vehicles
45. Real estate
46. Rental and leasing services and lessors of intangible assets
47. Legal services
48. Computer systems design and related services
49. Miscellaneous professional, scientific, and technical services
50. Management of companies and enterprises
51. Administrative and support services
52. Waste management and remediation services
53. Educational services
54. Ambulatory health care services
55. Hospitals and nursing and residential care facilities
56. Social assistance
57. Performing arts, spectator sports, museums, and related activities
58. Amusements, gambling, and recreation industries
59. Accommodation
60. Food services and drinking places
61. Other services, except government
62. Federal general government
63. Federal government enterprises
64. State and local general government
65. State and local government enterprises