The Industrial Reorganization of US Agriculture as Reflected in Input-Output Accounts

Yicheol Han
Post-Doctoral fellow
Northeast Regional Center for Rural Development; National Agricultural and Rural Development Policy Center, Pennsylvania State University
7G Armsby, The Pennsylvania State University, University Park, PA 16802-5602, USA
yuh14@psu.edu

Stephan J. Goetz
Professor
Northeast Regional Center for Rural Development; National Agricultural and Rural Development Policy Center, Pennsylvania State University
Department of Agricultural Economics and Rural Sociology, Pennsylvania State University
207-C Armsby, The Pennsylvania State University, University Park, PA 16802-5602, USA
sgoetz@psu.edu


Copyright 2015 by Yicheol Han and Stephan J. Goetz. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.
Introduction

- Industries develop in rapid bursts that follow from economic innovations.
- Economic activities of industries reorganize over time to assimilate economic innovations and environmental changes optimally, so that the industries continue to secure maximum profits.
- Economic activities of a sector (industry) are reflected in the economic input-output accounts (IO account), which for each sector show purchases from and sales to other sectors.
- The IO table can be regarded as a network in which economic sectors are nodes and the flows of commodities or transactions between sectors are edges.
- Social network analysis can be applied to the IO table.
- The purpose of this study is to examine when and how agriculture has undergone changes within the US, through a social network analysis of agricultural activities in the IO table over time.

Method and Data

- Analyze the reorganization of agriculture through social network analysis

<table>
<thead>
<tr>
<th>centrality</th>
<th>description</th>
<th>equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>strength</td>
<td>The amount of transactions ( \sum \sum w_{ij} )</td>
<td></td>
</tr>
<tr>
<td>entropy</td>
<td>The diversity of transactions ( \sum p_i \ln \frac{p_i}{\ln N} )</td>
<td>( \sum p_i )</td>
</tr>
</tbody>
</table>

- Historical Input-Output Accounts are used
- 1963–2007 Benchmark IO Accounts from BEA
- 1993–2012 Annual IO Accounts from BLS
- Prices adjusted by the Consumer Price Index

Results

- Agriculture is a scale-free network
- Most small transactions and a few large transactions between industries
- Agriculture has become resilient
- Total transactions are increased 21% while the largest transaction is decreased 40%
- Transactions of agriculture in 2007 are more diverse than those in 1963.

- Economic size of agriculture has not increased compared to that of all economy.
- But, agriculture experience rapid changes in 1972, 1977, 1987 (the first and second oil crisis, computer industry)

Method and Data

<table>
<thead>
<tr>
<th>centrality</th>
<th>description</th>
<th>equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>strength</td>
<td>The amount of transactions ( \sum \sum w_{ij} )</td>
<td></td>
</tr>
<tr>
<td>entropy</td>
<td>The diversity of transactions ( \sum p_i \ln \frac{p_i}{\ln N} )</td>
<td>( \sum p_i )</td>
</tr>
</tbody>
</table>

Backbone of Agriculture in the IO network

1963

1992

2007

Selling and purchasing changes

Selling-side

- General Federal defense gov.
- Noncomparable consumption of fixed capital
- Education services
- Federal electric utilities
- Scientific research and development services
- Fresh and frozen food products
- Food services and drinking places
- Apparel manufacturing
- Apparel and accessory manufacturing
- Apparel and accessory manufacturing

Purchasing-side

- General Federal defense gov.
- Noncomparable consumption of fixed capital
- Education services
- Federal electric utilities
- Scientific research and development services
- Fresh and frozen food products
- Food services and drinking places
- Apparel manufacturing
- Apparel and accessory manufacturing
- Apparel and accessory manufacturing

Conclusion

- Agriculture has become resilient with diverse transactions between industries.
- The major changes were initiated in 1997-1998.
- Agriculture sells more products to government, sport, IT and R&D industries, while purchasing more commodities from service industries.