# 2016 Conference Presentations

The Mid-Continent Regional Science Association is pleased to offer Presentations from our recent conferences. The manuscripts contained in the Proceedings and the presentations are the voluntary contributions of conference participants.

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# Economic Impact of a Tennessee Milk Plant: A Hybrid Model IMPLAN-Based Analysis

**David Hughes, Andrew Griffith, David Mendez, Robert Holland, and Kevin Ferguson**

**University of Tennessee**

**Paper Presented at The Mid-Continent Regional Science Association and IMPLAN meeting, Charlotte, NC June 9-11, 2016**

# Presentation Outline

- Reasons for the Study
- Hybrid Input-Output Model
- Prior Studies
- Tennessee Model
- Results
- Summary and Conclusions

# Why Recent Interest in Local-Regional Processing?

- Economic development types: growth potential of agribusiness processing
- Agribusiness leadership: processing regional production creates markets for farmers, grow farm income and agribusiness processing
- Processors:
  - carbon footprint and shipping costs
  - Local foods market angle

# Tennessee Milk Plant Interest

- Milk-based value added processors in Tennessee (ice cream, yogurt) maybe interested in local sourcing
- A possible dried and condescended milk plant could source such operations
- Hence economic impact analysis of such an operation on state economy

# Hybrid Input-Output Model

- IMPLAN ready-made model (impose local data totals on national relationships)
- Hybrid model is adjusted ready-made model based on superior data and knowledge
- Model adjustments based on financial records, published data, industry experts
- Fundamental Economic Structure: more natural resource oriented sectors (e.g., agriculture including processing) more likely to need adjustments

# Prior Studies: Mostly Milk Sector Contribution Studies

- New Mexico 2005, $1.98 billion output, 14,313 full-time equivalent jobs
- Washington State 2011,18,066 jobs, $0.661 billion labor income, $5.201 billion output
- Virginia 2014, 13,819 jobs, $3.225 billion output and $452.4 million labor income
- Casey 2013, $241.963 million in output due to a new milk condensing plant in Nevada

# Tennessee Hybrid Model

- IMPLAN-based I-O for 2013
- Tennessee-based detailed input costs and net returns from USDA-ERS used to adjust dairy coefficients
- Margining of some values not others
- Capital recovery costs of machinery and equipment were adjusted downward (i.e., returns to other property income were reduce)

# Dry, condensed, and evaporated dairy product manufacturing

- Data from Economic Census (2015) Dry, Condensed, and Evaporated Dairy Product Manufacturing
- Nevada Study
- Most importantly unpublished industry sources
- Used to adjust coefficients and estimate plant size (especially with regard to fluid milk consumption)

# Model Scenarios

- 4 impact scenarios based on level of local milk used
- 1. No increase in TN milk production (plant uses TN milk, but out-of-state milk completely replaces milk diverted to the plant)
- 2. Increase same as RPC (19.154% of supply new TN milk production)
- 3. 50% milk to plant is new TN production
- 4. All milk to the plant is new TN production

# Results Under 4 Scenarios

# 1. No increase in TN milk

| Sector | Employment | Labor Income | Gross State Product | Output |
|---|---|---|---|---|
| | | (2013 $) | (2013 $) | (2013 $) |
| Total | 724 | 50,693,036 | 89,707,703 | 288,164,098 |
| Agriculture | 4 | 30,478 | 98,634 | 256,563 |
| Mining | 1 | 18,150 | 30,312 | 93,580 |
| Construction | 8 | 521,070 | 455,642 | 1,386,489 |
| Manufacturing | 173 | 22,257,656 | 43,706,737 | 208,519,494 |
| TIPU | 80 | 4,628,611 | 6,612,374 | 14,835,760 |
| Trade | 143 | 7,825,430 | 14,717,108 | 22,970,967 |
| Service | 300 | 14,219,177 | 22,315,201 | 35,565,038 |
| Government | 14 | 1,192,465 | 1,771,694 | 4,536,207 |
| Percentage of Total Change | | | | |
| Agriculture | 0.6% | 0.1% | 0.1% | 0.1% |
| Mining | 0.1% | 0.0% | 0.0% | 0.0% |
| Construction | 1.2% | 1.0% | 0.5% | 0.5% |
| Manufacturing | 23.9% | 43.9% | 48.7% | 72.4% |
| TIPU | 11.1% | 9.1% | 7.4% | 5.1% |
| Trade | 19.8% | 15.4% | 16.4% | 8.0% |
| Service | 41.4% | 28.0% | 24.9% | 12.3% |

# 2. RPC increase in TN milk

| Sector | Employment | Labor Income | Gross State Product | Output |
|---|---|---|---|---|
| | | (2013 $) | (2013 $) | (2013 $) |
| Total | 1,017 | 56,564,345 | 100,353,840 | 319,641,618 |
| Agriculture | 223 | 2,231,141 | 4,939,924 | 19,095,113 |
| Mining | 1 | 20,564 | 35,078 | 106,172 |
| Construction | 9 | 561,253 | 490,556 | 1,494,306 |
| Manufacturing | 174 | 22,357,390 | 44,007,242 | 211,488,312 |
| TIPU | 92 | 5,285,012 | 7,510,027 | 16,887,856 |
| Trade | 157 | 8,568,152 | 16,105,016 | 25,138,201 |
| Service | 345 | 16,208,615 | 25,277,884 | 40,337,644 |
| Government | 16 | 1,332,219 | 1,988,113 | 5,094,013 |
| | | | | |
| Agriculture | 22.0% | 3.9% | 4.9% | 6.0% |
| Mining | 0.1% | 0.0% | 0.0% | 0.0% |
| Construction | 0.9% | 1.0% | 0.5% | 0.5% |
| Manufacturing | 17.1% | 39.5% | 43.9% | 66.2% |
| TIPU | 9.0% | 9.3% | 7.5% | 5.3% |
| Trade | 15.4% | 15.1% | 16.0% | 7.9% |
| Service | 33.9% | 28.7% | 25.2% | 12.6% |
| Government | 1.6% | 2.4% | 2.0% | 1.6% |

# 3. 50% of Plant Supply increase in TN milk

| Sector | Employment | Labor Income | Gross State Product | Output |
|---|---|---|---|---|
| | | (2013 $) | (2013 $) | (2013 $) |
| Total | 1,488 | 66,014,883 | 117,490,003 | 370,308,255 |
| Agriculture | 577 | 5,773,357 | 12,732,529 | 49,417,893 |
| Mining | 1 | 24,449 | 42,750 | 126,440 |
| Construction | 10 | 625,933 | 546,755 | 1,667,851 |
| Manufacturing | 176 | 22,517,924 | 44,490,938 | 216,266,961 |
| TIPU | 110 | 6,341,563 | 8,954,901 | 20,190,938 |
| Trade | 179 | 9,763,649 | 18,339,011 | 28,626,610 |
| Service | 418 | 19,410,840 | 30,046,658 | 48,019,696 |
| Government | 18 | 1,557,169 | 2,336,463 | 5,991,866 |
| | | | | |
| Agriculture | 38.7% | 8.7% | 10.8% | 13.3% |
| Mining | 0.0% | 0.0% | 0.0% | 0.0% |
| Construction | 0.7% | 0.9% | 0.5% | 0.5% |
| Manufacturing | 11.8% | 34.1% | 37.9% | 58.4% |
| TIPU | 7.4% | 9.6% | 7.6% | 5.5% |
| Trade | 12.0% | 14.8% | 15.6% | 7.7% |
| Service | 28.1% | 29.4% | 25.6% | 13.0% |
| Government | 1.2% | 2.4% | 2.0% | 1.6% |

# 4. 100% Of Plant Supply increase in TN milk

| Sector | Employment | Labor Income | Gross State Product | Output |
|---|---|---|---|---|
| | | (2013 $) | (2013 $) | (2013 $) |
| Total | 2,253 | 81,336,714 | 145,272,274 | 452,452,327 |
| Agriculture | 1,149 | 11,516,231 | 25,366,410 | 98,579,171 |
| Mining | 1 | 30,747 | 55,187 | 159,301 |
| Construction | 12 | 730,795 | 637,867 | 1,949,214 |
| Manufacturing | 179 | 22,778,192 | 45,275,138 | 224,014,418 |
| TIPU | 139 | 8,054,512 | 11,297,425 | 25,546,111 |
| Trade | 215 | 11,701,866 | 21,960,911 | 34,282,247 |
| Service | 536 | 24,602,499 | 37,778,106 | 60,474,340 |
| Government | 23 | 1,921,872 | 2,901,231 | 7,447,524 |
| | | | | |
| Agriculture | 51.0% | 14.2% | 17.5% | 21.8% |
| Mining | 0.0% | 0.0% | 0.0% | 0.0% |
| Construction | 0.5% | 0.9% | 0.4% | 0.4% |
| Manufacturing | 7.9% | 28.0% | 31.2% | 49.5% |
| TIPU | 6.2% | 9.9% | 7.8% | 5.6% |
| Trade | 9.5% | 14.4% | 15.1% | 7.6% |
| Service | 23.8% | 30.2% | 26.0% | 13.4% |
| Government | 1.0% | 2.4% | 2.0% | 1.6% |

# Summary and Conclusions

- Assumptions regarding how much milk production would increase in the state are key in driving model results:
  - Jobs: 724 to 2,253
  - Labor income: $50.7 to $81.3 million
  - GSP: $89.7 to $145.3 million
  - Output: $288.1 to $425.4 million
- Economic impacts are sufficiently large to warrant investigation by appropriate leaders regarding feasibility.

# RICHMOND, VIRGINIA COMMUNITY SOLAR IMPACT ANALYSIS: IMPLICATIONS FOR FUTURE STATE-LEVEL POLICY PROPOSALS

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Prepared for the 47th Annual Mid-Continent Regional Science Association (MCRSA) Conference

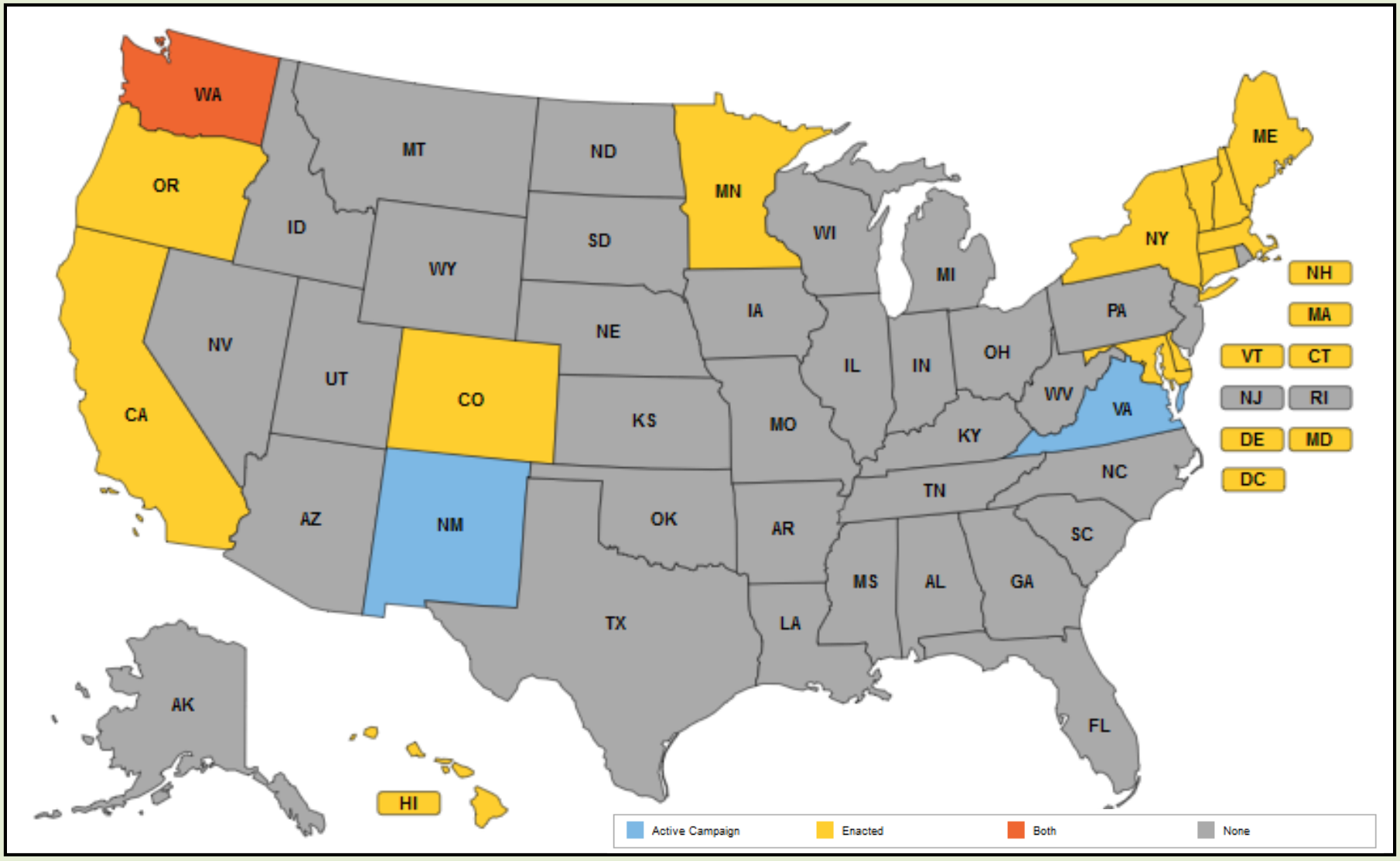
# Introduction

- Solar photovoltaic (PV) systems
  - Decreasing costs
  - Increasing deployment
- Diverse public policy approaches to encourage solar PV (e.g., NEM, RPS, tax credits, tax exemptions, loans)
- Community Shared Solar
  - Lack of feasibility of certain customers to own solar PV systems (e.g., lack of homeownership, roof orientation, shading, size)
    - Roughly 25% of U.S. households & businesses have the structural ability to install panels on their roofs (Denholm & Margolis, 2008)

# Community Shared Solar

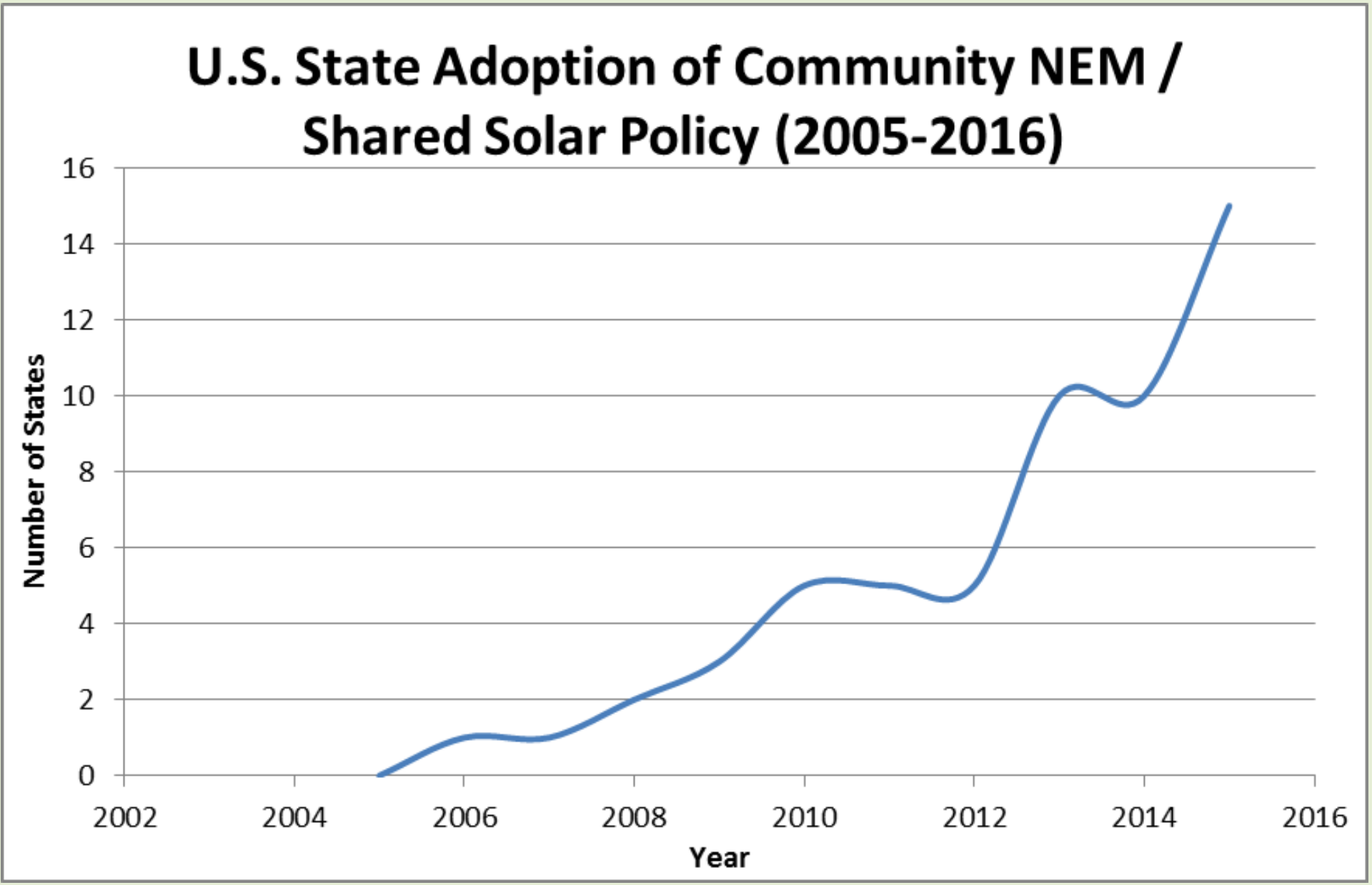
- Economies of scale and ideal project locations
- Financial benefits and mitigate concerns about climate change and rising energy costs (Bomberg & McEwan, 2012); local control (Weinrub, 2010); community cohesion (Bollinger & Gillingham, 2012; Irvine, Sawyer, & Grove, 2012)
- Three common models
  - Utility Owned
  - Special Purpose Entity Owned
  - Nonprofit Owned
- In Virginia, no rules that require utilities to permit community shared solar

# U.S. Community Shared Solar Policy






*Note.* Figure from Shared Renewables HQ (2015) website. http://www.sharedrenewables.org/community-energy-projects/




*Note.* Compiled by author from National Conference of State Legislatures (2015) and Shared Renewables HQ (2016).

# Research Questions

- What is the feasibility for community shared solar installations in the Richmond, VA region?
- What impact could such installations have?
- What is the path forward to initiate community shared solar projects in the Richmond, VA region?

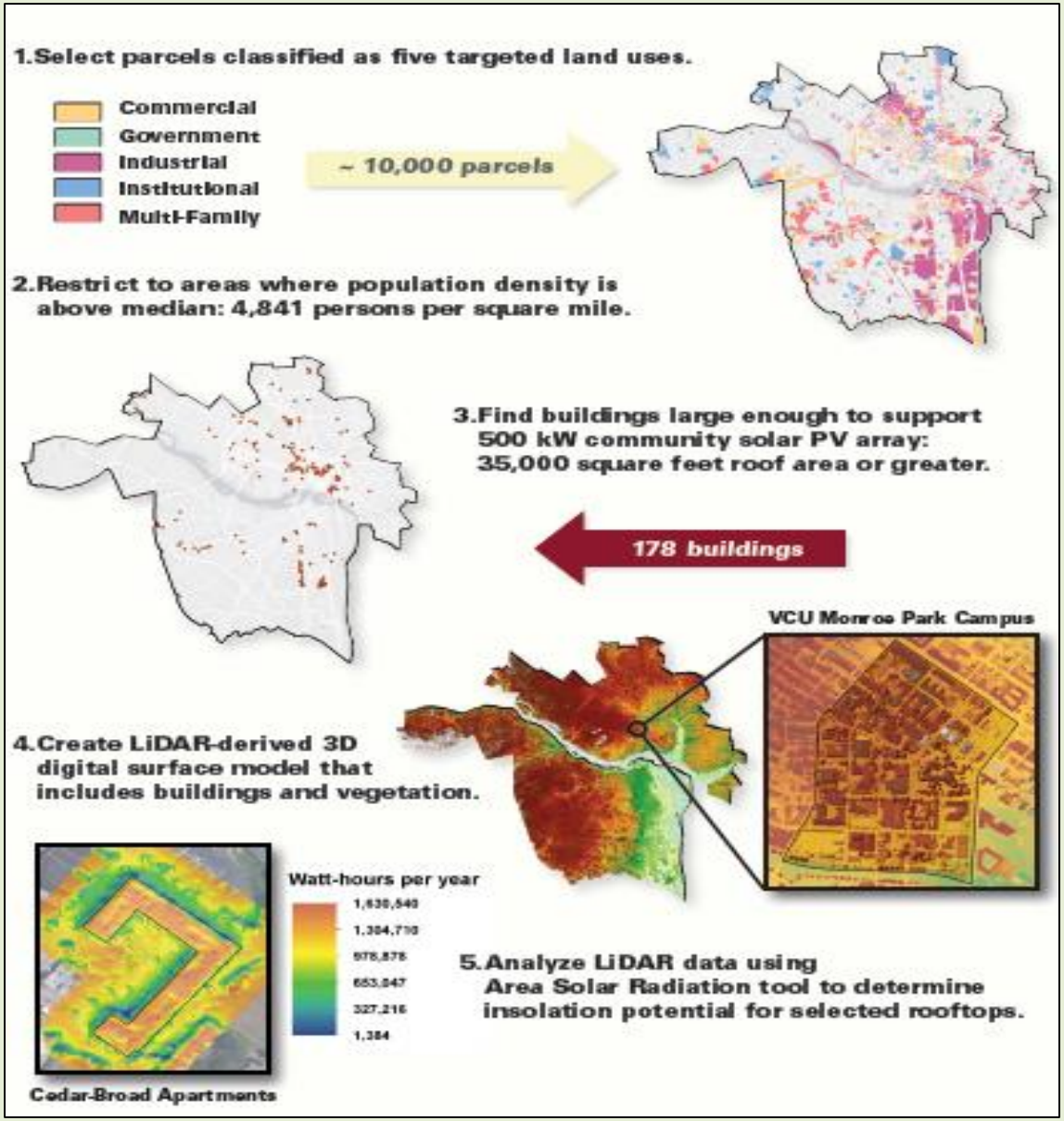
# Methodology

- GIS to find properties in Richmond with strong potential for community shared solar array
  - Parcels, Land Use, Structures (City of Richmond)
  - Population Density (U.S. Census Bureau)
  - LiDAR Point Cloud (USGS)

"Light detection and ranging." Pulsed laser scanning to create accurate 3D model of surfaces.

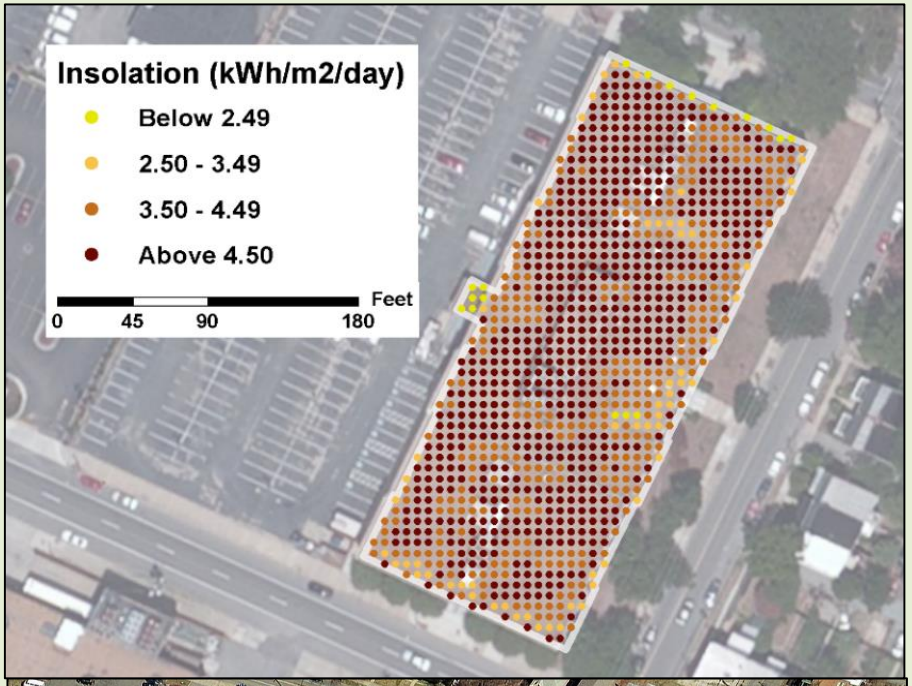
- Environmental Impact
  - Energy produced
  - $CO_2$ reduced
  - Equivalent homes powered & cars taken off the road
- Jobs and Economic Development Impact (NREL's JEDI)
  - Project costs
  - Local spending
  - Labor impacts (direct, supply chain, and induced)
  - Earnings impacts

# Site Selection



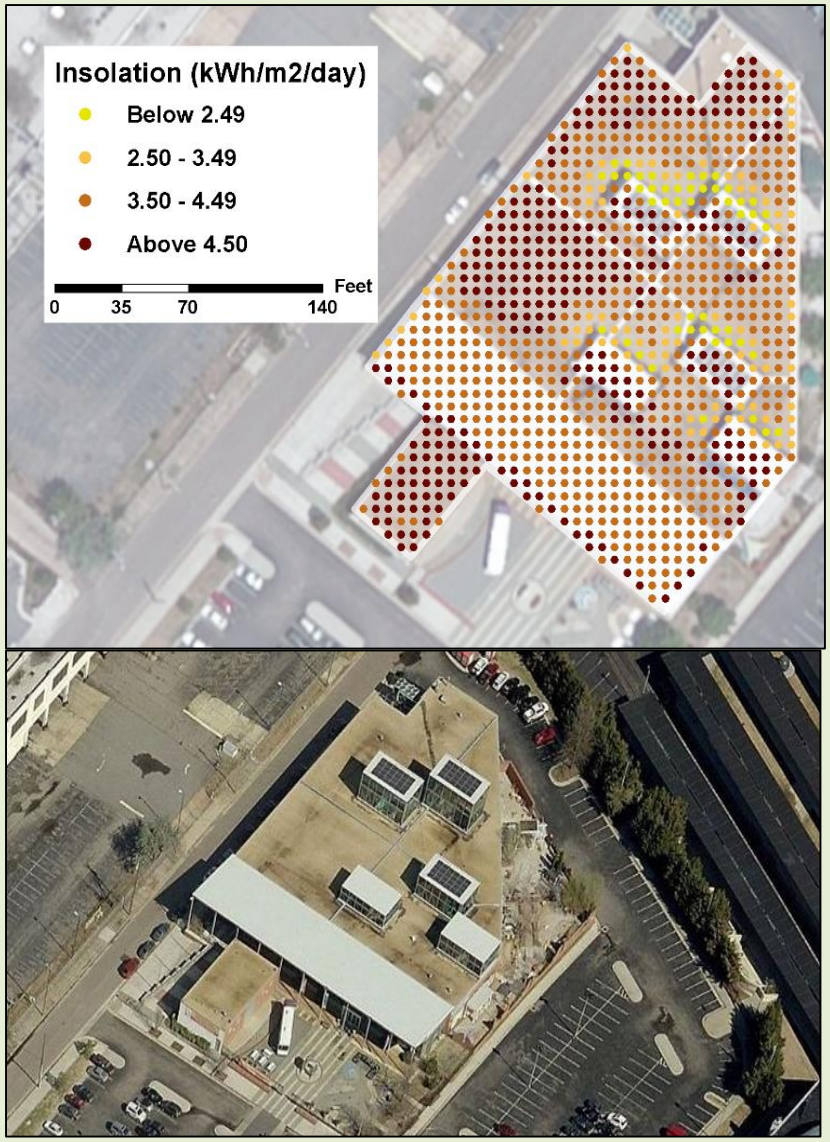
# Site 1: Carytown Place (Commercial)

- 10 North Nansemond St.
- Average Insolation: 4.38 kWh/m$^2$/day
- Potential system size: 511 kW
- Annual energy production: 612,840 kWh
- Retail and residential market
- Simple roof geometry



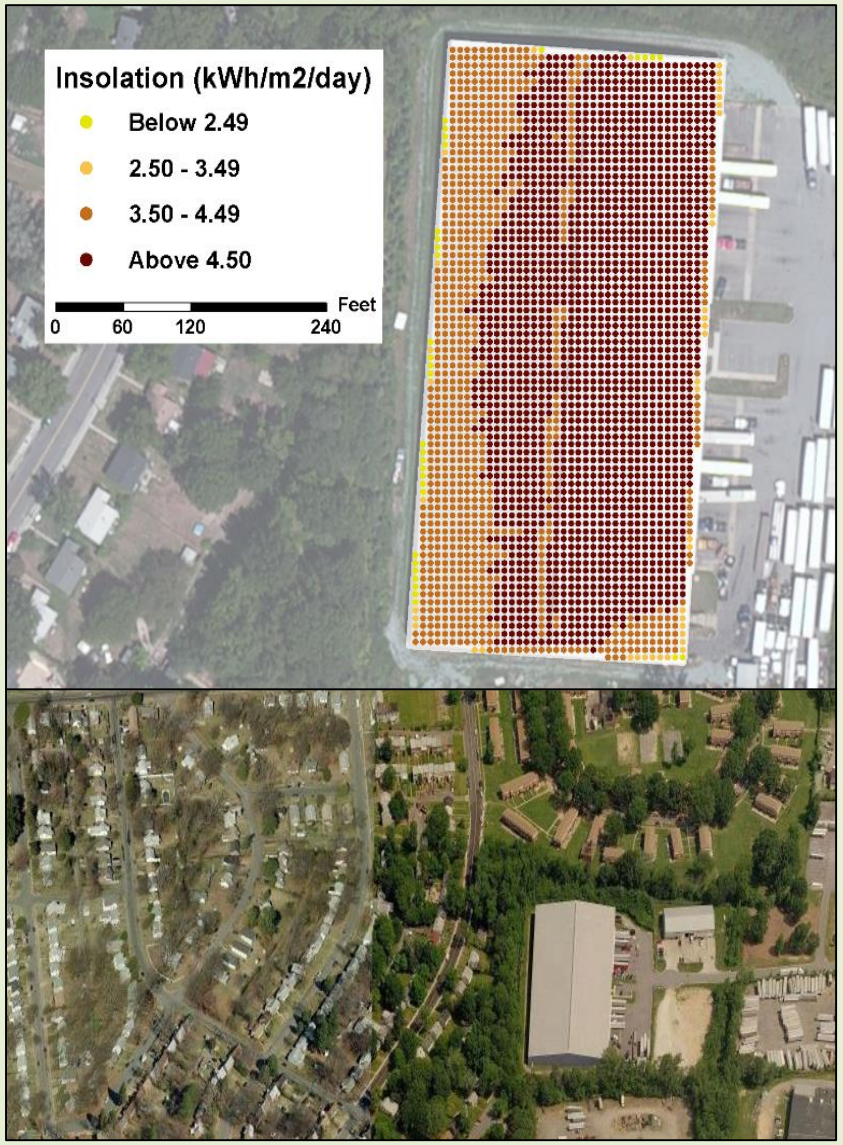

# Site 2: Children's Museum (Gov't)

- 2626 West Broad St.
- Average Insolation: 4.16 kWh/m$^2$/day
- Potential system size: 471 kW
- Annual energy production: 536,973 kWh
- Educational opportunity
- Several roof obstacles



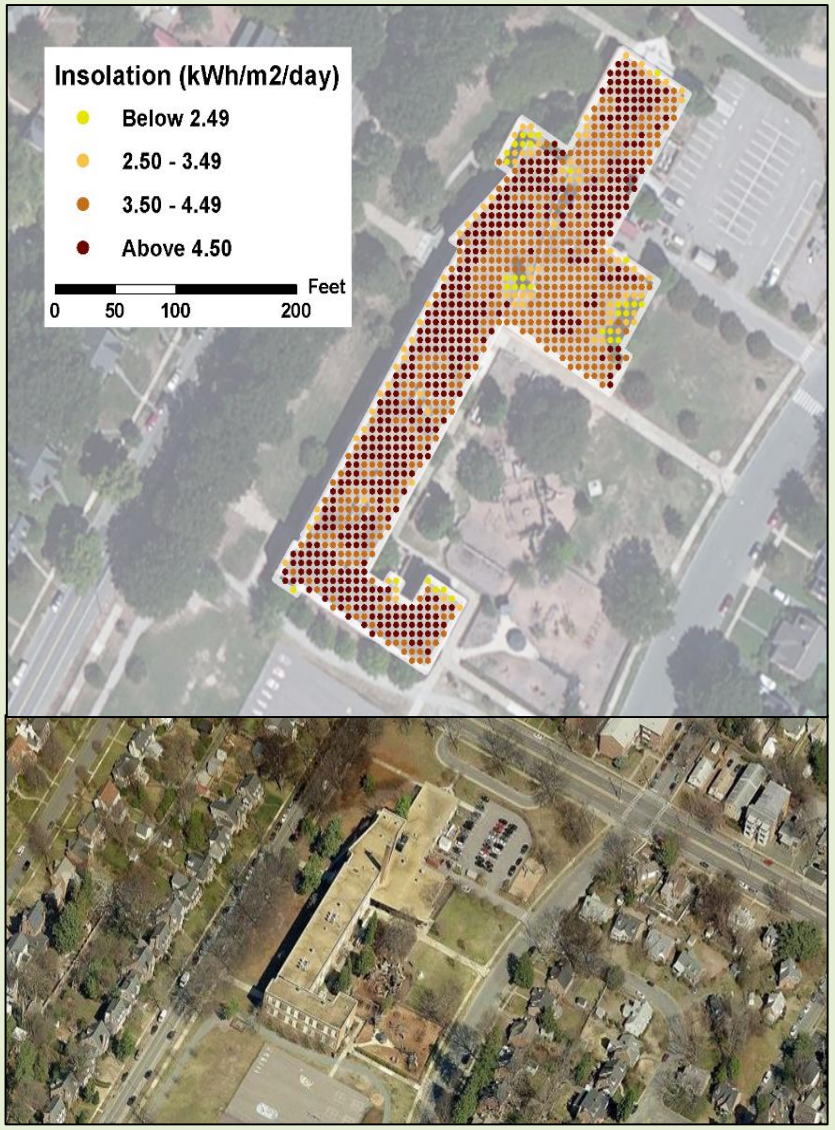
# Site 3: Old Dominion Warehouse (Ind.)

- 1598 Carter Creek Rd.
- Average Insolation: 4.46 kWh/m$^2$/day
- Potential system size: 4,470 kW
- Annual energy production: 5,460,583 kWh
- Very high solar yield
- Simple, low-pitch roof



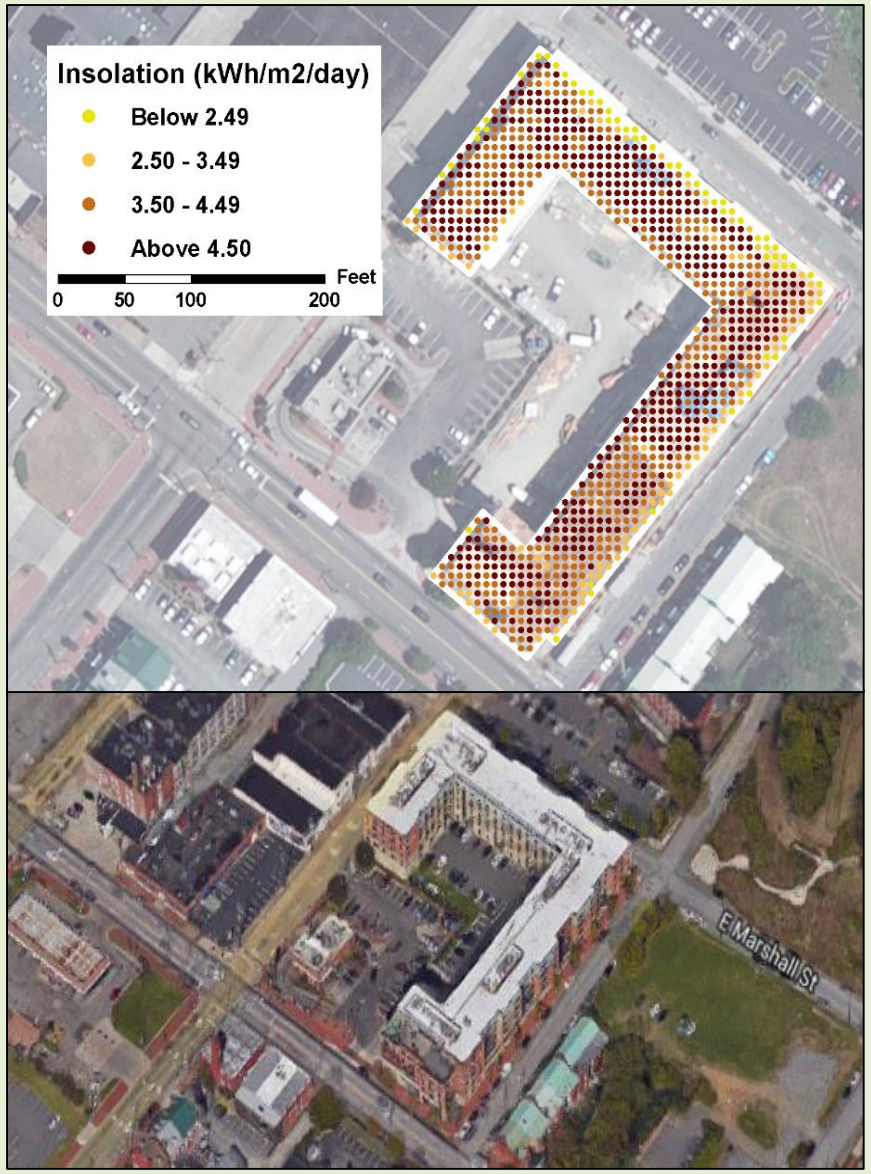
# Site 4: Mary Munford School (Inst.)

- 211 Westmoreland St.
- Average Insolation: 4.26 kWh/m$^2$/day
- Potential system size: 482 kW
- Annual energy production: 561,890 kWh
- Strong existing community
- High-income area



# Site 5: Cedar-Broad Apartments (M.F.)

- 1820 East Broad St.
- Average Insolation: 4.20 kWh/m$^2$/day
- Potential system size: 469 kW
- Annual energy production: 538,502 kWh
- On-site member base
- Transient market



# Environment / Economic Development

- Community Shared Solar PV:
  - Reduces GHG emissions to mitigate future global warming and climate change impacts
  - Reduces water use (from power plants) and criteria air pollutants (e.g., $SO_2$, $NO_x$, & PM 2.5)
  - Protects ecosystems
  - Provides energy security (e.g., rising energy costs; terrorist attacks; natural disasters)
  - Enhances community cohesion (e.g., peer-effects)
  - Creates job opportunities (e.g., solar industry) and local spending

# Environmental Impact

| Community Solar Capacity | Energy Produced (kWh/year) | $CO_2$ Reduced (lbs.) | Equivalent # Homes Powered | Equivalent # Cars off Road |
|---|---|---|---|---|
| 250 kW | 307,969 | 332,474 | 23 | 47 |
| 500 kW | 615,938 | 664,948 | 46 | 94 |
| 1 MW | 1,231,875 | 1,329,895 | 92 | 189 |
| 2 MW | 2,463,750 | 2,659,791 | 184 | 377 |

*Note.* Author calculations.

- Energy Produced (kWh/yr.) = kW × 0.75 (de-rating factor) × 4.5hr/day (insolation) × (365 day)/yr.
- CO2 Reduced (lbs.) = kw × (1079.57 lbs GHGs)/MW × MW/(1000 kw).

# Installation Costs and Local Spending

- National Renewable Energy Laboratory's Jobs and Economic Development Impact (JEDI) model

| Community Solar Capacity | Project Installation Cost ($) | Local Spending ($) |
|---|---|---|
| 250 kW | 1,441,618 | 873,618 |
| 500 kW | 2,883,235 | 1,747,235 |
| 1 MW | 5,776,470 | 3,494,470 |
| 2 MW | 11,532,940 | 6,988,940 |

*Note.* Author calculation from http://www.nrel.gov/analysis/jedi/download.html

# Jobs and Earnings Impact

| Community Solar Capacity | Direct Jobs | Direct Earnings ($) | Supply Chain Jobs | Supply Chain Earnings ($) | Induced Impacts Jobs | Induced Impacts Earnings | Total Jobs | Total Earnings |
|---|---|---|---|---|---|---|---|---|
| 250 kW | 4.2 | 332,700 | 3.5 | 258,000 | 2.4 | 136,400 | 10.1 | 721,100 |
| 500 kW | 8.3 | 665,400 | 7.1 | 516,100 | 4.8 | 272,700 | 20.3 | 1,454,100 |
| 1 MW | 16.7 | 1,330,700 | 14.1 | 1,032,100 | 9.7 | 545,400 | 40.5 | 2,908,300 |
| 2 MW | 33.4 | 2,661,400 | 28.3 | 2,064,200 | 19.3 | 1,090,800 | 81 | 5,816,500 |

# Conclusions

- High theoretical potential for community shared solar in Richmond, VA
  - 178 buildings suitable for 500 kW system
- Weak solar energy incentives and utility lobbying has hindered community solar development
- Recommendations
  - Educate public through outreach programs
  - Understand potential sites and environmental / economic development impacts
  - Ease transition via group billing legislation or utility owned community shared solar program

# Questions?

- For additional questions/comments concerning this research, please email me at michaudg@ohio.edu
- Thank you

# Analysis of Indirect Economic Impacts of Earthquake Scenarios in British Columbia and Quebec

Dan Wei, Adam Rose and Michael Lahr

University of Southern California

Rutgers University

June 10, 2016

# Presentation Outline

- Study scenarios
- Analytical approach
- Adaptation of the Canadian Provincial input-output tables
- Economic resilience
- Economic impact analysis results
- SDA of the results

# Study Scenario

- In this study, we analyze the indirect economic losses in BC and QC of two earthquake scenarios:
  - an earthquake scenario with a Richter magnitude of 9.0 in BC
  - an earthquake scenario with a Richter magnitude of 7.1 near Quebec City
- Economic consequence analysis is focused on business interruption losses from building/content damages and lifeline service disruptions.

# Analytical Approach

- Use input-output analysis approach
- 24-sector I-O tables for the provinces of BC and QC are obtained from Statistics Canada
- Two versions are used:
  - Demand-side (upstream in supply-chain)
  - Supply-side (downstream in supply-chain)
- Approach to calculate the direct BI losses:
  - Based on AIR Model Results
  - Building damage: direct BI estimated from AIR Model
  - Utility lifeline disruption: $DOL_{i,n} = DailyOuput_i \times \%\ Affected \times \%\ Loss\ of\ Function$
  - Transportation infrastructure: ATC (1991) approach

# Adaptation of the Canadian Provincial I-O Tables

- Combine Transportation Margins and Transportation Services sectors
- Other sectoral aggregation
- Estimate direct regional input coefficients and construct intra-regional transaction tables
  - StatsCan's provincial tables did not delineate between production inputs produced locally or outside of the province
  - To get intra-regional exchanges, use of imports need to be removed
  - Use formula $\rho = \frac{\mathbf{q} - \mathbf{e}}{\mathbf{q} - \mathbf{e} + \mathbf{m}}$ to calculate the vector of regional purchase coefficients (RPCs)
  - Multiply the original I-O table by the RPCs vector to obtain the intra-regional transaction table.

# Defining Economic Resilience

- Static: Ability of a system to maintain function when shocked (efficient use of remaining resources at a given point in time).

- Dynamic: Speed of a system to recover from a shock (efficient use of resources over time for investment in repair and reconstruction).

Source: Rose, A. 2009. *Economic Resilience to Disasters*. Community and Regional Resilience Institute Research Report 8.

# Measuring Econ Resilience of 9/11

- 95% of over 1,100 WTC area firms relocated after 9/11
- If all of firms in the WTC area went out of business, direct business interruption (BI) loss would = $58.4B
- If all relocation were immediate, then no BI
- Businesses relocated within 8 months , BI = $16.1B
- Resilience Metric: Avoided Loss ÷ Max Potential Loss

$42.3B ÷ $58.4B = 72%

# Typical Resilience Tactics

- Use of inventories
- Conservation
- Input substitution
- Import substitution
- Utility unimportance
- Production recapture
- Transportation re-routing

# Simulation Results

## Economic Impacts of BC Earthquake Scenario (in millions 2012 CAN $)

| | Case | Total Output Loss | Total Income Loss | Total Value-added Loss | Total Employment Impacts | Percentage Annual Total Output Loss |
|---|---|---|---|---|---|---|
| A. | Base Case (No Resilience) | 24,157.6 | 7,972.0 | 12,811.5 | 155,099 | 6.58% |
| B. | With Lifeline Importance | 21,295.4 | 7,055.2 | 11,298.2 | 138,768 | 5.80% |
| C. | With Conservation | 24,056.9 | 7,939.8 | 12,758.2 | 154,523 | 6.55% |
| D. | With Transport Re-routing | 23,880.4 | 7,891.0 | 12,673.3 | 153,688 | 6.50% |
| E. | With Production Recapture | 5,235.9 | 1,849.6 | 2,715.4 | 40,532 | 1.43% |
| F. | With All Resilience Adjustments | 4,403.4 | 1,574.9 | 2,296.2 | 35,187 | 1.20% |

# Simulation Results (cont'd)

## Economic Impacts of QC Earthquake Scenario (in millions 2012 CAN $)

| | Case | Total Output Loss | Total Income Loss | Total Value-added Loss | Total Employment Impacts | Percentage Annual Total Output Loss |
|---|---|---|---|---|---|---|
| A. | Base Case (No Resilience) | 20,079.6 | 6,123.9 | 9,764.1 | 130,112 | 3.21% |
| B. | With Lifeline Importance | 17,630.0 | 5,359.0 | 8,547.8 | 115,341 | 2.82% |
| C. | With Conservation | 19,970.5 | 6,090.4 | 9,710.1 | 129,463 | 3.19% |
| D. | With Transport Re-routing | 19,743.4 | 6,038.3 | 9,625.5 | 128,511 | 3.16% |
| E. | With Production Recapture | 6,738.4 | 2,099.0 | 3,239.5 | 48,533 | 1.08% |
| F. | With All Resilience Adjustments | 5,963.8 | 1,857.0 | 2,873.6 | 43,359 | 0.95% |

# Adjustment for Multiple Sources of BI

- Business may suffer shocks from multiple sources, and thus potential double-counting of losses
- Adjustment is made based on time periods for various sources of shocks
- Assume half of the cases when two or more shocks occurred simultaneously involved redundancies
- After adjustment,
  - gross output impacts reduce from $24.2 to $21.4 billion (w/o resilience) and from $4.4 to $4.1 billion (w/ resilience) for BC;
  - gross output impacts reduce from $20.1 to $17.1 billion (w/o resilience) and from $6.0 to $5.6 billion (w/ resilience) for QC;

# Simulation Results (cont'd)

## Output Losses from Various Sources for BC Earthquake Scenario

| | Source of Impact | Total Output Impacts (w/o Resilience) (M $) | % Output Impacts (w/o Resilience) | Total Output Impacts (w/ Resilience) (M $) | % Output Impacts (w/ Resilience) |
|---|---|---|---|---|---|
| 1 | Building Damages | 18,611.8 | 5.069% | 3,802.3 | 1.036% |
| 2 | Oil Pipeline Disruption | 34.15 | 0.009% | 3.79 | 0.001% |
| 3 | Gas Pipeline Disruption | 396.30 | 0.108% | 12.77 | 0.003% |
| 4 | Water Supply Disruption | 563.76 | 0.154% | 32.17 | 0.009% |
| 5 | Power Supply Disruption | 671.08 | 0.183% | 86.49 | 0.024% |
| 6 | Telecom System Disruption | 852.20 | 0.232% | 48.57 | 0.013% |
| 7 | Airports Disruption | 82.88 | 0.023% | 41.44 | 0.011% |
| 8 | Seaports Disruption | 110.56 | 0.030% | 55.28 | 0.015% |
| 9 | Roads Disruption | 43.62 | 0.012% | 10.91 | 0.003% |
| 10 | Railroads Disruption | 18.35 | 0.005% | 9.17 | 0.002% |
| | **Total** | **21,384.7** | **5.824%** | **4,102.9** | **1.117%** |

# Simulation Results (cont'd)

## Output Losses from Various Sources for QC Earthquake Scenario

| | Source of Impact | Total Output Impacts (w/o Resilience) (M $) | % Output Impacts (w/o Resilience) | Total Output Impacts (w/ Resilience) (M $) | % Output Impacts (w/ Resilience) |
|---|---|---|---|---|---|
| 1 | Building Damages | 13,996.6 | 2.237% | 5,224.1 | 0.835% |
| 2 | Oil Pipeline Disruption | 50.19 | 0.008% | 4.72 | 0.001% |
| 3 | Gas Pipeline Disruption | 239.79 | 0.038% | 7.53 | 0.001% |
| 4 | Water Supply Disruption | 384.82 | 0.062% | 20.18 | 0.003% |
| 5 | Power Supply Disruption | 1,314.85 | 0.210% | 155.88 | 0.025% |
| 6 | Telecom System Disruption | 738.43 | 0.118% | 36.23 | 0.006% |
| 7 | Airports Disruption | 31.87 | 0.005% | 15.94 | 0.003% |
| 8 | Seaports Disruption | 163.41 | 0.026% | 81.71 | 0.013% |
| 9 | Roads Disruption | 60.95 | 0.010% | 11.39 | 0.002% |
| 10 | Railroads Disruption | 97.15 | 0.016% | 36.30 | 0.006% |
| | Total | **17,078.1** | **2.729%** | **5,593.9** | **0.894%** |

# Sectoral Impacts

- BC Scenario
  - In absolute terms, Finance, Insurance, Real Estate & Rental & Leasing sector is expected to have the highest impact
  - In percentage terms, Other Services sector and Educational Services sector are expected to have the highest impacts

- QC Scenario
  - In absolute terms, Manufacturing sector is expected to have the highest impact
  - In percentage terms, Education Services and Other Services sectors are expected to have the highest impacts

# Structural Decomposition Analysis of the Impacts of the two Earthquake Scenarios

- Structural decomposition techniques are widely used to determine the underlying driving factors of the change (or difference) in a variable over time or across regions.
- Apply SDA to better understand the major causes of difference in the impact results of BC and QC scenarios
- Compare relative contributions from various factors, including resilience
- Using gross output impacts from building damage (with resilience adjustment) of the BC and QC scenarios as an example

# Comparison of BC and QC Impact Results

| Sector | | with Resilience | | |
|---|---|---|---|---|
| | | BC | QC | Difference |
| 1 | Crop & Animal Production | 30.00 | 80.61 | -50.6 |
| 2 | Forestry & Logging | 62.69 | 23.59 | 39.1 |
| 3 | Fishing, Hunting & Trapping | 1.45 | 1.23 | 0.2 |
| 4 | Support Activities for Agriculture & forestry | 8.71 | 6.33 | 2.4 |
| 5 | Mining and Oil & Gas Extraction | 20.65 | 74.79 | -54.1 |
| 6 | Utilities | 51.85 | 99.14 | -47.3 |
| 7 | Construction | 196.65 | 530.80 | -334.1 |
| 8 | Manufacturing | 114.32 | 997.15 | -882.8 |
| 9 | Wholesale Trade | 120.66 | 197.19 | -76.5 |
| 10 | Retail Trade | 225.95 | 309.69 | -83.7 |
| 11 | Transportation & Warehousing and Transportation Margins | 849.03 | 585.08 | 264.0 |
| 12 | Information & Cultural Industries | 32.05 | 113.74 | -81.7 |
| 13 | Finance, Insurance, Real Estate & Rental & Leasing | 320.31 | 480.02 | -159.7 |
| 14 | Professional, Scientific & Technical Services | 135.27 | 201.63 | -66.4 |
| 15 | Administrative, Waste Management & Remediation Services | 60.15 | 101.81 | -41.7 |
| 16 | Educational Services | 39.50 | 26.58 | 12.9 |
| 17 | Health Care & Social Assistance | 228.20 | 168.41 | 59.8 |
| 18 | Arts, Entertainment & Recreation | 113.33 | 84.05 | 29.3 |
| 19 | Accommodation & Food Services | 333.28 | 242.58 | 90.7 |
| 20 | Other Services (Except Public Administration) | 354.60 | 264.54 | 90.1 |
| 21 | Operating, Office, Cafeteria & Laboratory Supplies | 52.26 | 90.88 | -38.6 |
| 22 | Travel, Entertainment, Advertising & Promotion | 67.57 | 118.97 | -51.4 |
| 23 | Non-Profit Institutions Serving Households | 87.37 | 72.65 | 14.7 |
| 24 | Government Sector | 296.42 | 352.63 | -56.2 |
| | Total | **3,802.29** | **5,224.07** | **-1,421.8** |

# SDA Formulas

$$\mathbf{x} = \mathbf{x}^{D} + \mathbf{x}^{S} - \mathbf{x}^{direct}$$

$$\mathbf{x} = \mathbf{Lf} + \mathbf{vG} - \mathbf{x}^{direct}$$

$$\mathbf{x}_{\mathbf{r}} = \mathbf{R}(\mathbf{Lf} + \mathbf{vG} - \mathbf{x}^{direct}) = \mathbf{RLf} + \mathbf{R}(\mathbf{vG}) - \mathbf{Rx}^{direct}$$

$$\Delta\mathbf{x}_{r} = (\mathbf{R}_{BC}\mathbf{L}_{BC}\mathbf{f}_{BC} - \mathbf{R}_{QC}\mathbf{L}_{QC}\mathbf{f}_{QC}) + [\mathbf{R}_{BC}(\mathbf{v}_{BC}\mathbf{G}_{BC}) - \mathbf{R}_{QC}(\mathbf{v}_{QC}\mathbf{G}_{QC})]$$
$$- (\mathbf{R}_{BC}\mathbf{x}_{BC}^{direct} - \mathbf{R}_{QC}\mathbf{x}_{QC}^{direct})$$

# SDA Formulas

$$\Delta\mathbf{x} = (1/2)[\mathbf{R}_{BC}(\Delta\mathbf{L})\mathbf{f}_{QC} + \mathbf{R}_{QC}(\Delta\mathbf{L})\mathbf{f}_{BC}]$$
$$+ (1/4)(\mathbf{R}_{BC}\mathbf{L}_{BC} + \mathbf{R}_{QC}\mathbf{L}_{QC})(\Delta f)(\mathbf{B}_{BC} + \mathbf{B}_{QC})$$
$$+ (1/4)(\mathbf{R}_{BC}\mathbf{L}_{BC} + \mathbf{R}_{QC}\mathbf{L}_{QC})(f_{BC} + f_{QC})(\Delta\mathbf{B})$$
$$+ (1/2)(\Delta\mathbf{R})(\mathbf{L}_{BC}\mathbf{f}_{BC} + \mathbf{L}_{QC}\mathbf{f}_{QC})$$
$$+ (1/2)[\mathbf{R}_{BC}(\mathbf{v}_{BC}\Delta\mathbf{G}) + \mathbf{R}_{QC}(\mathbf{v}_{QC}\Delta\mathbf{G})]$$
$$+ (1/4)\{\mathbf{R}_{BC}[(\Delta v)(\mathbf{M}_{BC} + \mathbf{M}_{QC})]\mathbf{G}_{QC} + \mathbf{R}_{QC}[(\Delta v)(\mathbf{M}_{BC} + \mathbf{M}_{QC})]\mathbf{G}_{BC}\}$$
$$+ (1/4)\{\mathbf{R}_{BC}[(v_{BC} + v_{QC})(\Delta\mathbf{M})]\mathbf{G}_{QC} + \mathbf{R}_{QC}[(v_{BC} + v_{QC})(\Delta\mathbf{M})]\mathbf{G}_{BC}\}$$
$$+ (1/2)(\Delta\mathbf{R})(\mathbf{v}_{BC}\mathbf{G}_{BC} + \mathbf{v}_{QC}\mathbf{G}_{QC})$$
$$- (1/2)(\mathbf{R}_{BC} + \mathbf{R}_{QC})(\Delta\mathbf{x}^{direct})$$
$$- (1/2)(\Delta\mathbf{R})(\mathbf{x}_{BC}^{direct} + \mathbf{x}_{QC}^{direct})$$

# Summary of SDA Results

| | With Resilience | |
|---|---|---|
| | Level | Percent |
| **Technology Difference** | 54.36 | -4% |
| **Final Demand Reduction Level** | 756.08 | -53% |
| **Final Demand Mix** | 113.11 | -8% |
| **Production Recapture—Demand-Side** | -2,059.17 | 145% |
| **Allocation Difference** | 28.85 | -2% |
| **VA Reduction Level** | 758.48 | -53% |
| **VA Mix** | 283.47 | -20% |
| **Production Recapture—Supply-Side** | -2,124.78 | 149% |
| **Direct Output Loss** | -465.96 | 33% |
| **Production Recapture—Direct Output Loss** | 1,233.78 | -87% |
| **Total** | **-1,421.78** | **100%** |

# Conclusion

- Input-Output approach valid for S-R economic disruptions, if supplemented by resilience adjustments
- The BC earthquake scenario results in $21.4 billion output losses and QC earthquake scenario results in $17.1 billion output losses without resilience
- Resilience can reduce total losses for BC to $4.1 billion and QC to $5.6 billion
- Resilience Metric: Avoided Loss ÷ Max Potential Loss

  BC: $17.3B ÷ $21.4B = 81%

  QC: $11.5B ÷ $17.1B = 67%

# Conclusion (cont'd)

- SDA indicates that resilience (production recapture in the building damages case) contributes the largest impacts to the difference in the gross output impact results of BC and QC
  - Shorter repair and reconstruction period in BC than in QC
  - Business capability of production recapture diminishes with length of disruption period
- Final demand and value-added level changes are the second largest contributor to the difference of impact results between the two provinces

# DO CONTRIBUTION OF AGRICULTURE PROCEDURES DIFFER ACROSS STATES?

## A survey of methodological approaches used by economists.

Leah English M.S., Jennie Popp, Ph.D. and Wayne Miller, Ph.D.

MCRSA/IMPLAN Conference

Charlotte, NC

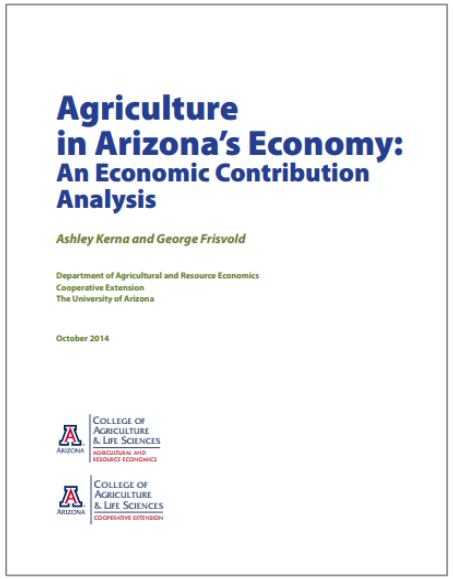
09/10/2016

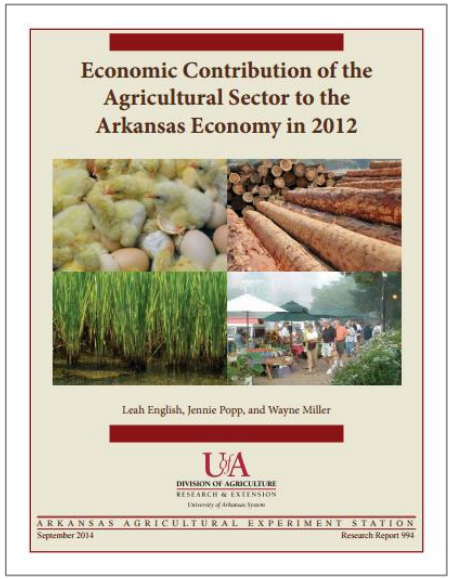
DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

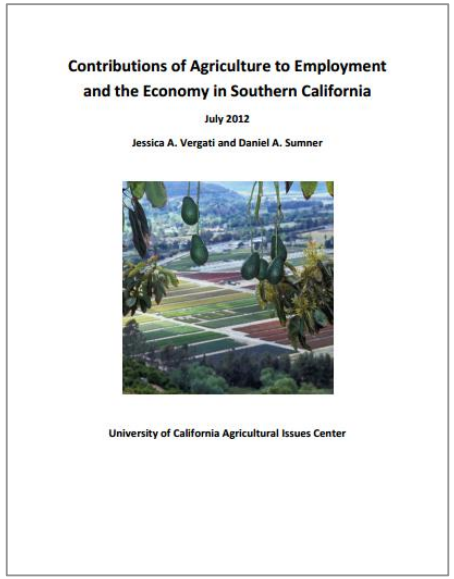
Center for Agricultural and Rural Sustainability

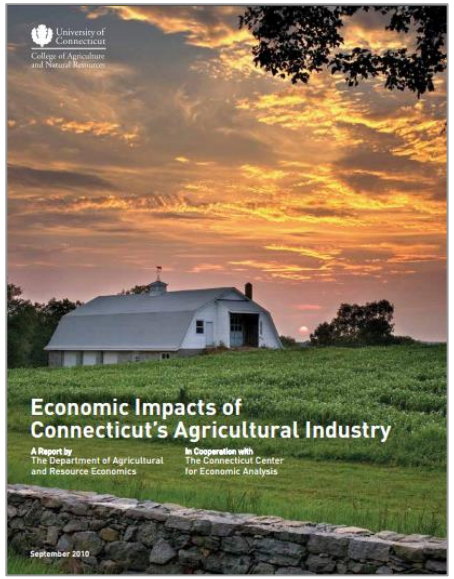
# CONTRIBUTION OF AGRICULTURE:

- Over the past decade, at least **24 states** have used IMPLAN to conduct agriculture analyses at some level

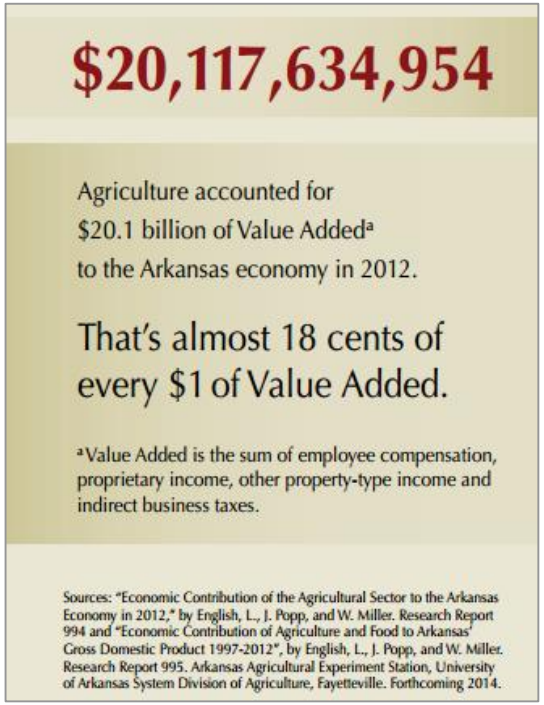
# CONTRIBUTION OF AGRICULTURE:

- **Contribution versus Impact**
  - Watson et al. – Determining Economic Contribution and Impacts: *What is the difference and why do we care?*
  - Economic Contribution – the gross change in economic activity associated with an industry, event or policy in an existing regional economy – ***ex post***
  - Economic Impact – the net changes in new economic activity associated with an industry, event, or policy in an existing regional economy – ***ex ante***

# CONTRIBUTION OF AGRICULTURE:

- **Output versus Value Added**
  - Output – sales or receipts and other operating income, commodity taxes, and inventory change
  - Value Added – equals the difference between an industry's gross output and the cost of its intermediate inputs

# CONTRIBUTION OF AGRICULTURE:





# IN THE NEWS:

OPINION: DAILY JOURNAL

## Another Day, Another Phony Economic Impact Study

Dr. Roy Cordato
in Daily Journal

November 21, 2013
12:00AM

RALEIGH — Making the news recently are results of a new "economic impact" study funded by a trade association representing the nuclear industry. The study purports to show that the nuclear industry in North Carolina and South Carolina generates $25 billion annually in economic activity for the two states and creates 29,000 jobs.

# CONTRIBUTION OF AGRICULTURE SURVEY:

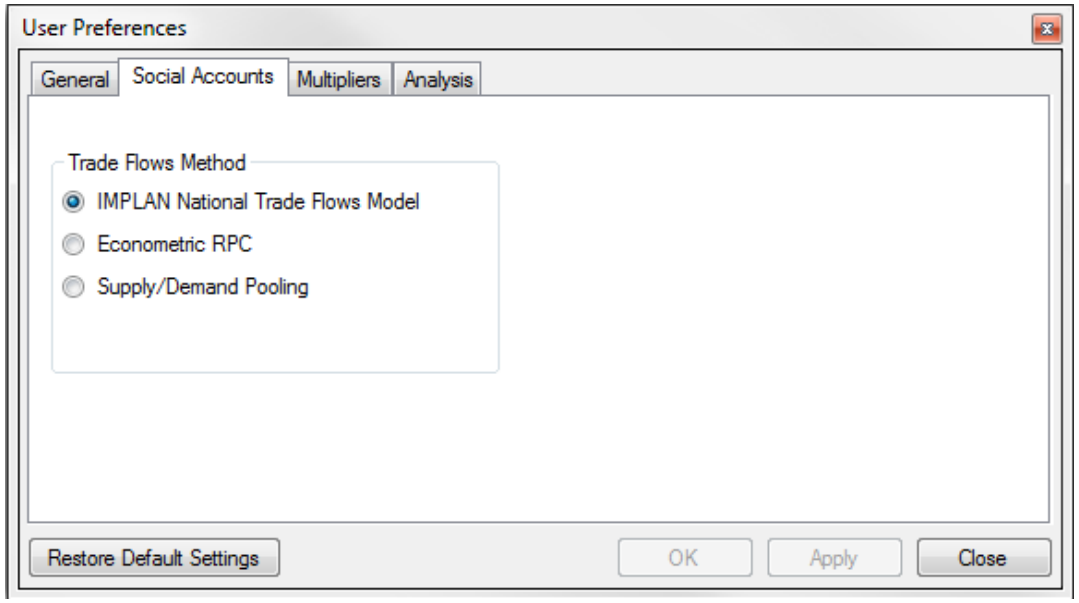
- **Methodology & Definition of Agriculture**:
  - 18 full responses
    - 44% perform contribution of agriculture analyses annually
    - 28% perform analyses every 2-4 years
    - Most respondents also perform regional and/or county level analyses in addition to state-level
  - Primary audiences are state legislatures and agricultural commodity groups

# CONTRIBUTION OF AGRICULTURE METHODOLOGY:

- **Multi-Industry Contribution Analysis**:
  - IMPLAN offers general guidelines for conducting multi-industry contribution analyses
    - Customize Study Area Data
    - Modify Commodity Production – edit commodity production so that each industry produces only its primary commodity
    - Modify Trade Flows – zero out the Local Use Ratio (RSC) or RPC's so that no one will purchase from these industries beyond the amount specified when setting up your events
    - Set Up Contribution Analysis:
      - Add a new industry change activity and generate events for each agriculture sector.
      - Enter sector output values for each industry in the Industry Sales column.
      - Make sure the Event Year reflects your data set.
      - Create a new scenario and analyze.

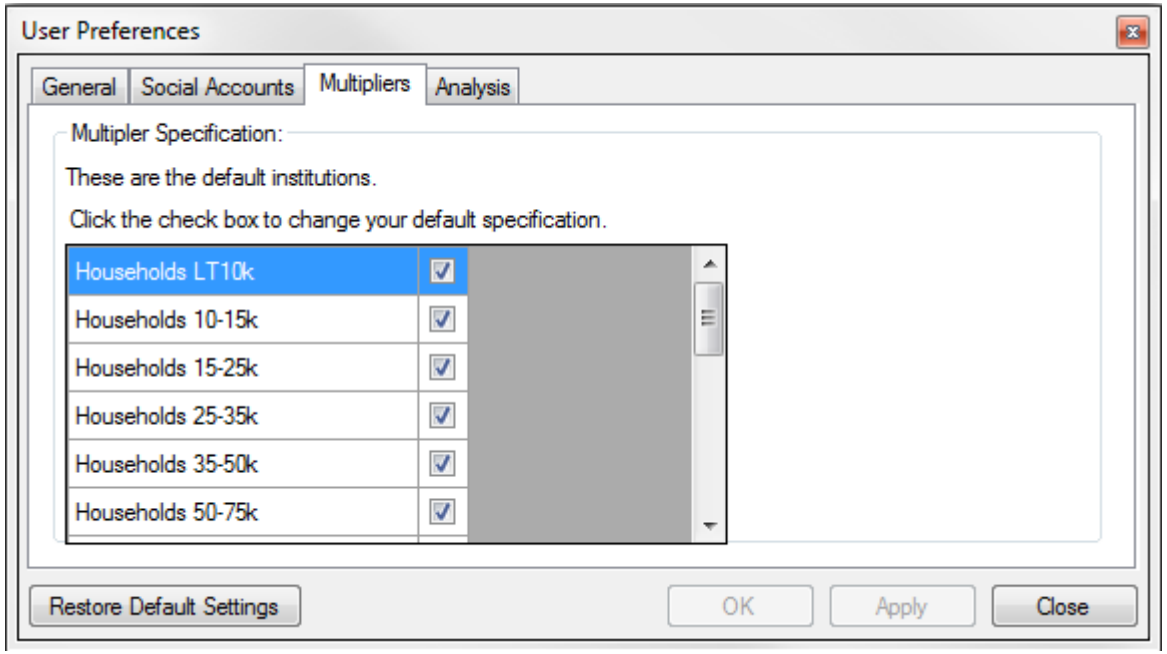
# CONTRIBUTION OF AGRICULTURE METHODOLOGY:

- **Factors that can affect analysis outcome**:
  - Selection of Trade Flows Method – 72% use IMPLAN National Trade Flows method



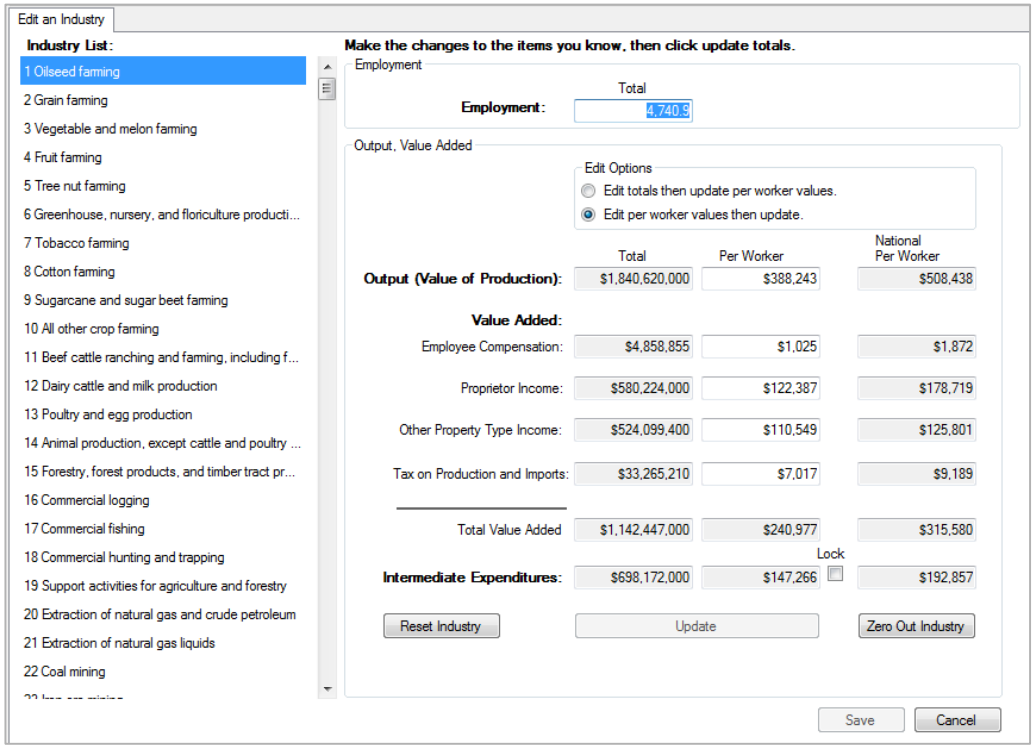
# CONTRIBUTION OF AGRICULTURE METHODOLOGY:

- **Factors that can affect analysis outcome**:
  - Specification of Multipliers – 100% included households, 44% added state/local gov't multipliers, 31% included corporations, 2 respondents used all multipliers



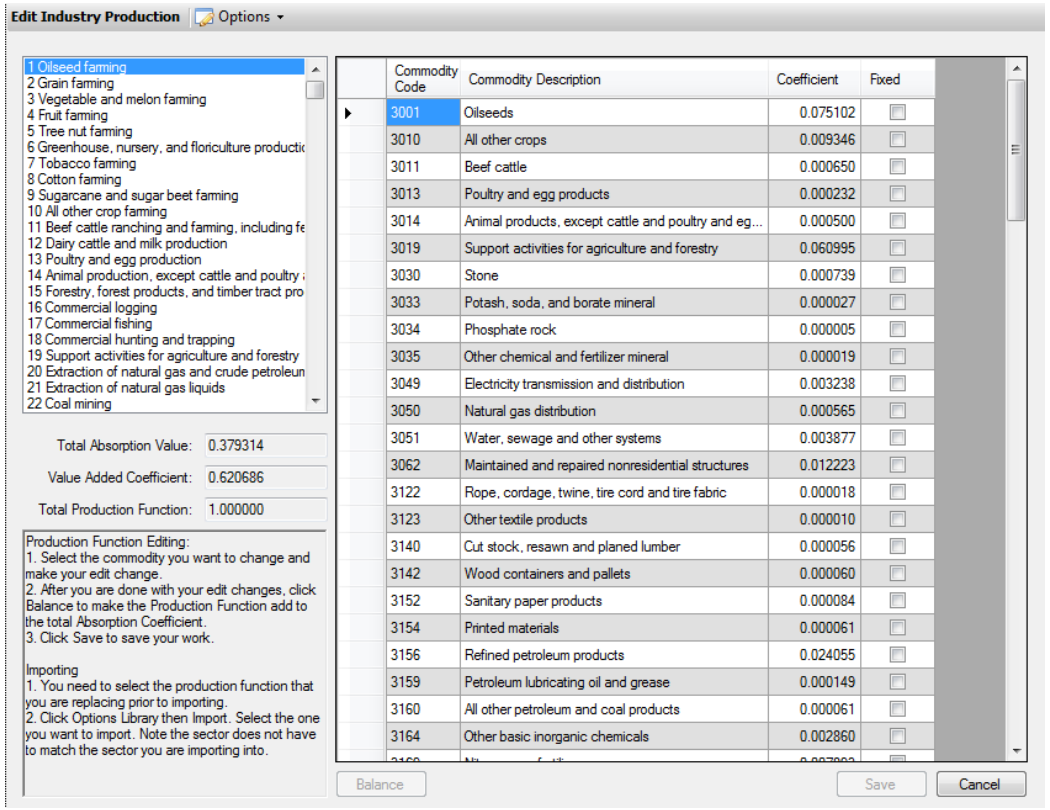
# CONTRIBUTION OF AGRICULTURE METHODOLOGY:

- **Factors that can affect analysis outcome**:
  - Study Area Data – 67% make adjustments to study area data



# CONTRIBUTION OF AGRICULTURE METHODOLOGY:

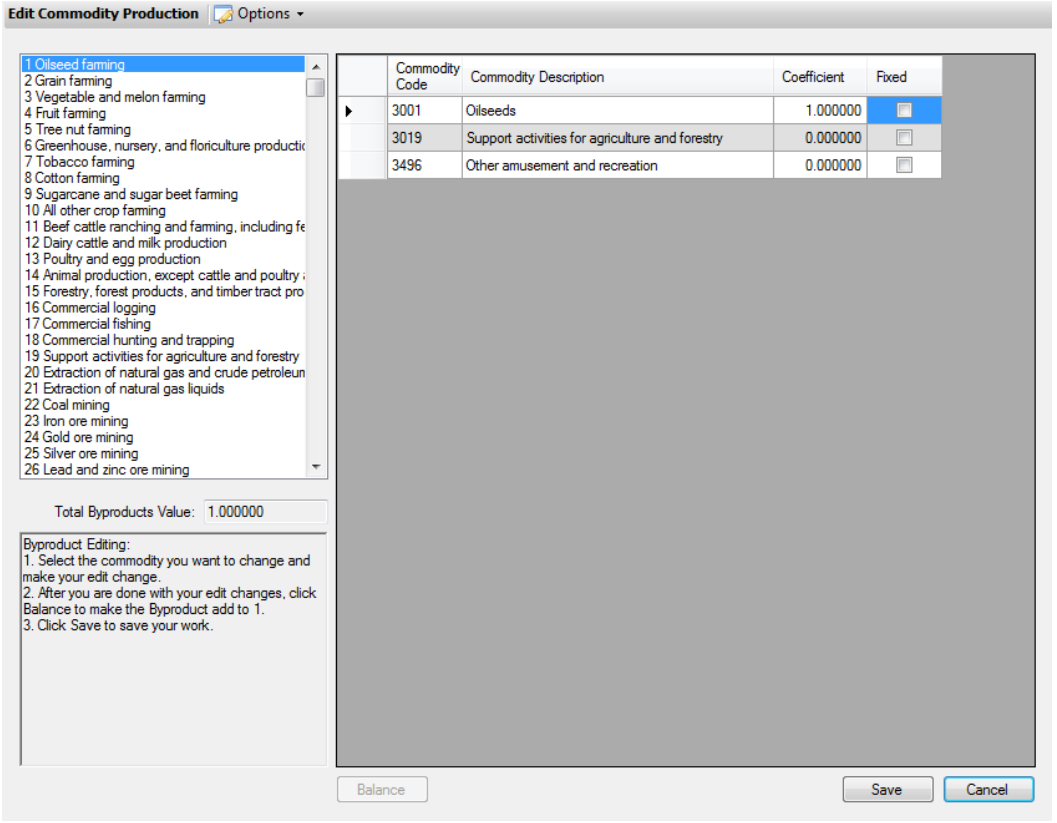
- **Factors that can affect analysis outcome**:
  - Industry Production Coefficients – 44% make adjustments




| Commodity Code | Commodity Description | Coefficient | Fixed |
|---|---|---|---|
| 3001 | Oilseeds | 0.075102 | |
| 3010 | All other crops | 0.009346 | |
| 3011 | Beef cattle | 0.000650 | |
| 3013 | Poultry and egg products | 0.000232 | |
| 3014 | Animal products, except cattle and poultry and eg... | 0.000500 | |
| 3019 | Support activities for agriculture and forestry | 0.060995 | |
| 3030 | Stone | 0.000739 | |
| 3033 | Potash, soda, and borate mineral | 0.000027 | |
| 3034 | Phosphate rock | 0.000005 | |
| 3035 | Other chemical and fertilizer mineral | 0.000019 | |
| 3049 | Electricity transmission and distribution | 0.003238 | |
| 3050 | Natural gas distribution | 0.000565 | |
| 3051 | Water, sewage and other systems | 0.003877 | |
| 3062 | Maintained and repaired nonresidential structures | 0.012223 | |
| 3122 | Rope, cordage, twine, tire cord and tire fabric | 0.000018 | |
| 3123 | Other textile products | 0.000010 | |
| 3140 | Cut stock, resawn and planed lumber | 0.000056 | |
| 3142 | Wood containers and pallets | 0.000060 | |
| 3152 | Sanitary paper products | 0.000084 | |
| 3154 | Printed materials | 0.000061 | |
| 3156 | Refined petroleum products | 0.024055 | |
| 3159 | Petroleum lubricating oil and grease | 0.000149 | |
| 3160 | All other petroleum and coal products | 0.000061 | |
| 3164 | Other basic inorganic chemicals | 0.002860 | |

# CONTRIBUTION OF AGRICULTURE METHODOLOGY:

- **Factors that can affect analysis outcome**:
  - Commodity Production Coefficients – 50% make adjustments



# CONTRIBUTION OF AGRICULTURE METHODOLOGY:

- **Factors that can affect analysis outcome**:
  - Trade Flows Coefficients – 67% make adjustments

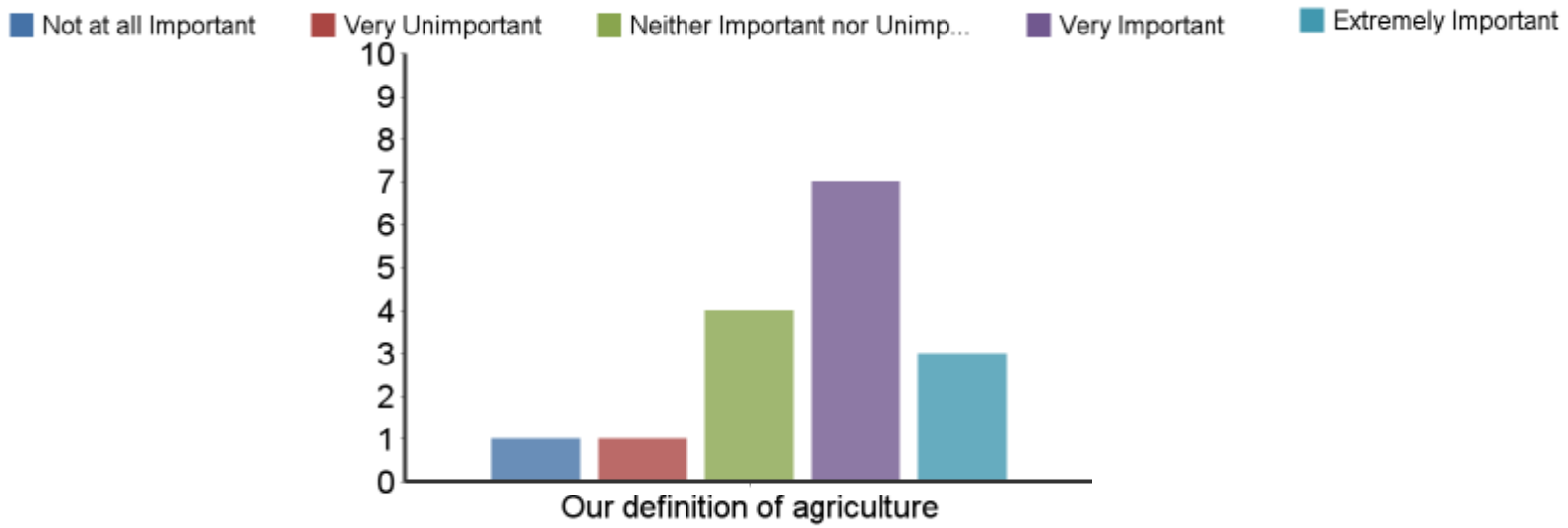
**Edit Trade Flows**

Trade Model

| | Sector | Description | Local Domestic Commodity Demand | Local Net Commodity Supply | Local Use of Local Supply | Local Use Ratio (RSC) | Average RPC |
|---|---|---|---|---|---|---|---|
| ▶ | 3001 | Oilseeds | $1,046,077,000 | $1,334,028,000 | $0 | 0.000 % | 22.665 % |
| | 3002 | Grains | $2,258,543,000 | $1,934,119,000 | $0 | 0.000 % | 46.355 % |
| | 3003 | Vegetables and melons | $132,470,700 | $28,913,280 | $0 | 0.000 % | 11.976 % |
| | 3004 | Fruit | $89,635,580 | $6,595,488 | $0 | 0.000 % | 3.750 % |
| | 3005 | Tree nuts | $38,368,520 | $1,453,543 | $0 | 0.000 % | 1.705 % |
| | 3006 | Greenhouse, nursery, and floriculture products | $124,382,500 | $54,638,450 | $0 | 0.000 % | 7.704 % |
| | 3007 | Tobacco | $13,666 | $536,561 | $0 | 0.000 % | 45.921 % |
| | 3008 | Cotton | $24,641,130 | $88,126,260 | $0 | 0.000 % | 87.537 % |
| | 3009 | Sugarcane and sugar beets | $114,162 | $1,046,615 | $0 | 0.000 % | 99.382 % |
| | 3010 | All other crops | $266,995,500 | $300,529,400 | $0 | 0.000 % | 72.965 % |
| | 3011 | Beef cattle | $334,549,200 | $567,257,500 | $0 | 0.000 % | 81.896 % |
| | 3012 | Dairy cattle and milk products | $144,260,700 | $21,528,300 | $0 | 0.000 % | 13.568 % |
| | 3013 | Poultry and egg products | $3,939,980,000 | $4,091,708,000 | $0 | 0.000 % | 77.363 % |
| | 3014 | Animal products, except cattle and poultry and eg... | $139,283,600 | $179,665,300 | $0 | 0.000 % | 77.414 % |

# DEFINING AGRICULTURE:

- **63%** of respondents believe that it is either very important or extremely important that researchers are consistent in their definition of agriculture




- Some expressed concern that a standard definition might not be practical due to varying demands of legislators and industry leaders.

# DEFINING AGRICULTURE:

- **All respondents agreed that agriculture would include**:
  - Crop Production
  - Livestock Production

- **Most (~90%) would also include**:
  - Crop Processing
  - Livestock Processing
  - Support Activities

# DEFINING AGRICULTURE:

- **~70% would include forestry under the definition of agriculture:**
  - Forestry Production
  - Forestry Processing

- **65% of respondents would include ag related sectors such as:**
  - Commercial Hunting and Trapping
  - Commercial Fishing

# DEFINING AGRICULTURE:

- **Defining Ag Processing:**
  - Over **75%** of respondents indicate that all industries classified under NAICS code 311 (Food Manufacturing) should be included in the contribution of agriculture analysis.
  - A lower percentage felt that those falling under NAICS classification 312 (Beverage and Tobacco Product Manufacturing) should also be included.
  - Less than **50%** would include Textile Mills, Textile Product Mills, Apparel Manufacturing, Leather and Allied Product Manufacturing, Wood Product Manufacturing, and Paper Manufacturing

# DEFINING AGRICULTURE:

- **41% would include:**
  - 262 - Farm machinery and equipment manufacturing
- **Around a quarter would add:**
  - 263 – Lawn and garden equipment and manufacturing
  - 267 – Food product machinery manufacturing
  - 269 – Sawmill, woodworking, and paper machinery
  - 459 – Veterinary services
  - 469 – Landscape and horticultural services
  - 501-503 – Food and drinking places

# DEFINING AGRICULTURE:

- **Other full sectors to consider:**
  - 35 – Other chemical fertilizer and mineral mining
  - 47 – Electric power generation – Biomass
  - 57 – Construction of new commercial structures, including farm structures
  - 164 – Other basic organic
  - 165 – Inorganic chemical manufacturing
  - 210 – Lime manufacturing
  - 215 – Mineral wool manufacturing
  - 368 – Wood kitchen cabinet and countertop manufacturing
  - 369 – Upholstered household furniture manufacturing
  - 370 – Non-upholstered wood household furniture manufacturing
  - 371 – Other household non-upholstered furniture manufacturing
  - 372 – Institutional furniture manufacturing
  - 373 – Wood office furniture manufacturing
  - 374 – Custom architectural woodwork and millwork
  - 376 – Showcase, partition, shelving, and locker manufacturing
  - 377 – Mattress manufacturing
  - 378 – Blind and shade manufacturing
  - 400 – Food and beverage stores

# DEFINING AGRICULTURE:

- **Partial contribution considerations:**
  - 20 – Extraction of natural gas and crude petroleum
  - 34 – Phosphate rock mining
  - 41 – Electric power generation – Hydroelectric
  - 42 – Electric power generation – Fossil fuel
  - 43 – Electric power generation – Nuclear
  - 44 – Electric power generation – Solar
  - 45 – Electric power generation – Wind
  - 46 – Electric power generation – Geothermal
  - 51 – Water, sewage, and other systems
  - 58 – Construction of other new nonresidential structures
  - 62 – Maintenance and repair construction of nonresidential structures
  - 173 – Medicinal and botanical manufacturing
  - 176 – Biological product (except diagnostic) manufacturing
  - 271 – All other industrial machinery manufacturing
  - 395 – Wholesale trade
  - 399 – Building material and garden equipment and supply stores
  - 402 – Retail – Gasoline stores
  - 406 – Retail – Miscellaneous store retailers
  - 411 – Truck transportation
  - 416 – Warehousing and storage
  - 455 – Environmental and other technical consulting services
  - 461 – Management of companies and enterprises
  - 463 – Facilities support services
  - 496 – Other amusement and recreation industries

# CONCLUSION:

- The methods used to conduct and report contribution of agriculture analyses appear to vary between researchers.
- The selection of sectors believed to directly influence agriculture varied greatly between researchers.
- As more public attention is being brought toward these types of analyses, it might be beneficial to work together to determine a standard for methodology for contribution of agriculture analyses.

# Thank You

# An Expanded Look into the Role of Economic Diversity on Unemployment

Jennifer Thorvaldson and Jimmy Squibb
*IMPLAN Group*

# Introduction

- By “economic diversity”, we mean diversity among industries
- We measure diversity with a normalized Shannon-Weaver index (S-W Index)
  - Measurement of entropy divided by maximum possible entropy: $\frac{\sum_i^N (\frac{E_i}{E} * \log_2 \frac{E_i}{E})}{\log_2 \frac{1}{N}}$
    - $E_i$ denotes employment in industry *i*, E denotes total employment, N is maximum number of industries
    - Range from 0 to 1, 0 being least diverse, 1 being most diverse
  - Common measurement, reported in IMPLAN software

# Motivation

- Policy motivation:
  - Classic case is regional economic policy, industry targeting, etc. (for example, does an area want to spend resources recruiting new types of businesses, or compounding specialization?)
  - People could just move, but generally have an interest in promoting a strong (smoothly growing) economy where they are.
- Research motivation:
  - The question of the effects of economic diversity has been around for a while
  - Perhaps we can motivate renewed interest and rigor with different data and methods
    - Taking up old questions with new data, new(er) statistical methods
    - In favor of asking newer questions, using newer theories, but wanted to start with the basic questions
  - Eventually, inform policy

# Short Literature Review

- Diversity often theorized to affect a region's stability and prospects for growth
- Empirical results mixed
  - Either no results, or somewhat beneficial for stability and unemployment (Malizia & Ke, 1993)
- Theoretical concerns (Wagner & Deller, 1998; Wagner, 2000)
  - Is the effect of diversity, per se, really what we are trying to measure?
    - Maybe it's actually import rates, economic integration
  - Why the norm of equally distributed employment?
  - Specialization seems to benefit some regions, e.g., Silicon Valley, but not others, e.g., Detroit
- Our goal: revisit empirical results with more (better?) data, different (better?) statistical methods

# Data

- Dependent variable: Annual changes in county-level unemployment rates from LAUS
- Independent variables: New set of IMPLAN data from 2001-2014
  - Based on consistent time-series source data from NIPA, BEA REA
  - Consistent estimation methods
  - Higher sector detail (536)
  - County level, only counties with consistent borders over time
- Good, but…
  - Synthetic: synthetic raw data and estimations to fill missing values from non-disclosures
  - LAUS data on place-of-residence basis, most employment data on place-of-work basis

# Methods

- Common panel data methods:
  - Fixed Effects (FE) – time and entity
  - Random Effects (RE) – we settled in favor of FE over this
  - Lagged Dependent Variable (LDV) – results generally consistent with FE models
- Models estimated generally look like:
  - $URC_i = \beta_n SW_{i(t-n)} + \gamma \mathbf{x}_{i(t-1)} + \mu_t + (\alpha_i \textit{ or } \alpha URC_{i(t-1)})$
    - URC: unemployment rate change from t-1 to t
    - *t* is time, *i* is county, *n* is for various lags & leads
    - **x** is vector of covariates including unstable sector shares, logs of population density, average pay, and total employment
    - μ are fixed time effects
    - α are fixed entity effects or LDV effects
  - Always estimated robust SEs clustered around *i*

# Results 1

- Sorting out causality
  - Lagged values of S-W Index generally had a negative, and significant, coefficient of about 3, but…
  - Contemporaneous values of S-W Index generally were positive, and significant
  - In an LDV model, we interacted lagged S-W, contemporaneous S-W, and the LDV, and achieved more consistent and significant results that corroborate the significantly negative coefficient, and are consistent with a causal relationship
  - Consistent with results from other research

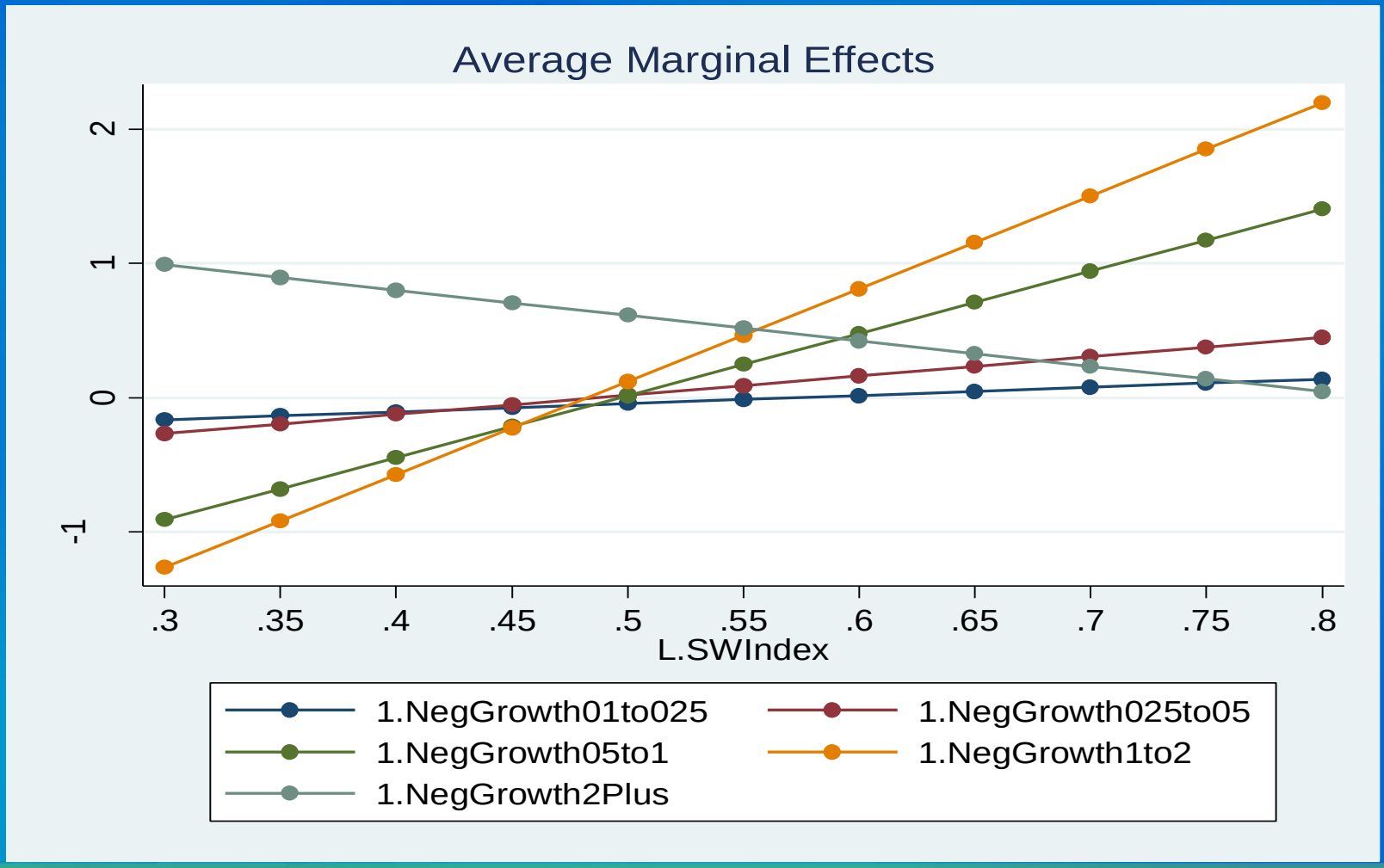
# Results 2

- Diversity and Responding to Employment Shocks
  - Interact positive and negative employment shock variables with S-W Index reveals a pattern: economic diversity has a destabilizing effect in either direction
    - in cases of negative employment changes, a larger S-W index exacerbated the increase in unemployment rate
    - in cases of positive employment changes, a larger S-W index boosted the decline in unemployment rate.
  - This was the case when we used continuous variables for employment shock as percentage of total employment or categorical variables for different levels of shocks
  - Employment shock variables behaved as expected

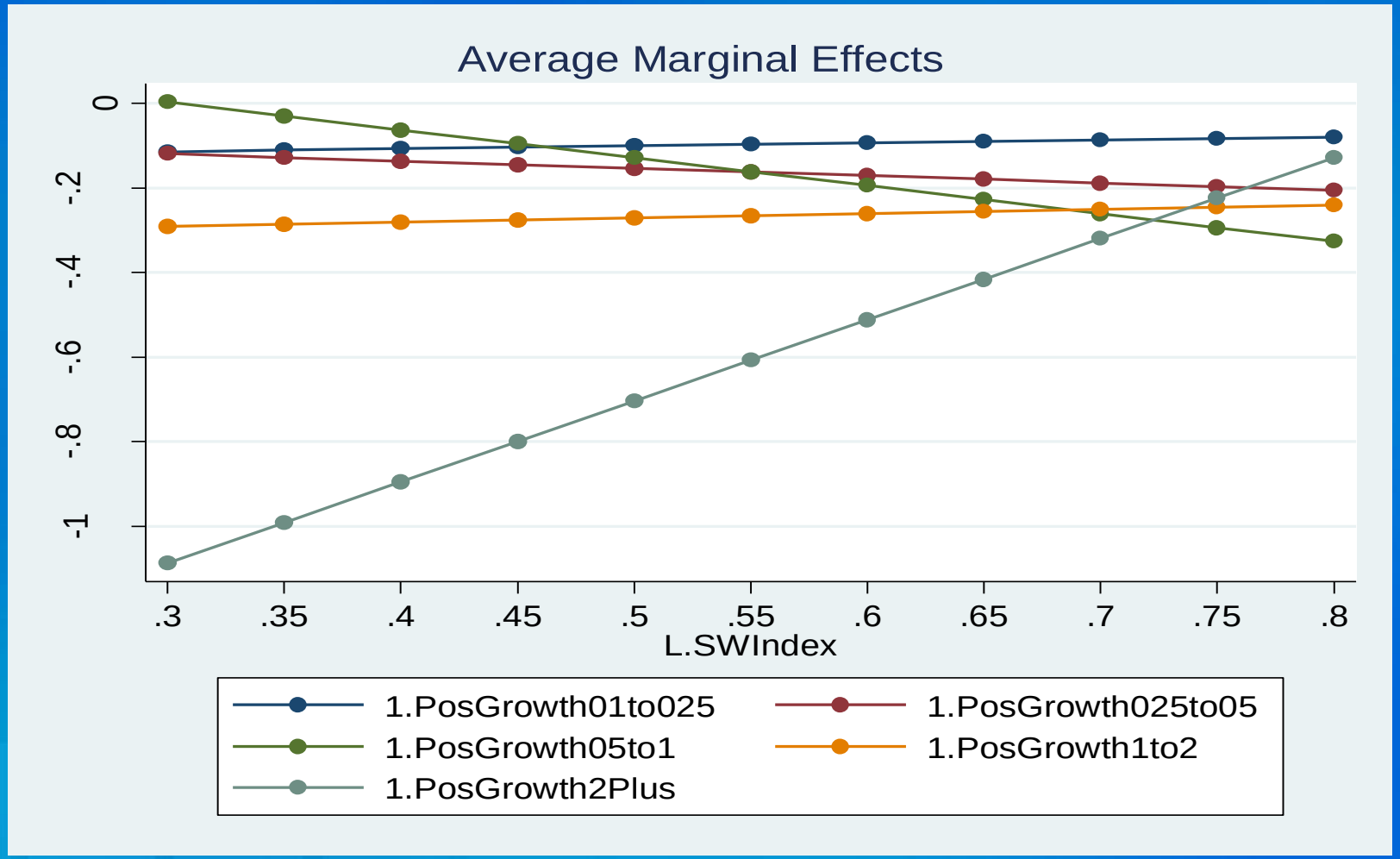
# Categorical Employment Shock Effects

| Average Marginal Effects | | | | |
|---|---|---|---|---|
| | dy/dx | Std. Error | z | P>\|z\| |
| 1.NegGrowth01to025 | 0.050693 | 0.014491 | 3.5 | 0.000 |
| 1.NegGrowth025to05 | 0.242605 | 0.017543 | 13.83 | 0.000 |
| 1.NegGrowth05to1 | 0.734524 | 0.032274 | 22.76 | 0.000 |
| 1.NegGrowth1to2 | 1.193585 | 0.128333 | 9.3 | 0.000 |
| 1.NegGrowth2Plus | 0.319163 | 0.465125 | 0.69 | 0.493 |
| 1.PosGrowth01to025 | -0.08966 | 0.012599 | -7.12 | 0.000 |
| 1.PosGrowth025to05 | -0.18031 | 0.013329 | -13.53 | 0.000 |
| 1.PosGrowth05to1 | -0.23097 | 0.017934 | -12.88 | 0.000 |
| 1.PosGrowth1to2 | -0.25481 | 0.042968 | -5.93 | 0.000 |
| 1.PosGrowth2Plus | -0.40558 | 0.168179 | -2.41 | 0.016 |

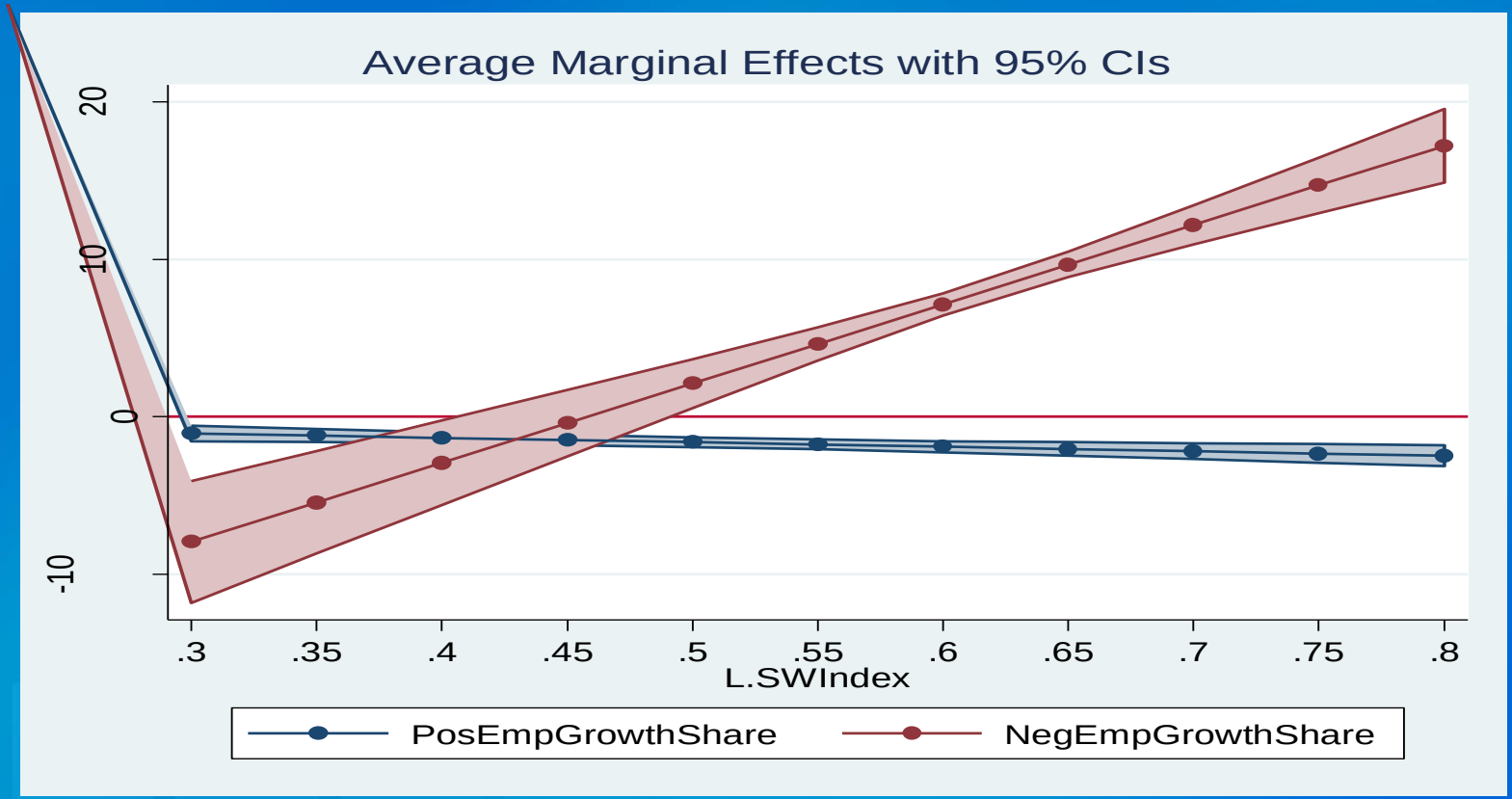
# Negative Employment Shock Effects At Different Values of S-W Index



# Positive Employment Shock Effects At Different Values of S-W Index



# Continuous Employment Shock Effects At Different Values of S-W Index

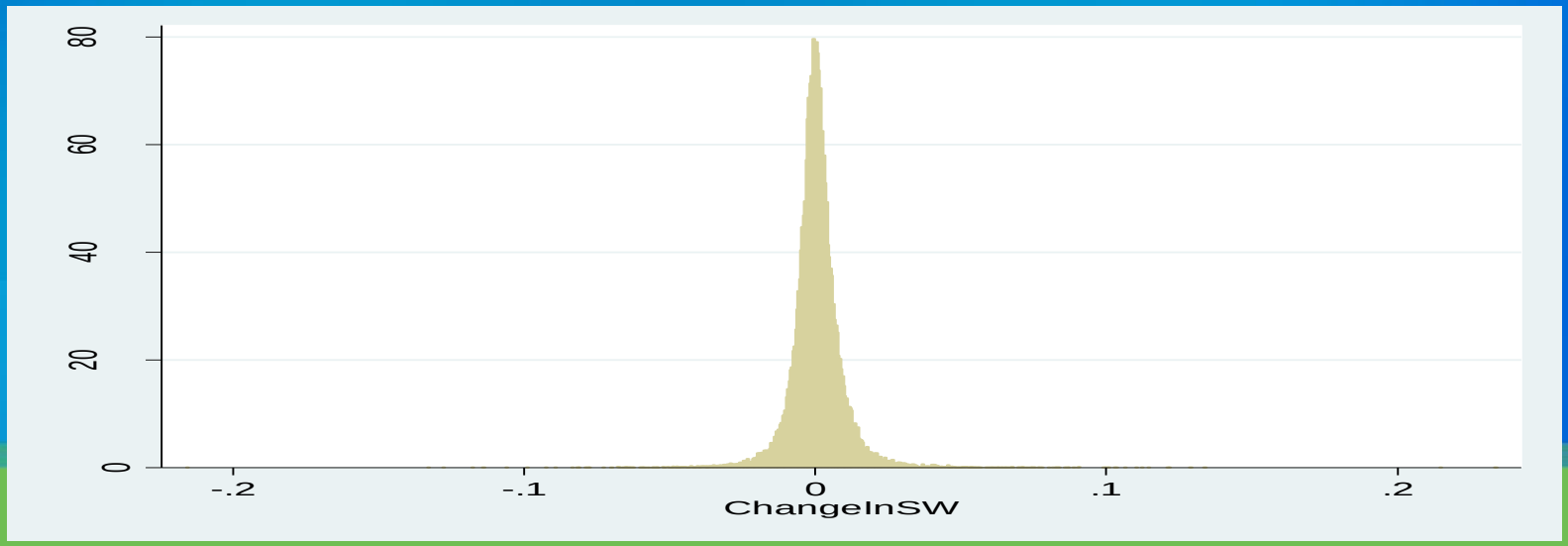


# Interpretation

- We suspect that the destabilizing effect of S-W-based diversity may be due to the higher level of interdependence between sectors in regions with higher economic diversity.
- If so, this should be thought of as a re-characterization of the "shielding" or "insulating" theory; more than just protecting an economy from negative external shocks, higher levels of diversity shield an economy from external shocks in either direction (i.e., whether positive or negative), while magnifying the effects of internal shocks due to the more self-contained nature of the economy.
- Full disclosure: we're not theoreticians and these are preliminary thoughts

# Economic Significance

- We found, consistent with much of the literature, a significant relationship between an entropy-based measurement of economic diversity and unemployment
- That said, the coefficient on S-W Index (or its marginal effect) tends to be around -3 (or closer to 0)
- Consider a coefficient of -3 and a change in S-W Index of 0.05. In a county that will move from 6% to 5% unemployment rate (URC of -1), the 0.05 increase in S-W Index will increase the magnitude of the change, a 6% to 4.85% decline (URC of -1.15)
  - To argue for policy significance might be a stretch based on this evidence, and in light of remaining uncertainties about the effects of economic diversity and opportunity costs of public resources devoted to economic development



# Conclusion

- Would like to do this over longer time periods, more business cycles
- Would like to try alternatives to S-W Index (e.g., other entropy metrics, Input-Output metrics), different areas (e.g., MSAs), different model specifications with the same data
- Comments or questions?