Assessing Vulnerability of Sectors and Regions to OCS Oil and Gas Industry Volatility

J. Matthew Fannin
Dept. Ag. Economics and Agribusiness, Louisiana State University

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Background

- Consequences of short-term demand disruptions
  - Impacts geographically where “direct effects” occur
  - Spillover effects on downstream suppliers and regions

Initial Strategy

- Structural Path Analysis
  - Weaknesses
    - Partitive Accuracy
    - Computational Capacity

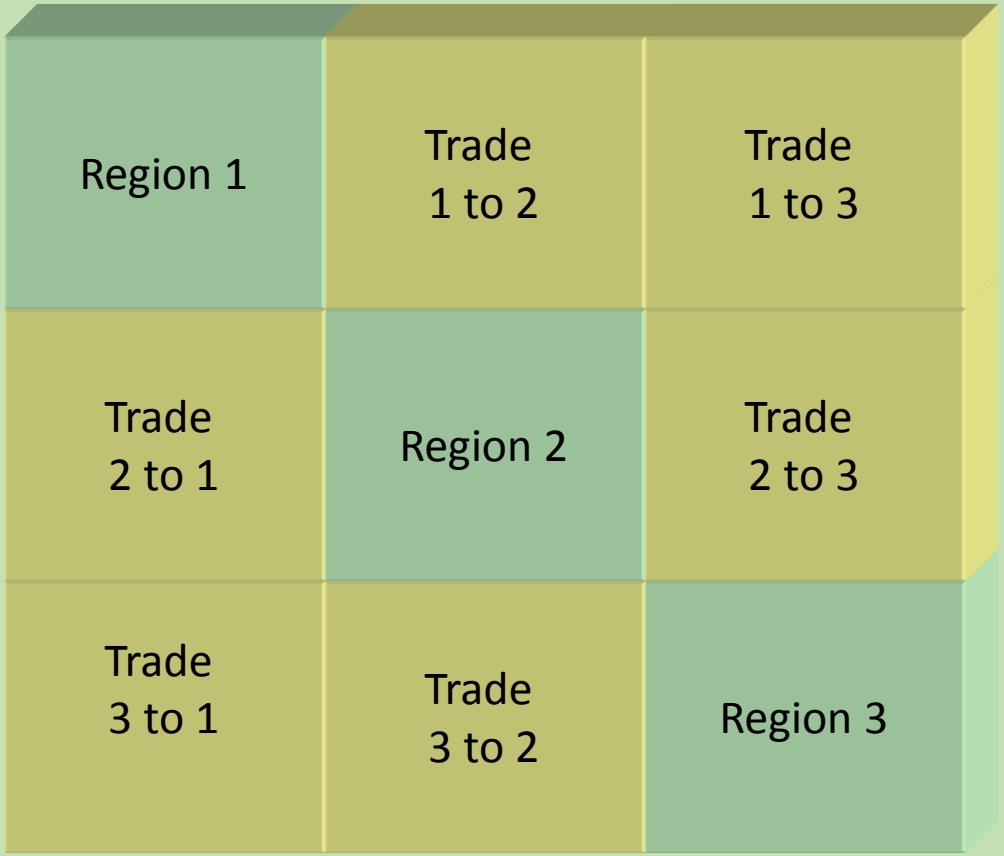
Alternative Strategy

- “Reduced form” multi-region strategy
  - Sector-based
  - Allows for multi-regional effects
  - Compares with-in region to spillover effects
  - Relative importance of regions to each other
  - Multi-regional models vs state models
  - Between region vs within region spillovers

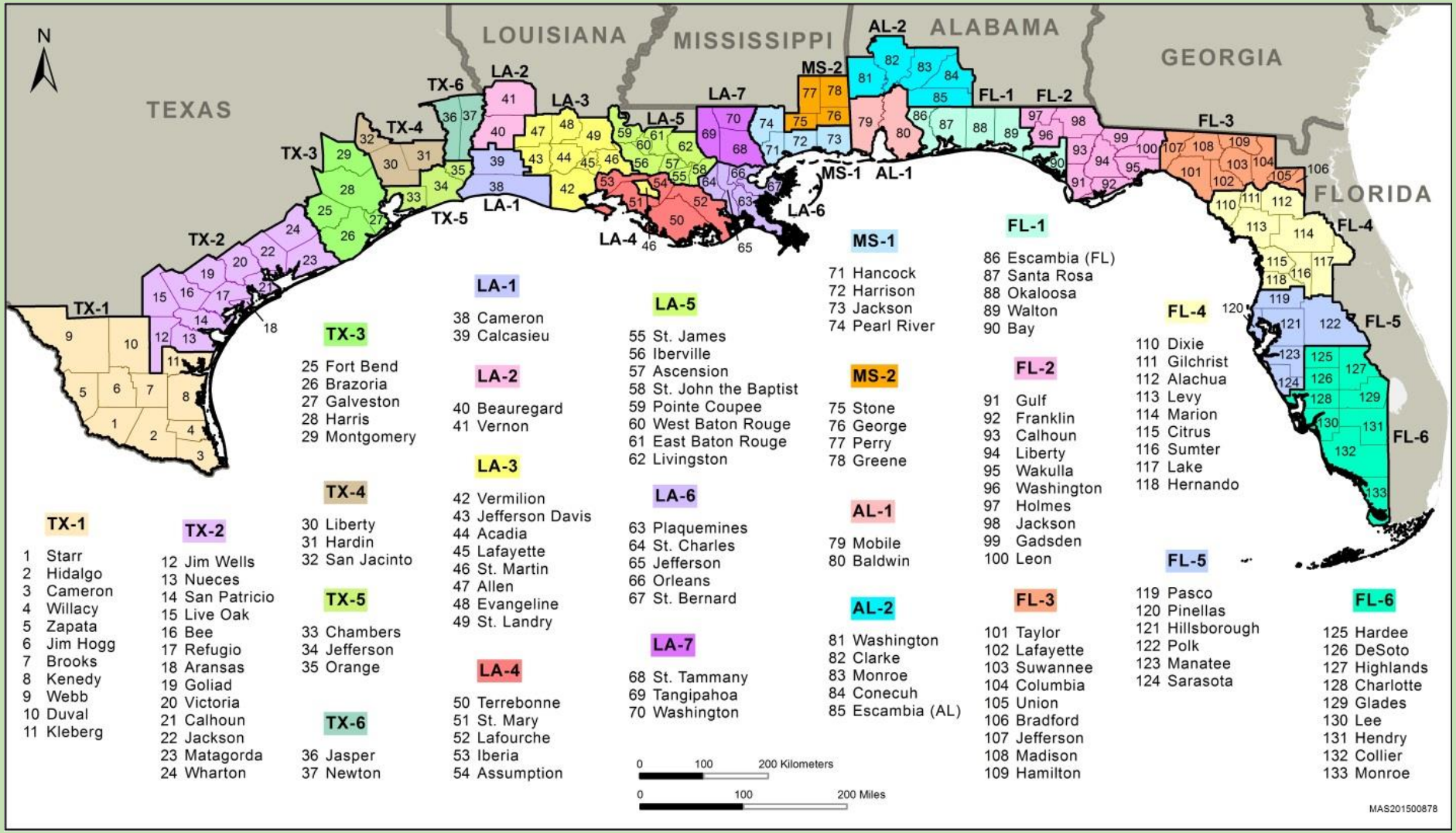
Approach

- Construct 7 BOEM multi-parish region input output models
- Connect all 7 BOEM multi-parish regions into a connected 7 region model
- Apply $1 million of Final Demand to Extraction of Oil and Gas Industry (Sector 20) in IMPLAN to each individual region separately
- Data Source: 2015 IMPLAN Data – Louisiana Parishes

Multi-Region Effects



BOEM Regions



Multi-Regional Output Effects

	LA-1	LA-2	LA-3	LA-4	LA-5	LA-6	LA-7
LA-1	**O^{11}**	O^{12}	O^{13}	O^{14}	O^{15}	O^{16}	O^{17}
LA-2	O^{21}	**O^{22}**	O^{23}	O^{24}	O^{25}	O^{26}	O^{27}
LA-3	O^{31}	O^{32}	**O^{33}**	O^{34}	O^{35}	O^{36}	O^{37}
LA-4	O^{41}	O^{42}	O^{43}	**O^{44}**	O^{45}	O^{46}	O^{47}
LA-5	O^{51}	O^{52}	O^{53}	O^{54}	**O^{55}**	O^{56}	O^{57}
LA-6	O^{61}	O^{62}	O^{63}	O^{64}	O^{65}	**O^{66}**	O^{67}
LA-7	O^{71}	O^{72}	O^{73}	O^{74}	O^{75}	O^{76}	**O^{77}**

- Diagonal elements represent within-region output effects
- Off-Diagonal Elements represent spillover output effects
- Column sums represent multi-regional output effects

Multi-Regional Output Effects

	LA-1	LA-2	LA-3	LA-4	LA-5	LA-6	LA-7
LA-1	1.8248	0.1225	0.0186	0.0030	0.0042	0.0012	0.0008
LA-2	0.0048	1.6447	0.0010	0.0001	0.0002	0.0001	0.0000
LA-3	0.0858	0.0499	2.0091	0.0803	0.1367	0.0120	0.0035
LA-4	0.0036	0.0037	0.0181	1.7080	0.0304	0.0326	0.0046
LA-5	0.0080	0.0095	0.0164	0.0139	2.0417	0.0111	0.0221
LA-6	0.0042	0.0077	0.0056	0.0348	0.0288	2.0590	0.0353
LA-7	0.0006	0.0004	0.0013	0.0000	0.0122	0.0173	1.9735
Total	**1.9320**	**1.8385**	**2.0702**	**1.8402**	**2.2542**	**2.1333**	**2.0399**
Spillover	**0.1072**	**0.1938**	**0.0611**	**0.1322**	**0.2125**	**0.0743**	**0.0664**
Spillover %	**5.55%**	**10.54%**	**2.95%**	**7.18%**	**9.43%**	**3.48%**	**3.26%**
of Total							

Pairwise Comparisons

- Strongest Linkages (Demand Region, Supply Region)
  - LA5, LA3 – 0.1367
  - LA2, LA1 – 0.1225
  - LA1, LA3 – 0.0858
  - LA4, LA3 – 0.0803

- LA3 is the greatest recipient from spillover effects in each region
  - 80% of LA 1 spillovers
  - 61% of LA 4 spillovers
  - 64% of LA 5 spillovers

Cumulative Effects

- Highest Combined Multi-Regional Effect: LA5 (2.25)
- Highest spillover in magnitude: LA5 (0.21)
- Highest spillover in percentage: LA2 (10.54%)

LA5, LA3 - Linkages

- Top 5 spillover sectors from $1 million final demand from IMPLAN Sector 20 (Extraction of Natural Gas & Crude Petroleum)
  - 38 – Support Activities for Oil and Gas Operations (Over 40% of Total Spillovers)
  - 20 – Extraction of Natural Gas & Crude Petroleum
  - 441 – Owner-Occupied Dwellings
  - 398 – Wholesale Trade
  - 440 – Real Estate

Scenario: 1 Year Growth and Decline

- Took highest four quarter moving average growth rate (25.29%) and lowest (37.93%) and applied to 2015 output estimates for IMPLAN Sector 20 in five Louisiana MSAs and applied to specific BOEM Regions for Multi-Region Impact Analysis
  - Lake Charles MSA (LA-1)
  - Lafayette MSA (LA-3)
  - Houma-Thibodaux MSA (LA-4)
  - Baton Rouge MSA (LA-5)
  - New Orleans MSA (LA-6)

Scenario: 1 Year Growth and Decline

($ Millions)	Lake Charles	Lafayette	Houma-Thibodaux	Baton Rouge	New Orleans
Output Estimate (2015)*	134.45	5,439.79	1,921.57	296.92	4,295.53
High Scenario (25.29%)	34.00	1,375.72	485.97	75.09	1,086.34
Low Scenario (-37.93%)	-36.41	-1,473.20	-520.40	-80.41	-1,163.31

*Output Estimate calculated from US Bureau of Economic Analysis MSA GDP estimates divided by proportion of output that was value added in 2015 IMPLAN Sector 20

Output Effects – High Scenario

($ Millions)	LA-1	LA-3	LA-4	LA-5	LA-6	Totals	Spillover /Local Ratio
LA-1	**62.05**	25.62	1.45	0.32	1.29	90.73	1.46
LA-2	0.16	1.37	0.07	0.02	0.06	1.68	
LA-3	2.92	**2,763.97**	39.02	10.27	13.00	2,829.18	1.02
LA-4	0.12	24.94	**830.03**	2.28	35.46	892.83	1.08
LA-5	0.27	22.56	6.76	**153.31**	12.06	194.97	1.27
LA-6	0.14	7.75	16.93	2.16	**2,236.79**	2,263.78	1.01
LA-7	0.02	1.74	0.00	0.91	18.81	21.49	
Total Effect	**65.70**	**2,847.96**	**894.26**	**169.27**	**2,317.48**	**6,294.66**	
Direct Effect	**34.00**	**1,375.72**	**485.97**	**75.09**	**1,086.34**	**3,057.12**	

Output Effects – Low Scenario

($ Millions)	LA-1	LA-3	LA-4	LA-5	LA-6	Totals	Spillover/ Local Ratio
LA-1	-93.06	-38.43	-2.18	-0.48	-1.94	-136.08	1.46
LA-2	-0.25	-2.06	-0.10	-0.02	-0.09	-2.52	
LA-3	-4.38	-4,145.40	-58.53	-15.40	-19.50	-4,243.20	1.02
LA-4	-0.19	-37.41	-1,244.88	-3.42	-53.18	-1,339.07	1.08
LA-5	-0.41	-33.83	-10.14	-229.94	-18.09	-292.41	1.27
LA-6	-0.22	-11.62	-25.39	-3.24	-3,354.75	-3,395.23	1.01
LA-7	-0.03	-2.62	0.00	-1.37	-28.22	-32.24	
Total Effect	-98.53	-4,271.37	-1,341.21	-253.87	-3,475.76	-9,440.75	
Direct Effect	-51.00	-2,063.31	-728.85	-112.62	-1,629.29	-4,585.08	

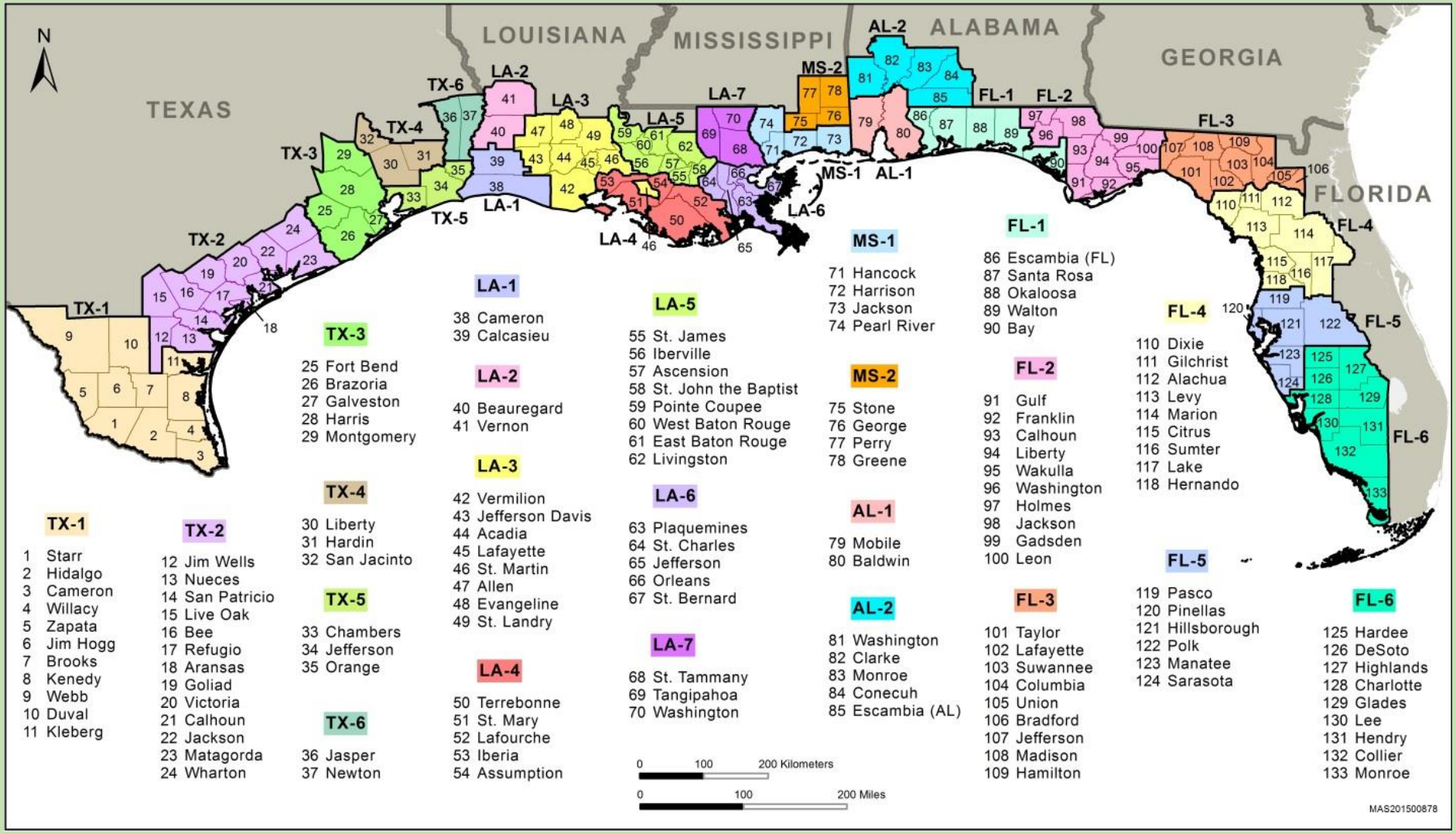
Summary of Scenarios

- LA-3 greatest impact (low and high scenario); LA-6 second highest
- LA-1 and LA-5 had greatest spillover ratio

Multi-Region vs Within Region Spillovers

- Compare 7 Multi-Parish BOEM Regions Spillovers to Multi-Parish Spillovers within LA-3 (IMPLAN Sector 20)
- Evaluate
  - Multiplier Size
  - Magnitude of Spillovers

BOEM Regions



Multi-Region vs Within Region Spillover Results

- Overall Results
  - Average BOEM Region Multiplier – 2.02
  - Average LA3 Parish Multiplier – 1.91
  - Average BOEM Region Spillover – 6.05%
  - Average LA3 Parish Spillover – 13.23%

Multi-Parish Output Effects

	Acadia	Allen	Evangeline	Jeff Davis	Lafayette	St. Landry	St. Martin	Vermilion
Acadia	**1.7791**	0.0079	0.0492	0.0945	0.0066	0.0235	0.0024	0.0023
Allen	0.0010	**1.4068**	0.0060	0.0028	0.0005	0.0037	0.0005	0.0007
Evangeline	0.0058	0.0018	**1.5377**	0.0009	0.0030	0.0117	0.0009	0.0019
Jeff Davis	0.0083	0.0074	0.0013	**1.6247**	0.0007	0.0009	0.0003	0.0005
Lafayette	0.2837	0.0158	0.2495	0.2289	**1.9640**	0.6064	0.1840	0.1816
St. Landry	0.0038	0.0145	0.0655	0.0021	0.0077	**1.5811**	0.0021	0.0017
St. Martin	0.0011	0.0003	0.0013	0.0000	0.0014	0.0027	**1.6164**	0.0007
Vermilion	0.0025	0.0005	0.0040	0.0000	0.0032	0.0028	0.0011	**1.6300**
Total Effect	**2.0854**	**1.4550**	**1.9146**	**1.9539**	**1.9870**	**2.2328**	**1.8077**	**1.8194**
Spillover	**0.3063**	**0.0482**	**0.3769**	**0.3291**	**0.0231**	**0.6517**	**0.1913**	**0.1894**
Spillover % of	**14.69%**	**3.31%**	**19.69%**	**16.85%**	**1.16%**	**29.19%**	**10.58%**	**10.41%**
Total								

Pairwise Comparisons

- Strongest Linkages (Demand Parish, Supply Parish)
  - St. Landry, Lafayette– 0.6064
  - Acadia, Lafayette– 0.2837
  - Evangeline, Lafayette – 0.2495
  - Jeff Davis, Lafayette– 0.2289
- Strongest Linkage excluding Lafayette
  - Jeff Davis, Acadia – 0.0945

- Lafayette is the greatest recipient parish from spillover effects in each region
  - >90% of spillovers for Acadia, St. Landry, St. Martin, and Vermilion

Aggregation Bias Implications

- Multi-region analysis has implications aggregation bias (which can be positive or negative)
  - Comparison of Output Multipliers (IMPLAN Sector 20)
    - State of Louisiana – 2.18
    - LA-3 Multi-Region – 2.07
    - LA-3 Single Region – 2.01
    - Lafayette Parish Multi-Parish - 1.99
    - Lafayette Parish Single Parish – 1.96
    - St. Landry Parish Multi-Parish – 2.23
    - St. Landry Parish Single Parish – 1.58

Aggregation Bias Implications

- Aggregation Bias will vary by sector
- Geographic size of region has implications for
  - Aggregating industries with same sectors with sizably different
    - Production functions
    - Local purchasing patterns

Modeling Limitations

- IMPLAN multi-region models have several limitations
  - Limitations on IMPLAN trade data quality
  - Limitations of IMPLAN production functions

Thank You

- Matt Fannin, Ph.D.
  William H. Alexander Professor
  Dept. of Ag. Economics and Agribusiness
  Louisiana State University Agricultural Center
  mfannin@agcenter.lsu.edu
  (225) 578-0346

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