External economies: How innovative small manufacturers compete

Susan Helper

Case Western Reserve University

Introduction

- Supply Chains
  - Key aspects of global values are now shared across firms due to reduced vertical integration
  - But corporate strategy and public institutions have not adjusted to this new reality in the US
- Shared supply chains can
  - Promote learning
  - Be plagued by “free rider” problems that lead to underinvestment
- Some firms are able to combine high productivity, high profits, high wages
  - In part, by taking advantage of their urban environment, to engage in “high-road” production

susan.helper@case.edu

Outline

- Previous literature
- Our contribution: direct evidence on interfirm networking, internal firm strategies
- Field work and research questions
- Data: Survey of component manufacturers
- Results
  - Urbanization is correlated with higher productivity
  - Single-plant firms receive a greater productivity boost from external economies for idea-dependent production
    - Use of interfirm networking (tho neither use nor effectiveness of networking is correlated with urbanization)
    - Product design is even more productive for single plants in urban areas
    - Skilled trades are
- Conclusion

Research is on-going

- Survey for US Department of Labor, Jan 2011

susan.helper@case.edu

External economies

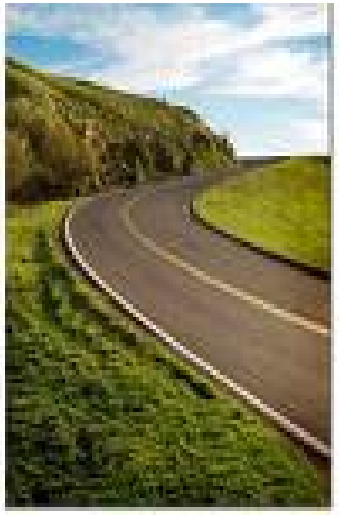
- Definition:
  - benefits of locating near factors which are external to a firm, such as supplies of specialized inputs
- Renewed importance as large firms outsource
  - Auto parts employment/assembly employment
    - 1990: **1.2/1**
    - 2008: **3.5/1**
- What is the relationship among:
  - external economies,
  - internal operations, and
  - firm performance?

“High-road” mfg can be win/win/win

- In “high-road” production, well-paid workers make cost-effective, sustainable products for consumers, and profits for owners
  - *How?*
    - High road techniques harness everyone’s knowledge—not just top executives’ -- to achieve innovation, quality, and variety
    - Example: “agile production”
      - Firms design, set up, produce a variety of products quickly

Barriers to adopting high-road production

- But, many firms don't use, due to market failures
  - Spillovers to workers and suppliers
    - Firms don't capture all the gains from high-road production, so they invest too little in it
  - Complementarities
    - Agile production requires near-simultaneous investments in information technology, training, process redesign, and marketing
    - No one of these investments would pay off without the other



A tale of two plants

- Stoneridge Pollak: Boston
- Stoneridge Histat: Lexington, OH
- Same SIC, same products, same process
- Yet: Boston has
  - 1/3 higher productivity
  - 1/3 higher wages
  - 10% higher profits

Plan of Analysis

External Econ ← → Strategy ←→ Performance

• Clustering	Design	Productivity
• Urbanization	SkilledTrade	Profits
• Networking	1-plant	Wages

Lots of literature

- Agglomeration economies
  - Studies almost universally find higher productivity, wages, and rents in urban areas
    - Rosenthal and Strange, 2004

Combining 2 literatures

- Regional economics
  - Rosenthal and Strange; Moretti, etc
  - National data
  - Attention to systemic effects
    - Direction of causality
  - Weak on mechanism
    - How does agglomeration affects productivity?
- Interfirm networking
  - Saxenian, Jacobs, Brusco, etc.
  - Detailed attention to mechanisms
  - Small samples; usually look only at successes

Theories of agglomeration economies

- Densely populated areas facilitate knowledge transfer and knowledge spillover
  - Proximity to idea generation increases likelihood of learning (Kuznets, 1962)
    - Proximity facilitates social networking (Jacobs, 1969; Saxenian, 1994; Gordon and McCann, 2000)
    - Workers acquire knowledge faster in dense urban environments, which facilitate more frequent interaction with skilled peers (Glaeser, 1999)
- Other theories of why cities are more productive:
  - Firms seek access to a natural resource; skilled workers prefer urban amenities; labor pooling; etc.

Evidence on knowledge transfer

- Patents
  - Patent citations are geographically concentrated (Jaffe, 1993)
  - Larger, denser cities have more patenting (Feldman and Audretsch, 1999)
- Human capital
  - Proximity to other educated workers is correlated with higher wages, productivity (e.g., Moretti, 2004)
- These literatures do not specify the mechanism thru which knowledge sharing occurs

Contribution: best of both lits?

- Direct survey evidence on
  - Extent and value of social networking by firms
  - Firm strategy and structure (beyond SIC)
    - Product design; Single-plant vs. multiplant
- National data
  - Allows us to examine agglomeration economies between and *within* cities (MSA's)
- We look at a "low-tech" industry
  - Component manufacturing

Weakness: Causation

- We examine correlation only among:
  - networking, urbanization, productivity
- Present qualitative evidence
  - Interviews and plant tours with urban and rural workers and managers in component manufacturing

The U.S. Component Manufacturing Industry

- Manufactures metal, plaster, and rubber components for final consumer products.
- Approximately one quarter are solely suppliers to auto industry.
- Many small firms, often squeezed between larger suppliers of raw materials and larger producers of consumer products.
- More tied to region than its customers, but increasingly dispersing out of cities.
- Facing a sudden surge in international competition.
- Represents 10.6% of U.S. manufacturing jobs, up from 8.8% in 1980.
- Many firms are small; 28% of suppliers to auto industry have <500 employees

Research Questions

- Agglomeration economies
- Interfirm networking
- Idea-dependent production
- External economies and firm structure

Agglomeration Economies

- Are firms with more neighbors more productive?

Interfirm networking

- Does dense population facilitate knowledge transfer through interfirm networking?
  - Localization (Being near similar firms)
    - John and the deep-draw stamping
    - Learning about sensors
  - Urbanization (Being near different firms)
    - Wirenet's maintenance study group
- Do firms with more neighbors have:
  - Greater extent of interfirm networking
  - More valuable ideas from interfirm networking?

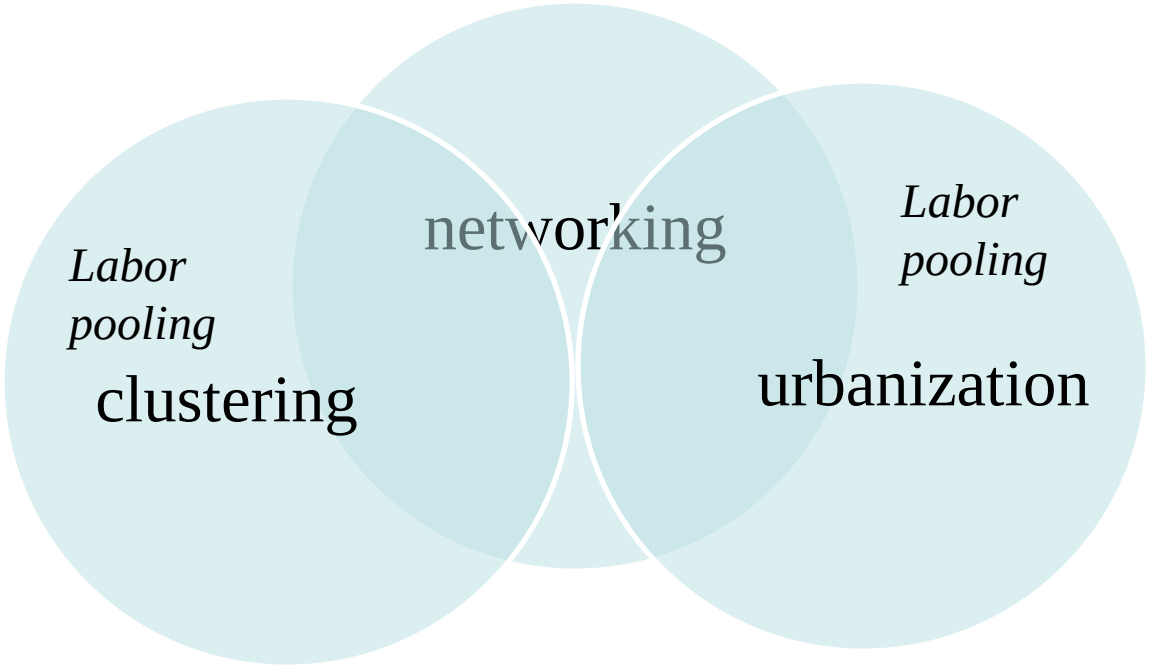
Idea-dependent production

- If information transfer is easier in urban areas, are cities particularly productive for idea-dependent production practices?
  - Product design
  - Note: this productivity could arise both due to interfirm networking, and to greater availability of design engineers
- If cities are esp. productive for product design, then are firms doing design more likely to locate there?
  - Firm location is not random!
- Is there a particular resource in a few cities that makes firms in those cities more productive?

Two Types of Agglomeration

- Clustering (Same-industry concentration):
  - Number of establishments sharing plant's 2-digit SIC (industrial classification) within 10-mile radius of the plant.
  - Likely to pick up many other aspects of clustering as well.
- Urbanization (location in urban area):
  - Number of non-manufacturing establishments within 10-mile radius.
- Both measures are highly correlated with number of employees in 10-mile radius

Information-based External Economies



External economies and firm structure

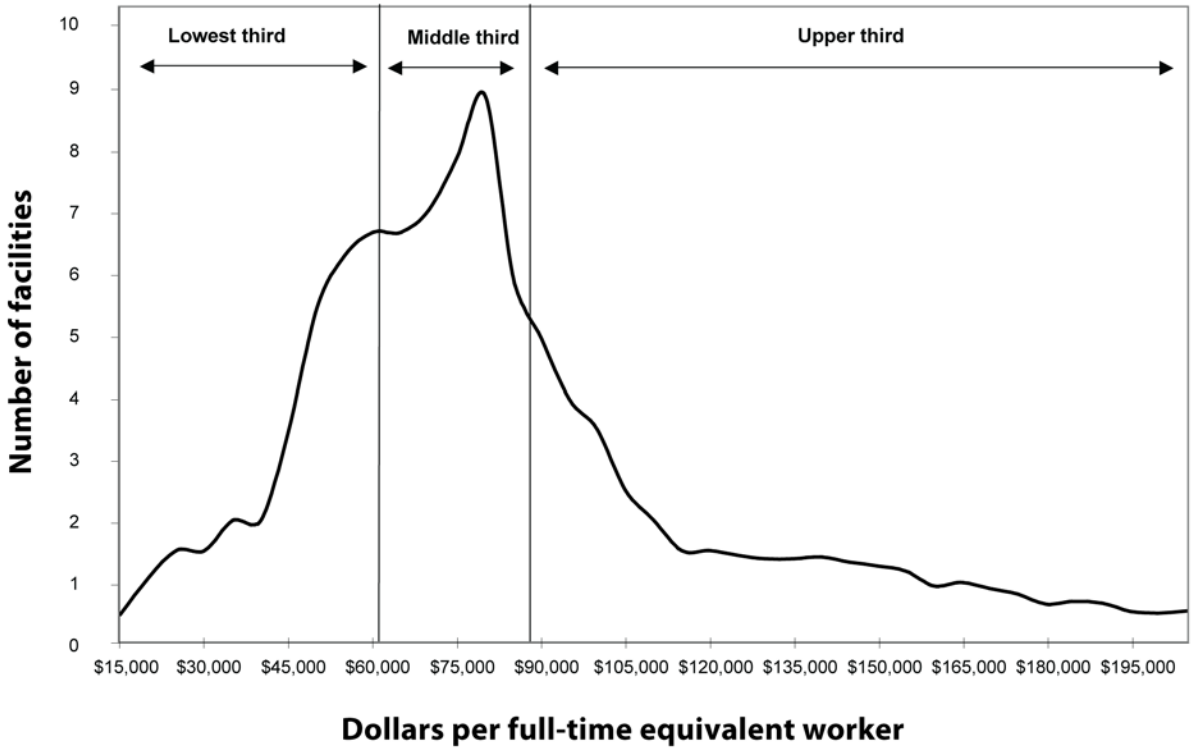
- Do single-plant firms depend more on external economies for knowledge transfer than do firms with a more elaborate internal structure?
  - Networking
    - Adopting IT
    - Learning about sensors
  - Finding engineers to design products and processes
    - Moonlighters
    - Transfers

Data

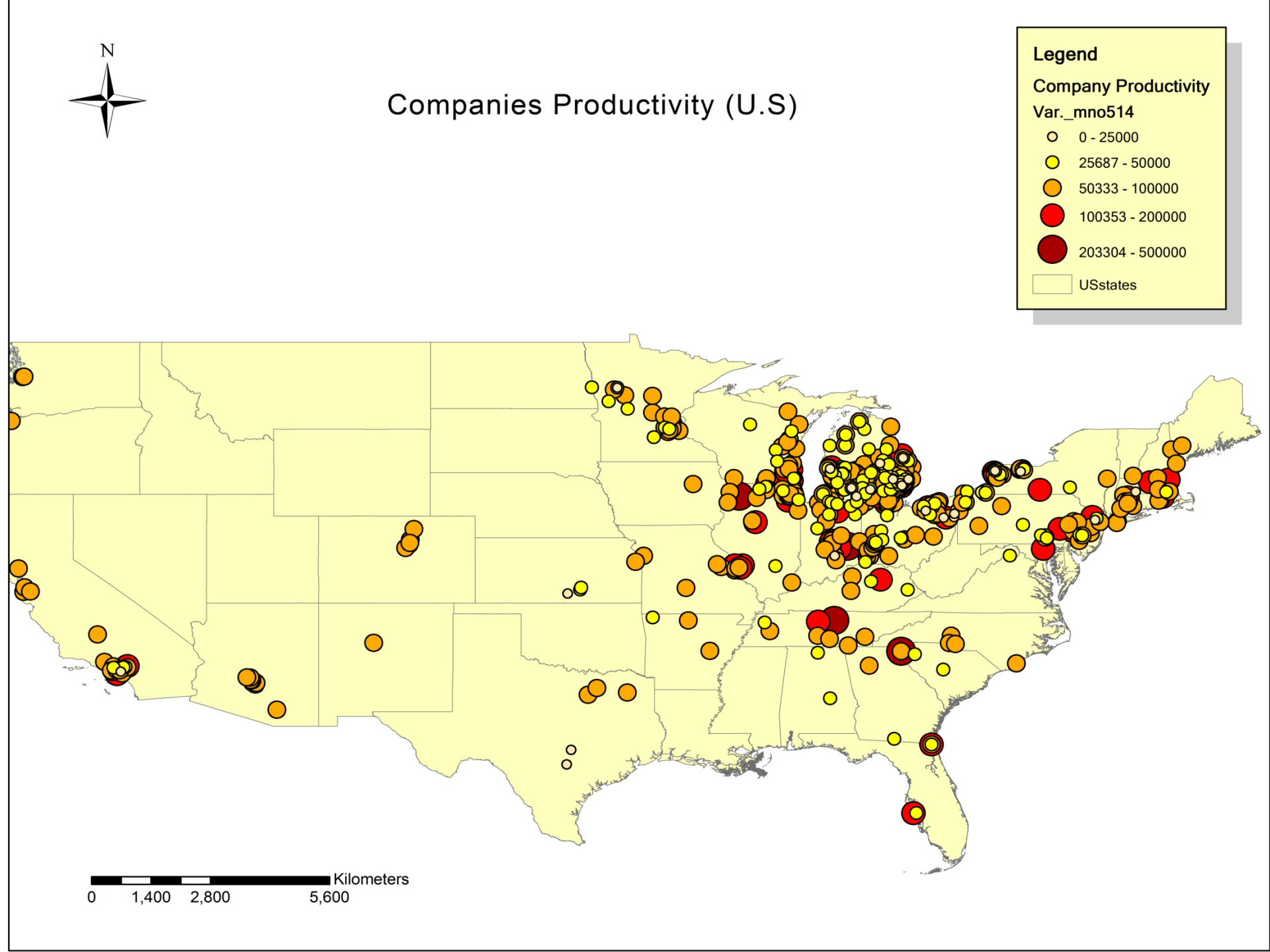
- *Benchmarking Questionnaire*
  - 615 plants responded to survey conducted by Michigan Manufacturing Technology Center in spring 2003
    - Highly detailed survey asks about revenues, costs, operations
    - Respondents are presidents, CFOs, plant managers
    - Low response rate (~10%), but no bias in size, productivity
    - Michigan is overrepresented; South is underrepresented
- *Relationship Questionnaire*
  - Survey sent to plants who answered benchmarking questionnaire
  - Asked about sources of ideas; relationships with customers, suppliers, rivals
  - 65% response rate

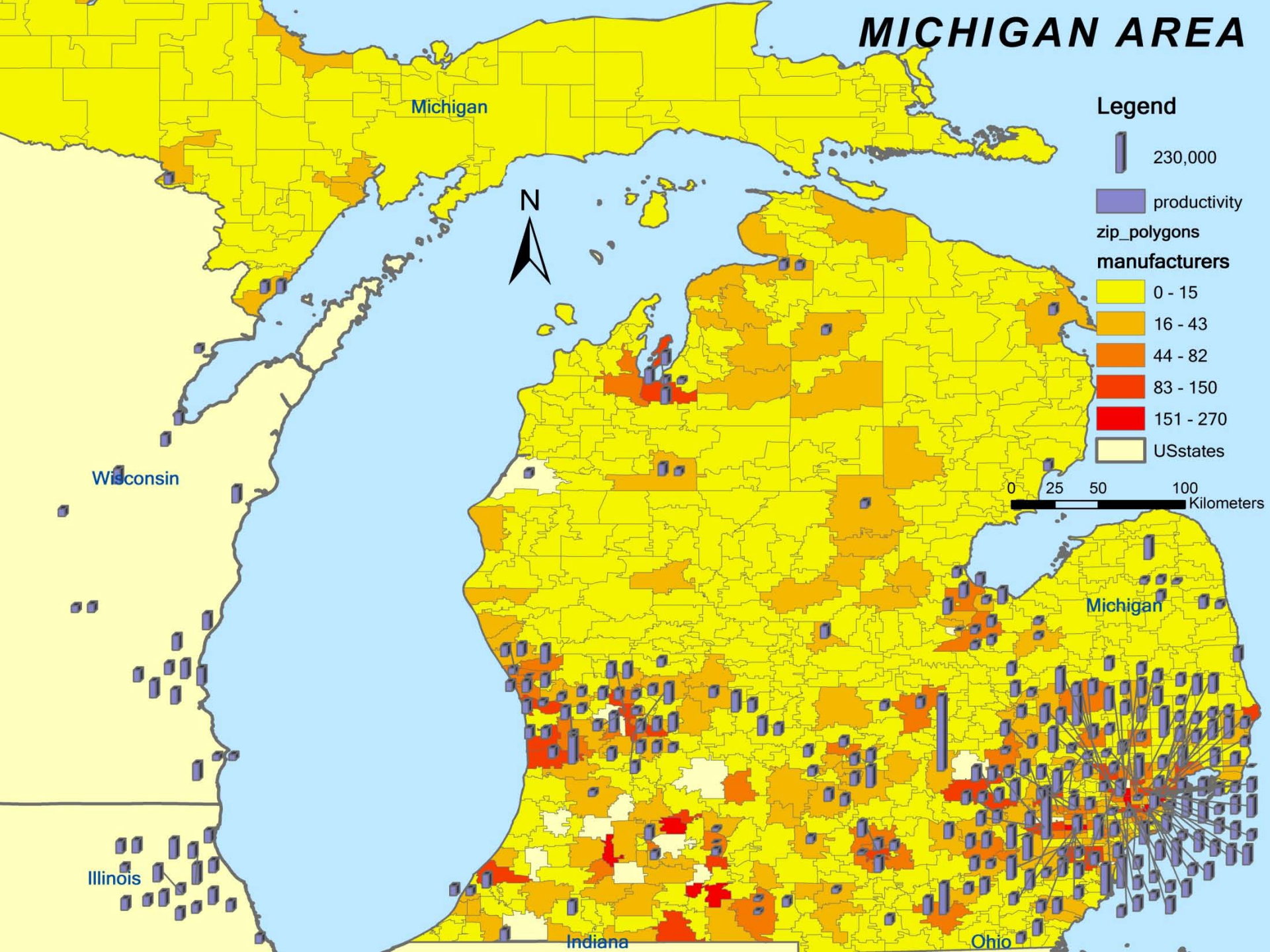
- Survey data linked to US Census Zip Code Business Patterns for 2000.

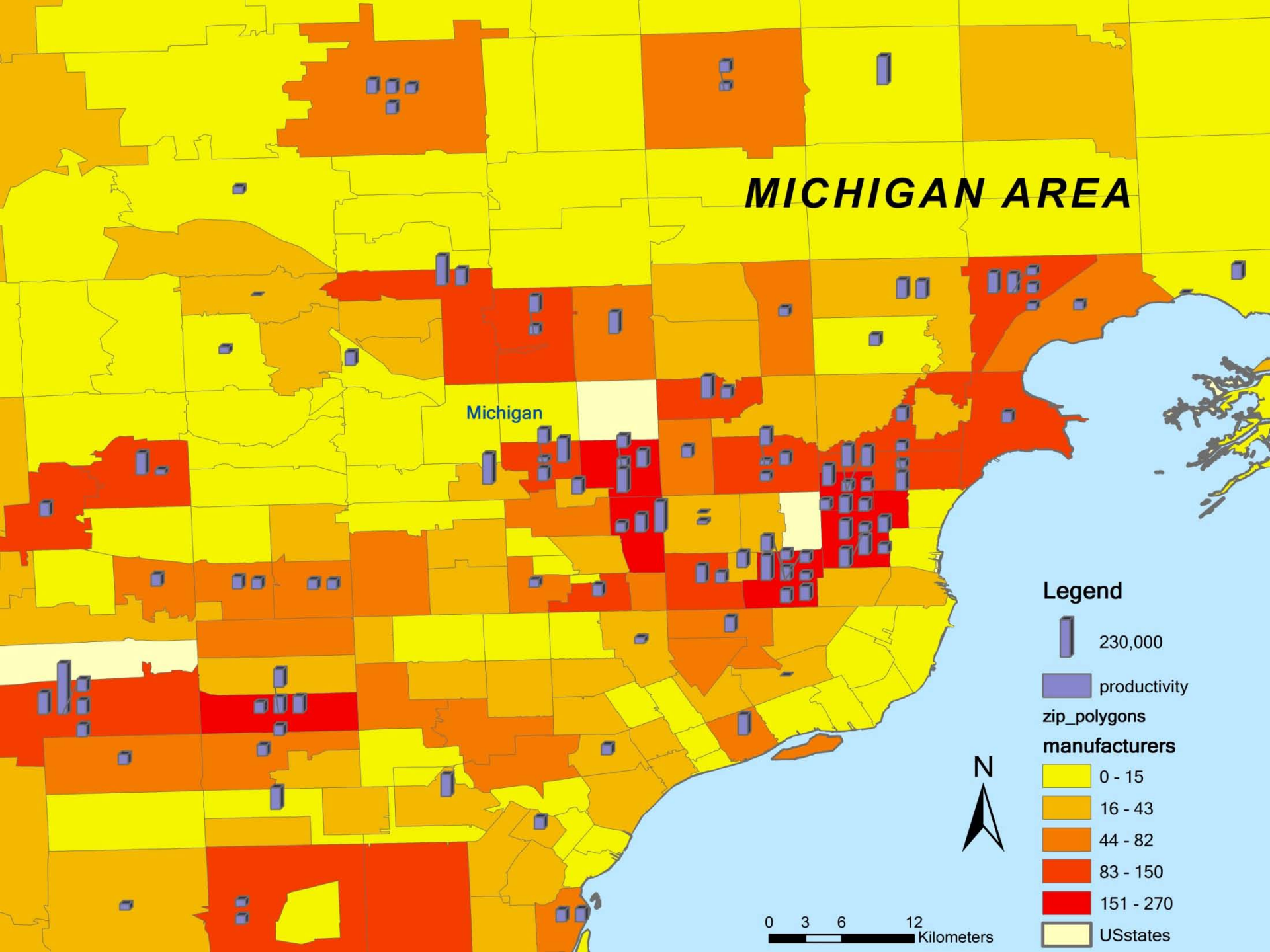
Productivity: Value added per full-time equivalent worker, 2006*

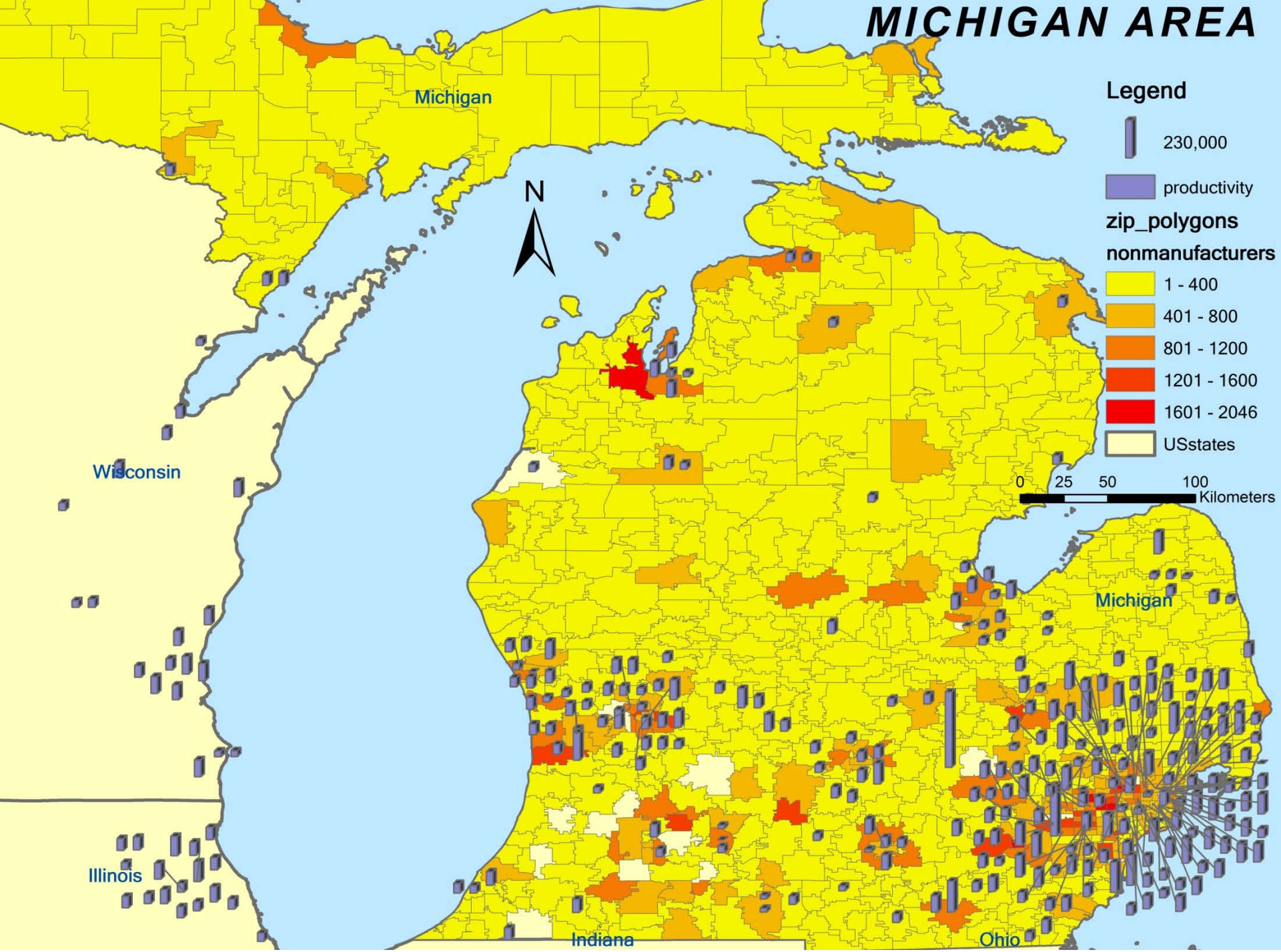


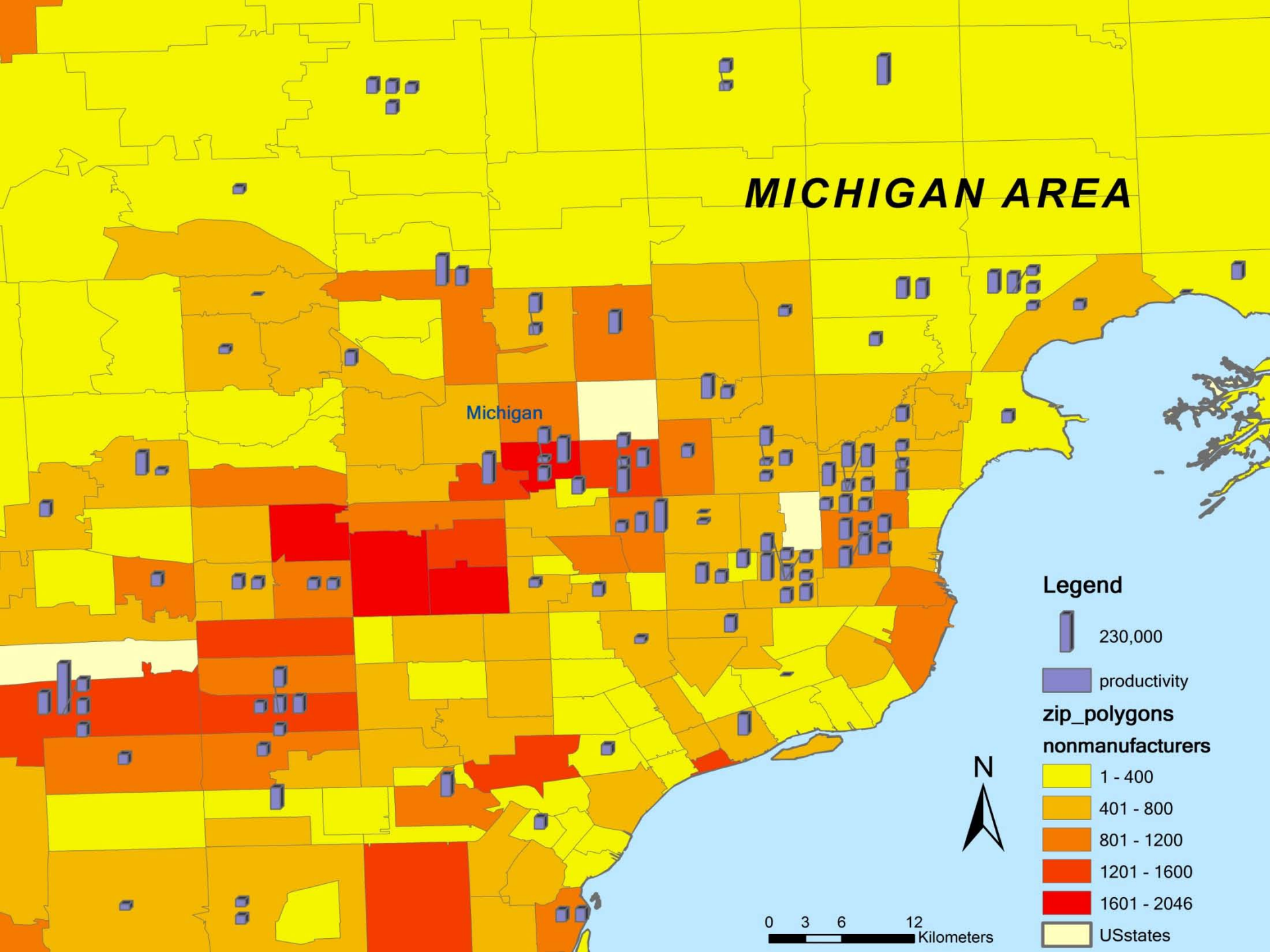
* Based on 2006 data gathered from 72 facilities in NAICS code 332116 (metal stamping).
SOURCE: Performance Benchmarking Service, Michigan Manufacturing Technology Center.


N
Companies Productivity (U.S)
Legend
Company Productivity
Var._mno514
0 - 25000
25687 - 50000
50333 - 100000
100353 - 200000
203304 - 500000
USstates
Kilometers
0
1,400
2,800
5,600


MICHIGAN AREA
Michigan
N
Legend
230,000
productivity
zip_polygons
manufacturers
0 - 15
16 - 43
44 - 82
83 - 150
151 - 270
USstates
0 25 50 100
Kilometers
Wisconsin
Michigan
Illinois
Indiana
Ohio


MICHIGAN AREA
Michigan
Legend
230,000
productivity
zip_polygons
manufacturers
0 - 15
16 - 43
44 - 82
83 - 150
151 - 270
USstates
N
0 3 6 12
Kilometers


MICHIGAN AREA
Michigan
N
Legend
230,000
productivity
zip_polygons
nonmanufacturers
1 - 400
401 - 800
801 - 1200
1201 - 1600
1601 - 2046
USstates
0 25 50 100
Kilometers
Wisconsin
Michigan
Illinois
Indiana
Ohio


MICHIGAN AREA
Michigan
Legend
230,000
productivity
zip_polygons
nonmanufacturers
1 - 400
401 - 800
801 - 1200
1201 - 1600
1601 - 2046
USstates
N
0 3 6 12
Kilometers

Results

- Urbanization is strongly related to productivity in this sample. Urbanization advantage holds for each industry
  - Productivity advantage of urban firms is robust to including
    - log, log-log, top coded, quadratic specification
    - controls for SIC (1-4 digit), technology, capital
- Move from 25th to 75th percentile on urbanization correlated with 10% increase in value added per worker.
- Once we control for urbanization,
  - Clustering is not correlated with productivity
    - Clustering is significant if we use crude Census measure of urbanization
  - Diversity is not correlated with productivity
  - Supply-weighted, customer-weighted employment is not significant

Inter-Firm Networking: Definitions

- Two constructs:
  - 1) extent of inter-firm networking
  - 2) perceived value of inter-firm networking.
- Each construct based on factor analysis of multiple questions.

Extent of Communications

- No. of shops communicate re: business issues?
  - In last 3 years, exclude key customers
    - Our managers and/or engineers socialize outside of work with their employees.
    - Our engineers and/or skilled workers are comfortable calling them to discuss a manufacturing issue.
    - We have helped them hook up with other shops to address a problem or respond to an opportunity.
    - We share solutions to general business issues.
    - We have toured their facility/they have toured ours.
    - We have cooperated closely with them to solve our difficult technical and/or design problems

Perceived Value of Communication

- [1 = Strongly disagree, 7 = strongly agree]
- When we have a tough problem to solve, paid consultants are more helpful than our contacts at other shops.
- We have rarely gotten any ideas that we would not have thought of ourselves from people other than our important customers.
- We have learned a lot from shops other than our important customers about reducing setup time. reducing inventory.

Networking: Results

- In overall sample, no correlation between either networking variable and productivity.
- However, single-plant firms have significant relationship between perceived value of networks and productivity.
  - For single plant firms, move from 25th to 75th percentile on value of social networks increases productivity by >10%.
- Multi-plant firms show *negative* relationship between networking and productivity.
  - Pay for corporate structure—should get learning benefits

Networking Results II

- Networking constructs appear completely uncorrelated with localization or urbanization.
- This is true for both single-plant firms and the entire sample.

Product design: results

- Firms that design a higher percentage of their own products have higher productivity
  - Design is even more productive in urban areas
  - These results are driven by single-plant firms
    - Increase from 0-35% →doubles their urban advantage
  - The results hold even controlling for CBSA!
    - Suggests that design productivity is not driven by some resource (eg a particular university) that is present in only a few cities

Product design: results (2)

- Despite higher urban productivity, high design firms aren't more likely to locate in urban areas.
- Possible explanation: productivity advantage captured by employees in urban design firm, not by those who decide firm strategy and location

Product design (3)

- Plants even more productive when combine product design and skilled workers

Skilled + Design for 1-plant firms

Value-added/worker	
Capital/wkr	***0.2093
Workers	0.0341
Urban	0.0373
Design%	***-4.4608
Urban*design	***0.5323
Skilled%	-0.993
Urban*skilled	0.0794
Design*skill	***13.829
Urban*design*skill	**-1.63379
_cons	8.483675
Sic2 controls	

1-plant firms gain no urban productivity advantage unless they have product design and skilled workers

Variables in logs; n =113

Summary

- Agglomeration economies are an important phenomenon even in this traditional industry.
  - Urbanization seems more important for generating productivity than does clustering
- Agglomeration economies are captured by both workers and firms
- We can explain about 20% of the productivity advantage for urban single-plant firms
  - It is due to the greater productivity of product design in urban areas
  - Other parts of the urban advantage (for both single- and multi-plant firms) may well be due to higher human capital within urban areas
  - Small urban firms offset increased costs of urban areas with more idea-dependent production (design)
- Inter-firm networks are an important source of ideas for single-plant firms
  - But, agglomeration advantage appears unrelated to use of inter-firm informational networks.
  - Small firms save on cost of corporate structure with interfirm networking; offsets their lower productivity

Policy implications

- External economies are productive
  - Theory suggests markets underprovide them
  - Strategies used by high-EE firms involve other externalities
    - Wage externality
      - Firms in urban areas pay higher wages; this is a benefit to urban location not taken into account by firm decision makers
    - Employment externality
      - » Single-plant firms are more productive if they network with other firms
      - » Single-plant firms are more rooted in a region → local subsidies less likely to 'leak'
    - Innovation externality
      - High productivity, high design firms in less direct competition with low-wage imports
      - Difficulty in patenting→design firms don't capture all rents

Policies

- Subsidies
  - If there are ‘market failures’, $1 of subsidy can return more than $1 of benefits
- Overcoming information problems
  - Complementarities within firms may strain management capabilities
  - Complementarities between firms have spillover effects

Backup slides

Policy implications

- Subsidizing urban manufacturing may enhance social welfare.
- Some subsidies will be more effective than others.

But subsidies to manufacturing may *reduce* welfare…

- Promote capabilities that the market does not want
  - Little evidence that this occurs
- Subsidizing firms to do things they would pay for themselves
  - This probably occurs; hard to measure
- Undercutting ‘good’ firms by subsidizing ‘bad’ firms
  - Example: giving firms skills they would have to pay high wages to get
  - Some evidence for this:
    - PA MEP clients have lower credit scores than do non-clients

Industrial commons

- Relations between customers and suppliers
- Relationships within and between suppliers
- Relationship with government

susan.helper@case.edu

Investments needed for world-class supply chain

Nature of investment, and possible facilitating program

	Within One Firm	**Across Many Firms**
Codified	Suggestion system (MEP)	Just-in-time (Councils)
Not codified	Product innovation (R&D tax credit)	Technology roadmapping (Councils)

Re-building industrial commons: theory

A Comparison of Economic Development Models		
Dimension	**Traditional Economic Development**	**Cluster-based Economic Development**
Economic Doctrine	Neoclassical economics	Innovation and Institutionalist economics
Key Actors	Individual firms	Groups of firms
Key Tools	Policies for the general business environment – tax and regulatory regimes, R&D investments, etc. Policies to benefit individual firms – loan guarantees, targeted procurement policies, etc.	Policies to support clusters, core institutions, network building, etc.
Key Process for Economic Growth	Markets allocating capital and labor inputs efficiently	Regional ecosystems engaging firms, financiers, universities, and other institutions in innovative activity
Role of Government	Provider of inputs and macroeconomic management	Provider of information; facilitator of collaborative, public-private partnerships

Source: Brookings Institution, Information Technology and Innovation Foundation, and Institute for Strategy and Competitiveness

susan.helper@case.edu

Rebuilding: policies

Recent Cluster-Supporting Federal Policy Efforts by the Obama Administration

Lead Agency	Program	Description	Status
Economic Development Administration (EDA)	Regional Innovation Clusters framework	Represents a new cross-agency framework for federal economic development assistance to target and align funding to well-developed regional strategies that prioritize institutional collaboration and leverage core regional strengths.	The first implementation is the Energy Regional Innovation Cluster (E-RIC) program discussed below For more information, see www.eda.gov/AboutEDA/RIC/
EDA	I6 Challenge	Supports entrepreneurs and eliminate barriers to commercialization within regional innovation ecosystems through a $12 million competitive grant administered by the EDA in partnership with the National Institutes of Health and the National Science Foundation (NSF)	Award announcements to occur in Fall 2010 For more information, see www.eda.gov/i6
Small Business Administration (SBA)	Regional Innovation Clusters program	Provides up to $600,000 for business training, technology transfer, and mentoring services to self-identified regional clusters that have in place the partnerships, technical capacity, and other assets necessary for small business growth	Award announcements to occur in Fall 2010 For more information, see www.sba.gov/clusters/
SBA	Advanced Defense Technology program	Awards up to $600,000 to support and grow small businesses in regional innovation clusters focused on advanced robotics, cyber-security, applied lightweight materials, and other critical defense needs identified in conjunction with the Department of Defense	Award announcements to occur in Fall 2010 For more information, see www.sba.gov/clusters/
Department of Energy (DOE)	Energy Efficient Building Systems Regional Innovation Cluster (E-RIC)	Connects DOE, EDA, SBA, NSF, the Department of Commerce's Manufacturing Extension Partnership, the Department of Labor, and the Department of Education in joint funding opportunity of up to $130 million over five years to support a regional research center that develops and commercializes new building energy efficiency technologies and engages partners to promote broader regional energy cluster growth	Award announced in August 2010 to Philadelphia-based research consortium For more information, see http://www.energy.gov/hubs/eric.htm
U.S. Department of Agriculture (USDA)	Rural Innovation Initiative	Seeks to pilot strategic regional planning that connects rural communities to core local and metropolitan assets and opportunities through a $176 million fund that pools and coordinates a share of resources from existing USDA programs	Proposed in the Administration's FY2011 budget request For more information, see p.14 of the USDA budget summary: http://www.obpa.usda.gov/budsum/FY11budsum.pdf
NSF	NSF Innovation Ecosystems	Aims to support regional clusters around universities with $12 million directed at increasing the impact of promising innovations through commercialization, industry alliances, and start-up formation	Proposed in the Administration's FY2011 budget request For more information, see p.4 of the NSF budget summary: http://www.nsf.gov/about/budget/fy2011/pdf/01-Overview_fy2011.pdf

susan.helper@case.edu

industry councils

- Shared supply chains can be highly productive, *if* they are governed collectively
- Industry council:
  - Industry participants agree on training, standards for investments in computer-aided design, roadmap for tooling new, green powertrains, etc.
  - Government provides grants on competitive basis (to overcome free-rider problems), but does not "pick winners"

susan.helper@case.edu

How could industry councils help?

- Elicit the detailed information necessary to design good policies (overcome bounded rationality)
  - identify blockages that retard innovation.
    - Lack of collaboration
  - identify training needs
    - Codification of processes, handling lightweight ("green") materials
  - manage the design of training for field agents of the Manufacturing Extension Program (MEP) who assist firms in their sector.
- Bring together different interests (overcome opportunism)
  - create social networks that allow firms to learn from each other.
  - make coordinated investments, both subsidized and not.
  - compete for competitive grant programs
    - Government sets terms to incentivize competing on innovation, not low wages
- Thus, avoiding government failure (Rodrik), creating "learning by monitoring" (Sabel)

susan.helper@case.edu

Changes needed to reap opportunity

- Adopt collaborative purchasing practices
  - Measure system cost
  - Adopt ‘value analysis’
    - Rigorous joint analysis of each process step improves systemic properties
- Remedy market failures of shared supply chains
    - Build cooperative institutions to help small suppliers
      - Recruit and train workers
      - Make “complementary investments”
        - » To engage in continuous improvement and/or rapidly introduce new products, firms need to make near-simultaneous investments in marketing, information technology, training, and equipment – hard for small firms to plan, implement, and finance this without help
      - Obtain working capital
        - » Banks want to reduce exposure to entire auto sector

susan.helper@case.edu

Agglomeration and Productivity

- *"Great are the advantages which people following the same skilled trade get from near neighborhood to one another. The mysteries of the trade become no mysteries, but rather are, as it were, in the air"*
    - Alfred Marshall

- "*There has been little research about why some firms are more productive in some places"*
    - Ed Glaeser

Causes of the auto crisis

susan.helper@case.edu

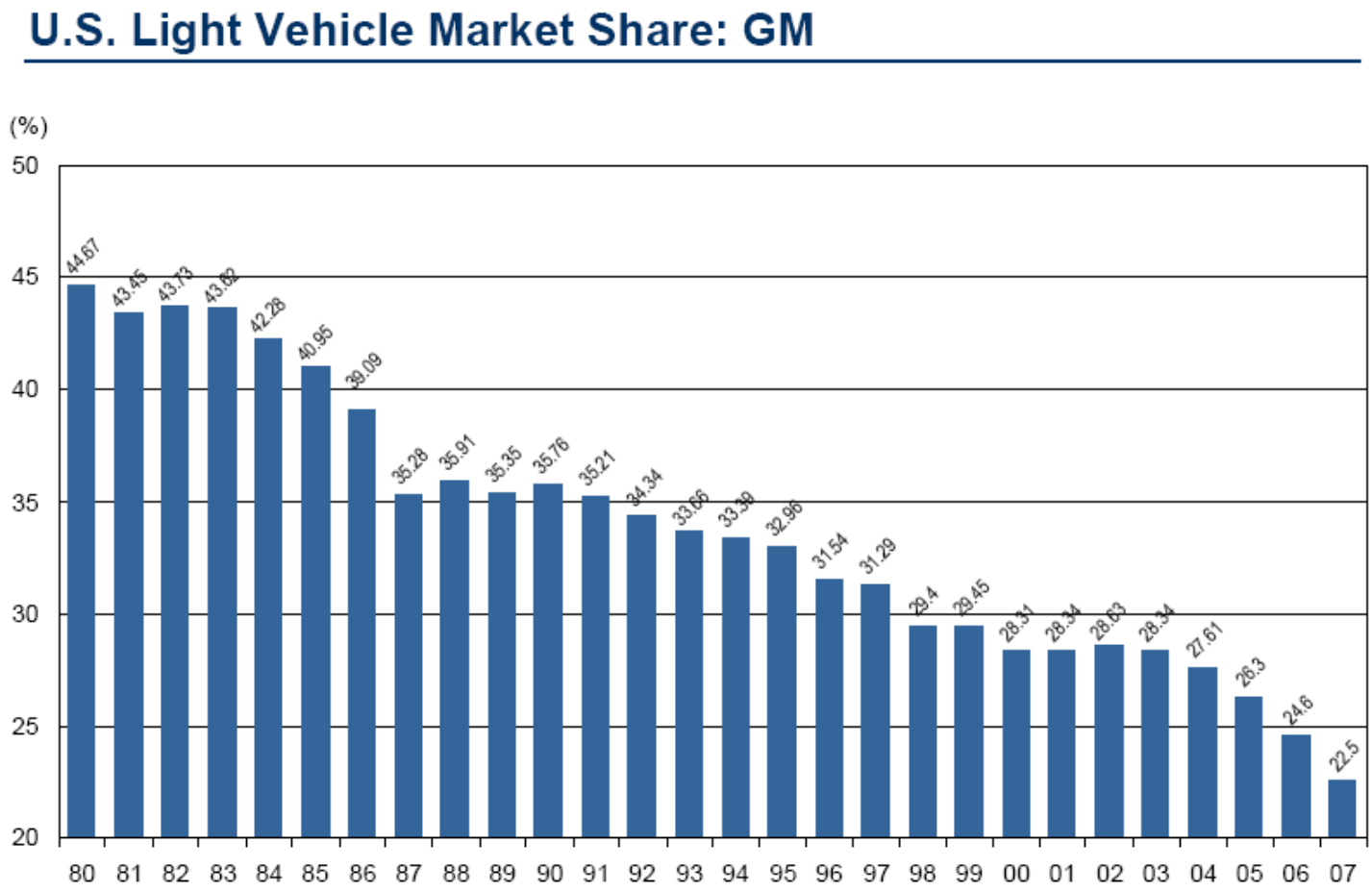
Detroit 3 Transaction Prices for Like-Like Vehicles Lag Behind Japanese OEMs by $2,500-$3,500

Category	GM	Ford	Chrysler	Toyota
Compact Car	$15,025	$15,031	$16,721	$18,418
Compact SUV	$21,688	$22,028	$21,833	-
Compact Truck	$19,516	$17,338	$21,960	$23,147
Large Car	$21,518	$23,047	$25,342	$31,753
Large SUV	$37,087	$35,425	$30,084	$44,971
Large Truck	$28,442	$28,555	$30,137	$29,222
Luxury Car	$37,650	$32,346	-	$41,728
Luxury Sport Car	$63,879	$64,394	-	$45,974
Luxury SUV	$45,525	$45,820	-	$46,032
Midsize Car	$19,127	$18,707	$20,754	$23,169
Midsize SUV	$23,707	$27,394	$25,790	$29,285
Minivan	$23,940	-	$25,070	$26,930
Van	$23,242	$22,639	$38,259	-

Source: Edmunds – January-May 2008

susan.helper@case.edu

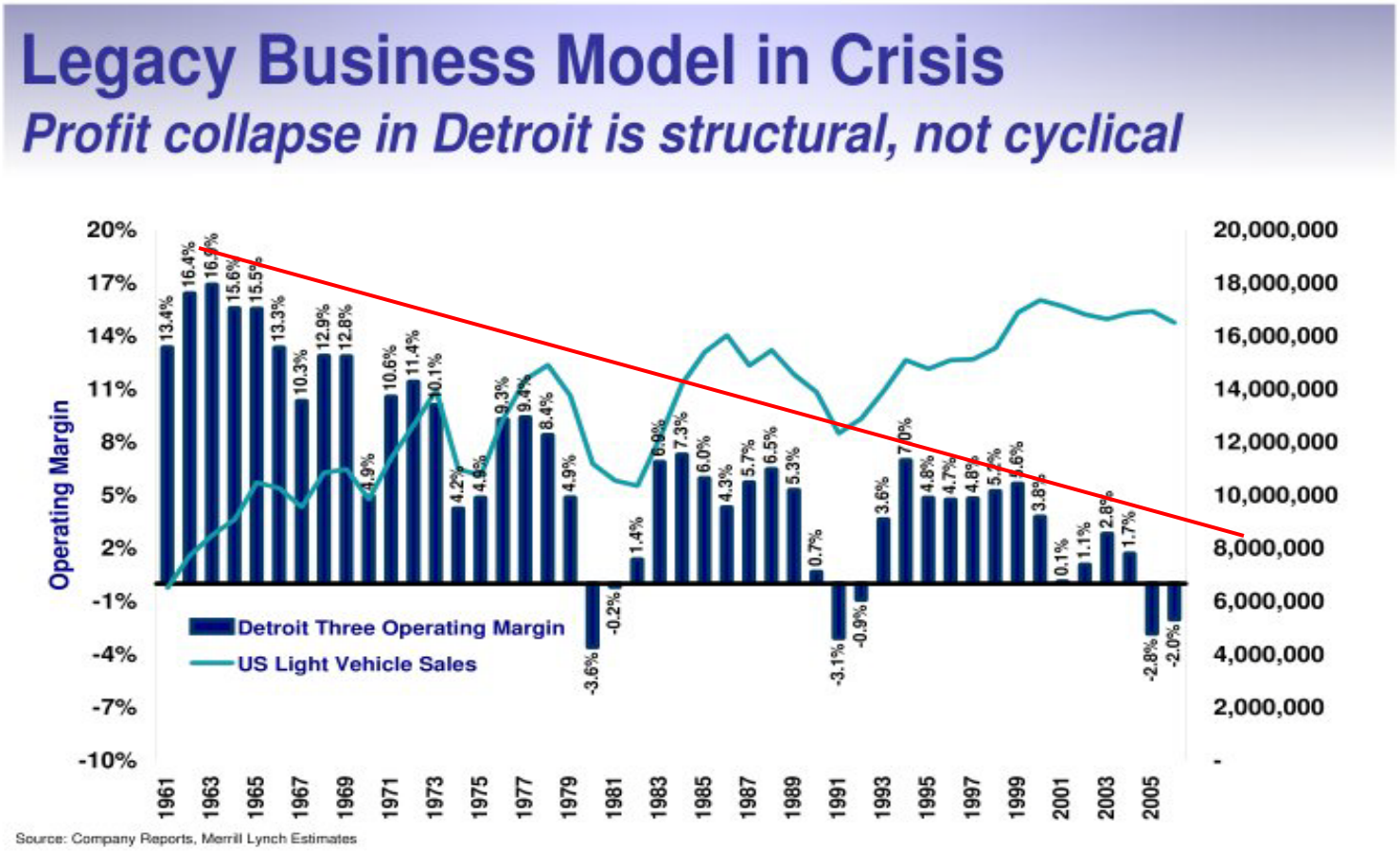
Steady decline at GM



susan.helper@case.edu

Source: S&P from Ward's; 2007 is January 2007

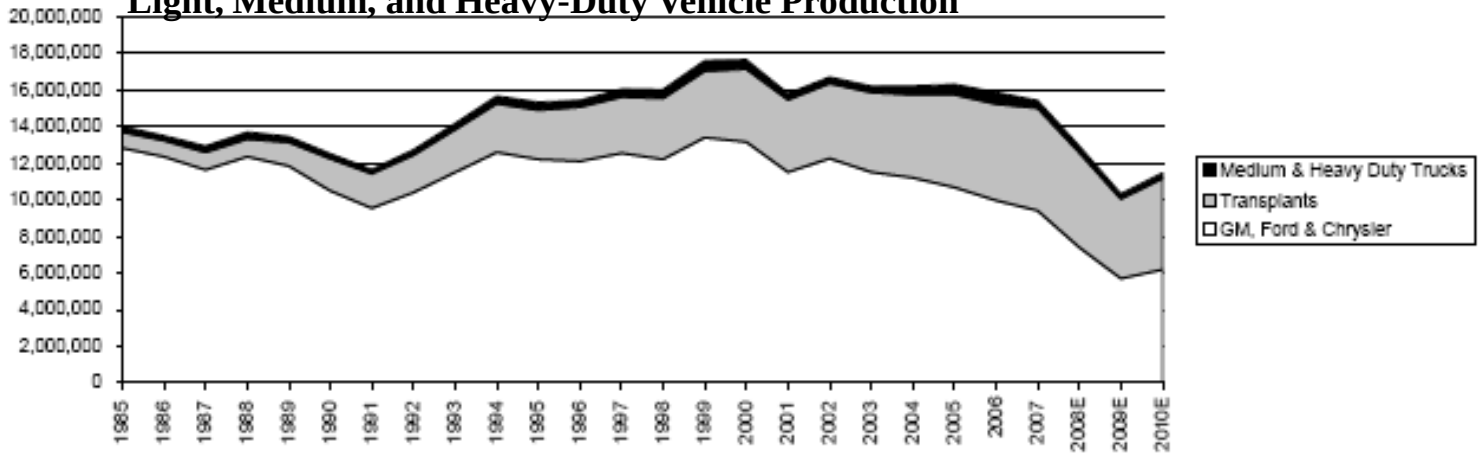
Detroit 3 Profits: in Decline for Decades



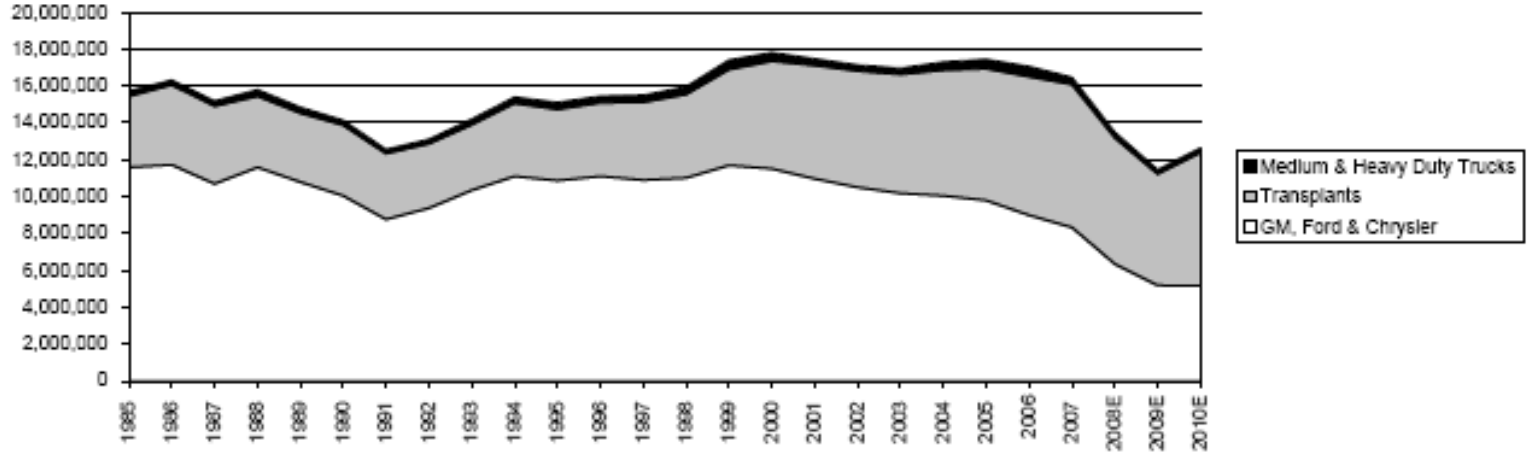
Source: Casesa-Shapiro

Transplants ("New Domestics") Have Taken Increasing Share of N.A./U.S. Markets

North American (US, Canada, Mexico)
Light, Medium, and Heavy-Duty Vehicle Production



U.S. Light, Medium, and Heavy-Duty Vehicle Production



Source:
KeyBank
Capital Markets

Result

- Detroit 3 share of US sales
  - 1980: 77%
  - 2009: 45%
- Detroit 3 share of US production
  - 1980: 97%
  - 2009: 55%

  - *Note: Detroit 3 = Ford, GM, Chrysler*

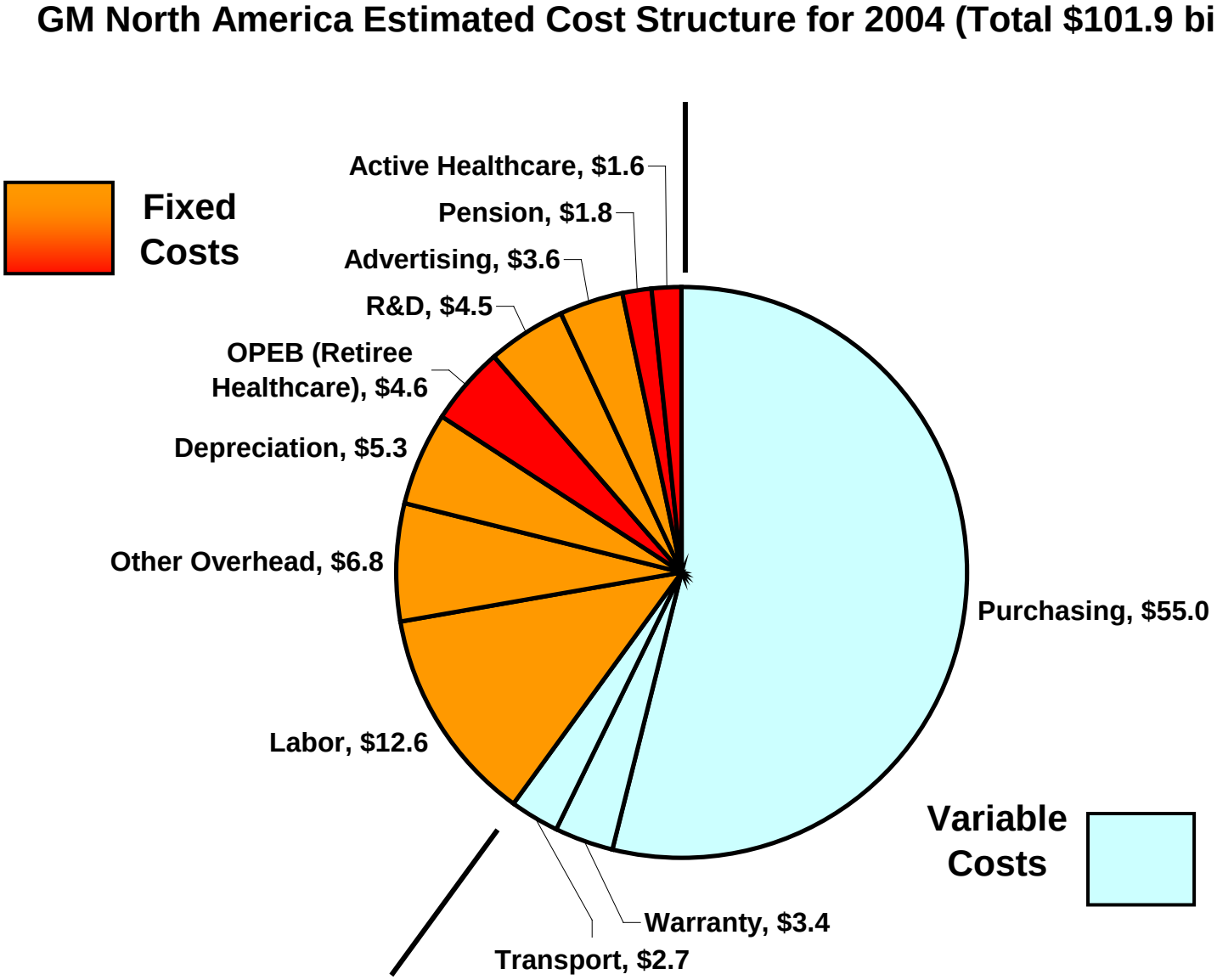
susan.helper@case.edu

The “Detroit Three” have a ***price*** problem more than a cost problem

- Suppliers play a key role in this problem—and in its solution
  - Capability problem
    - Massive outsourcing of the last 20 years created a shared supply chain, upon which automakers depend for design, production—
      - But each automaker wants to free-ride on others’ investment
    - Result: Underinvestment in design, quality, delivery, innovation capabilities
      - many supplier bankruptcies (even before general crisis)
  - Collaboration problem
    - US automakers incentivize purchasing agents to minimize piece prices
      - but this often results in increased system costs, reduced performance (eg, poor ride quality)
        - » due to poor management of interactions across parts, frequent engineering changes

susan.helper@case.edu

But Labor Costs are Not the Only Costs



Source: Deutsche Bank

Suppliers as a Source of Challenge

- Cause of US auto crisis often held to be union labor costs
  - But these costs, including “legacy costs” of health care and pensions made up < 10% of total costs

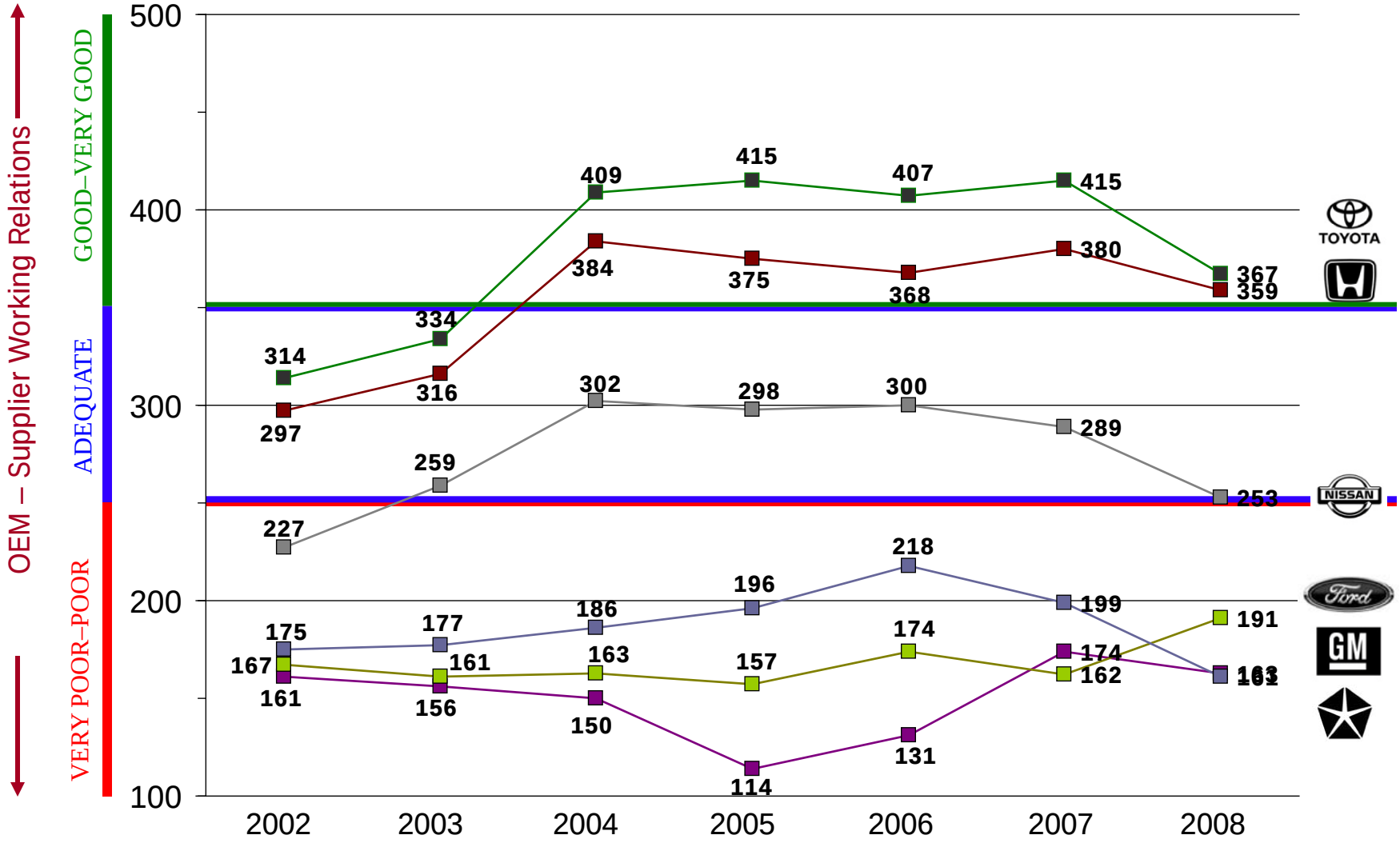
susan.helper@case.edu

Creation of shared supply chains

- Beginning in 1980s, huge wave of outsourcing
  - Ratio of employment at independent partsmakers/employment at assemblers
    - 1990: 1.2
    - 2008: 3.5

susan.helper@case.edu

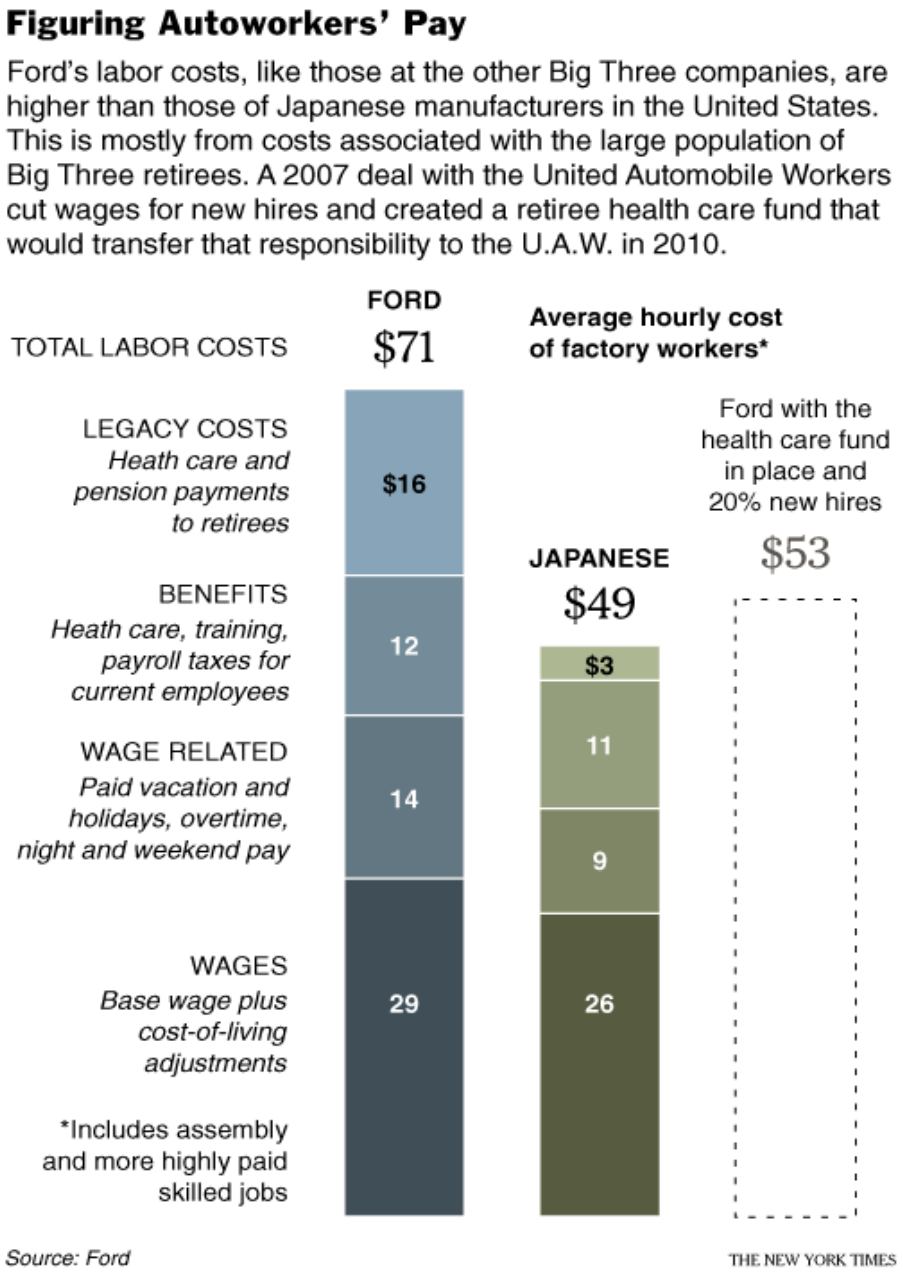
Major Gap Between D3 and Japanese in OEM-Supplier Relati



Planning Perspectives Inc: Working Relations Index

The Myth of the $71/hour Auto Worker

- To get to $71/hour, legacy costs for all D3 retirees added to hourly wage of shrinking number of current workers
- Higher health care costs for current D3 workers due to their higher average age
- Equalizing health care costs with competitors would mean reducing coverage for D3 workers below that of younger workforce at transplants
- New hire hourly pay set in 2007 UAW contract will be lower than transplant pay



High “legacy costs” a *result*, not a cause, of reduced market share

- Fixed retiree burden grows on a per-car basis as the number of cars sold falls
- If only one car sold, the “legacy cost” burden would be $50 billion

susan.helper@case.edu

New ownership after bankruptcy

- GM
  - US Treasury: 61%
  - UAW health care plan: 17%
  - Canada/Ontario: 12%
  - Bondholders: 10%
- Chrysler:
  - US Treasury: 10%
  - UAW health care plan: 68%
  - Canada/Ontario: 2%
  - Fiat: 20%

susan.helper@case.edu

Agenda

- Causes of the Auto Crisis in the US
  - Supply Chains: an Under-appreciated Factor
    - Key aspects of the value chain are now shared across firms due to reduced vertical integration, smaller firms
    - But corporate strategy and public institutions have not adjusted to this new reality
- Recovering from the crisis
  - The US needs to invest in its “industrial commons”
  - Institutions like IFI are critical

susan.helper@case.edu

New ownership does not solve all problems

- A short-term intervention (not long-term policy)
- A financially-driven bailout
  - Little understanding of the industry
    - Initially, no awareness of extent of supply chain
  - All “owners” subscribe to goal of maximizing shareholder value
    - Any deviation leads to incompetent/corrupt choices
- Balance sheets cleaned up, but little change in the method of production
  - People doing the same thing, just paid less
  - A few indicators of change

susan.helper@case.edu

Is change occurring?

- "Working relations index" scores of Detroit 3 improving
  - Note: overall average has fallen (slightly) since 2007
- But so far, transaction price gap not shrinking
  - 2010 price, including incentives, comparably equipped:
    - Chevy Cobalt 15,700
    - Ford Focus 16,000
    - Honda Civic 22,300
    - Toyota Corolla 18,500
      - » *Source: edmunds.com; automotive.com*

susan.helper@case.edu

US manufacturing can succeed

- Germany is #2 exporter of manufactured goods, despite higher wages than US

susan.helper@case.edu

“High-road” mfg can be win/win/win

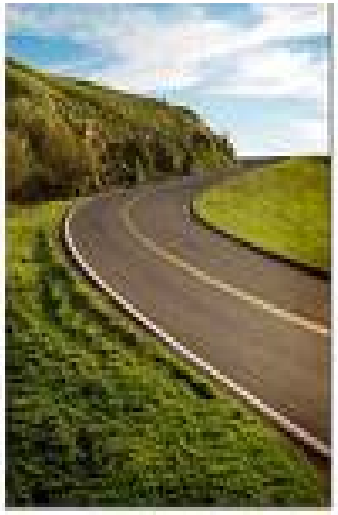
- In “high-road” production, well-paid workers make cost-effective, sustainable products for consumers, profits for owners
  - » *How?*
  - » High road techniques harness everyone’s knowledge—not just top executives’ -- to achieve innovation, quality, and variety
  - » Just one suggestion by workers at Mittal Steel in Cleveland saves $1 million per year
  - » Colonial Machine in Kent OH makes tools just in time, with innovative reusable tool bases and computerized equipment equip

High wages don’t have to mean high costs

- Direct labor is usually only 5-15% of cost
- Offset high wages with better performance
  - Individual high skills
  - Collaborative supply chain, clusters of nearby firms provide fertile ground for new ideas
    - Avoid hidden costs of off-shoring
      - Management loses focus on innovation at home
      - Increased risk from long supply chain
      - More difficult communication among design, engineering, and production means quality problems may fester
      - Eventually, design as well as production may move

Firms could close the gap with "high-road" production

- US manufacturers can compete with China.
  - But by *increasing* skill – not by imitating China
- But, many firms don't use, due to market failures
  - Spillovers to workers and suppliers
    - Firms don't capture all the gains from high-road production, so they invest too little in it
  - Complementarities
    - Colonial tool needed to invest in information technology, training, process redesign, and marketing
    - No one of these investments would pay off without the other



Why Promote High Road Production?

- Helps other stakeholders in the economy
  - Helps meet national goals such as energy sustainability
  - Doesn't throw money at firms without quid pro quo
- Makes workers integral to production—not disposable
  - Education, R&D are important—but by themselves do not provide good jobs for most Americans
- High road principles apply to all sectors
  - Not just manufacturing

Obstacles to high-road production

- Due to outsourcing of production, many small manufacturers are part of long supply chains
  - Autos: parts employment/assembly employment
    - 1990: 1.2/1 2008: 3.5/1
- These supply chains are shared across OEMs
  - Each has an incentive to “free ride” on others’ investments
  - But, customers can also be a powerful incentive to adopt high-road practices like quality methods

susan.helper@case.edu

Shared supply chains can be productive if governed well

- Examples:
  - Germany: Baden-Wurttemburg
  - Italy: Emilia-Romagna
  - US agriculture
- These industries all have structures to overcome free-rider problems

susan.helper@case.edu

US “industrial commons” in sad shape

- Externalities
  - Hard for firms to get payback on investments that others can appropriate
  - Training
  - Research and development
- Complementarities
  - Hard to coordinate within and between firms
  - *Investments are hardest just when they are most needed*

susan.helper@case.edu

Industrial commons

- Relations between customers and suppliers
- Relationships within and between suppliers
- Relationship with government

susan.helper@case.edu

Exit vs. Voice

Helper (1991) -- Modes of exchange in supplier relations

Exit

Buyer's response to a problem with a supplier is to find a new supplier

Assures compliance by drawing on the "stick" of threatening to exit from the relationship

Voice

Buyer's response is to work with the original supplier until problem is corrected

Relies on the "carrot" of improved profits on both sides resulting from improved products

Changes in Global Auto Industry: Implications for Collaboration

1. Competitive pressures for quality and diffusion of lean production
2. Deverticalization of OEMs and emergence of "mega-suppliers"
3. Modularity and predicted increase in supplier design independence
4. Global over-capacity and legacies of exit

- More intensive OEM-supplier interaction during design
- OEMs move design responsibilities to suppliers
- Product architecture remains primarily integral, requires high coordination
- Can be low trust at governance level

→ More inter-firm collaboration on design, can be with or without trust

Collaboration without Trust

Governance Level (Purchasing Regime)

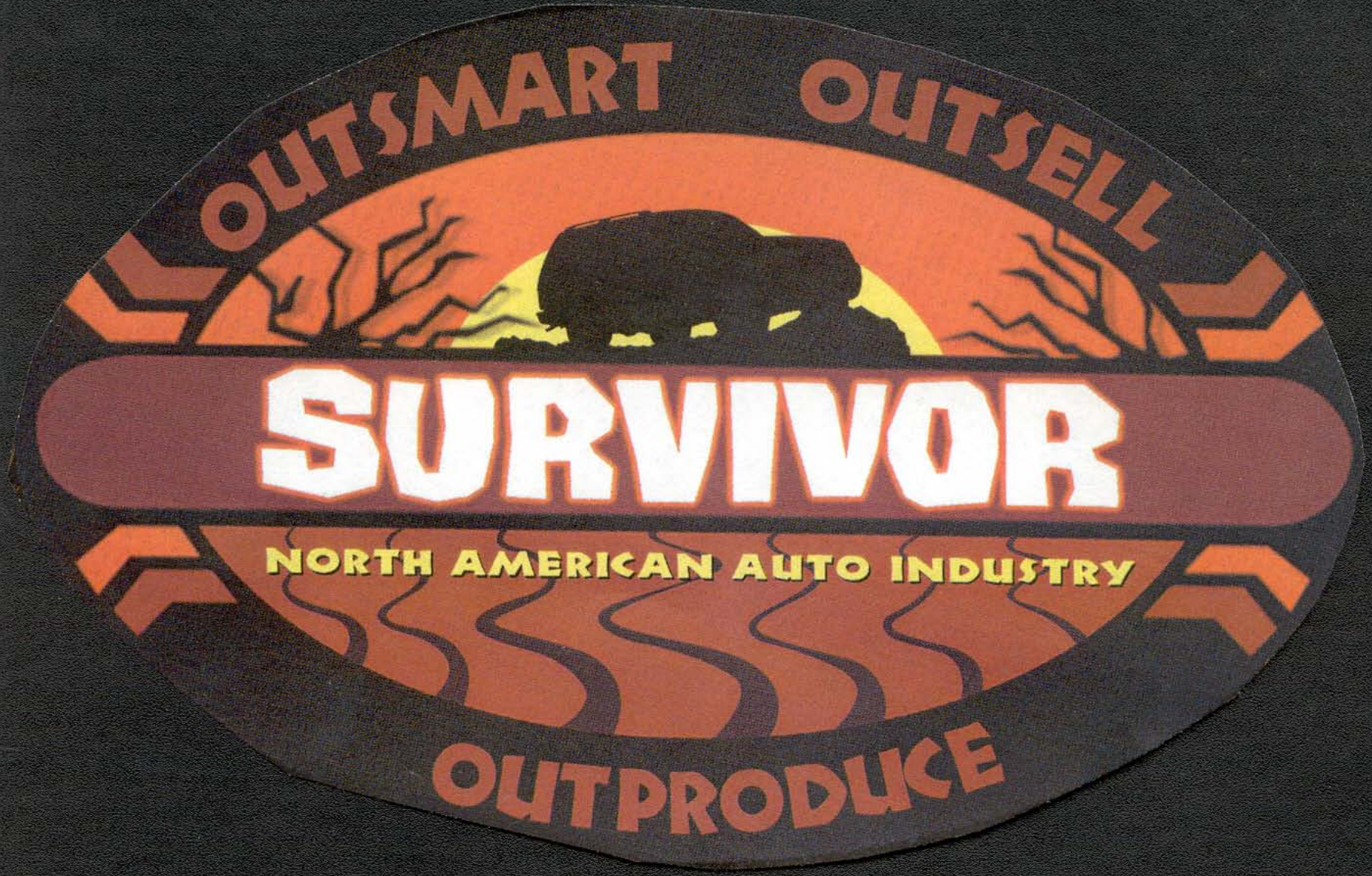
?

Task Level (Iterative Co-design)

Examples of trust-reducing activities

- Suppliers develop design proposals, OEMs send their plans around to get competitive quotes
- OEMs demand immediate 5% price cuts
- OEMs abruptly change policy and make suppliers responsible for tooling cost
- OEMs run reverse auctions in which aggressive bids pushing prices lower can't be verified later as coming from legitimate suppliers
- Supplier quality problems on major components/ subsystems are perceived by public (and in legal liability cases) as OEM responsibility

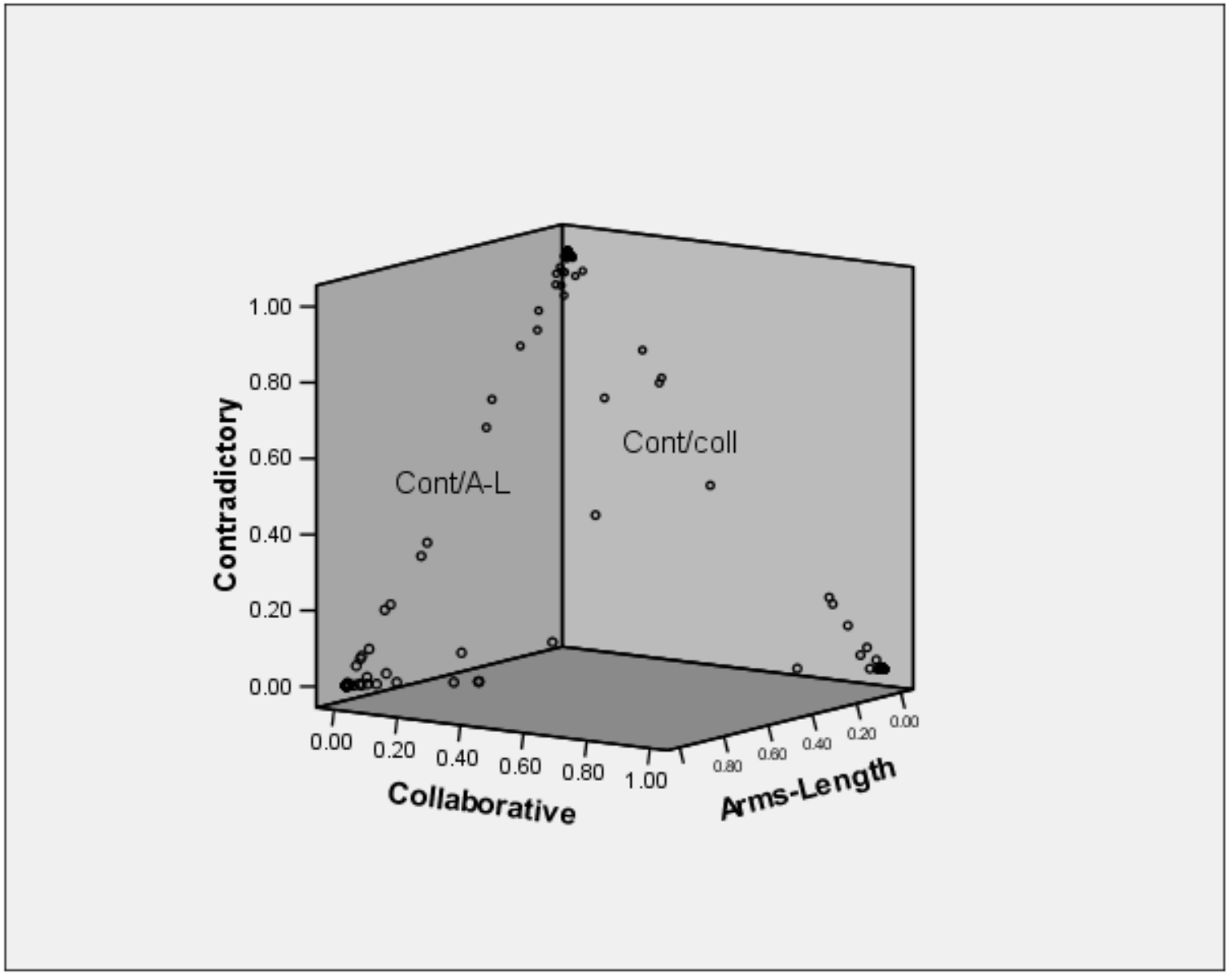
A Business Model for Survival



Why does CWT Exist?

- Collaboration is costly (Herrigel)
  - Would this explain reneging on commitments?
- Excess capacity in manufacturing allows OEMs to get benefits of collaboration (design services from suppliers) without paying costs (fulfilling commitments) (MacDuffie and Helper)
- Internal conflicts in OEMs: Engineers want good designs, purchasing wants low costs (Whitford and Zeitlin)
- *Any explanation has to be consistent with the existence of three types of relationships (collaborative, adversarial, collaboration w/o trust)*

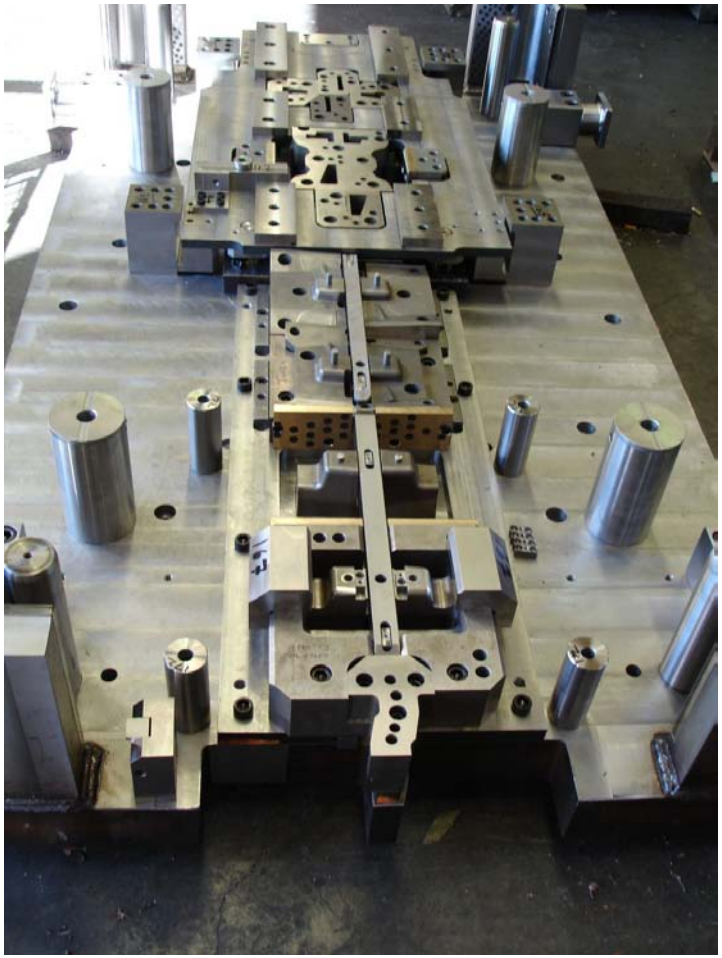
Relative probabilities of cluster membership



Collaboration without Trust: the Future

- Stable
  - Overcapacity will last for a long time
- Unstable
  - Will evolve into Pragmatic collaboration (Helper, MacDuffie, and Sabel, 2000)
    - Learning and monitoring simultaneously
    - Coping with uncertainty while overcoming opportunism
    - Routines for examining routines – Are current routines adequate? How can they be improved?
    - Iterative co-design and other interdependent process management disciplines
    - Trust not a necessary precondition, but generated during collaboration
  - Will evolve into bankruptcy

Case study: automotive dies



susan.helper@case.edu

US die-making: outsourcing

- Outsourced to small shops, who underbid each other on initial price
  - Make money on engineering changes, when OEM bargaining power is low→
    - Supplier may not want to find problems early
  - Shop cannot predict how many bids it will win→
    - Bid on diverse projects—don't develop expertise on any one type of die
    - Will be late in boom times
  - Die-makers shared across OEMs→ no customer wants to pay for upgrading

US die-making: offshoring

- Chinese subsidies for die-making in last 10yrs
  - entrepreneurs get free factory and equipment if they meet employment goals
  - Piece prices 15-30% lower than US
  - Have developed standard ways of working to overcome distance
    - Webcams, detailed time sheets to show progress
- US die-making lost 1/3 of employees, 2000-5
  - Skilled as well as unskilled mfg being lost

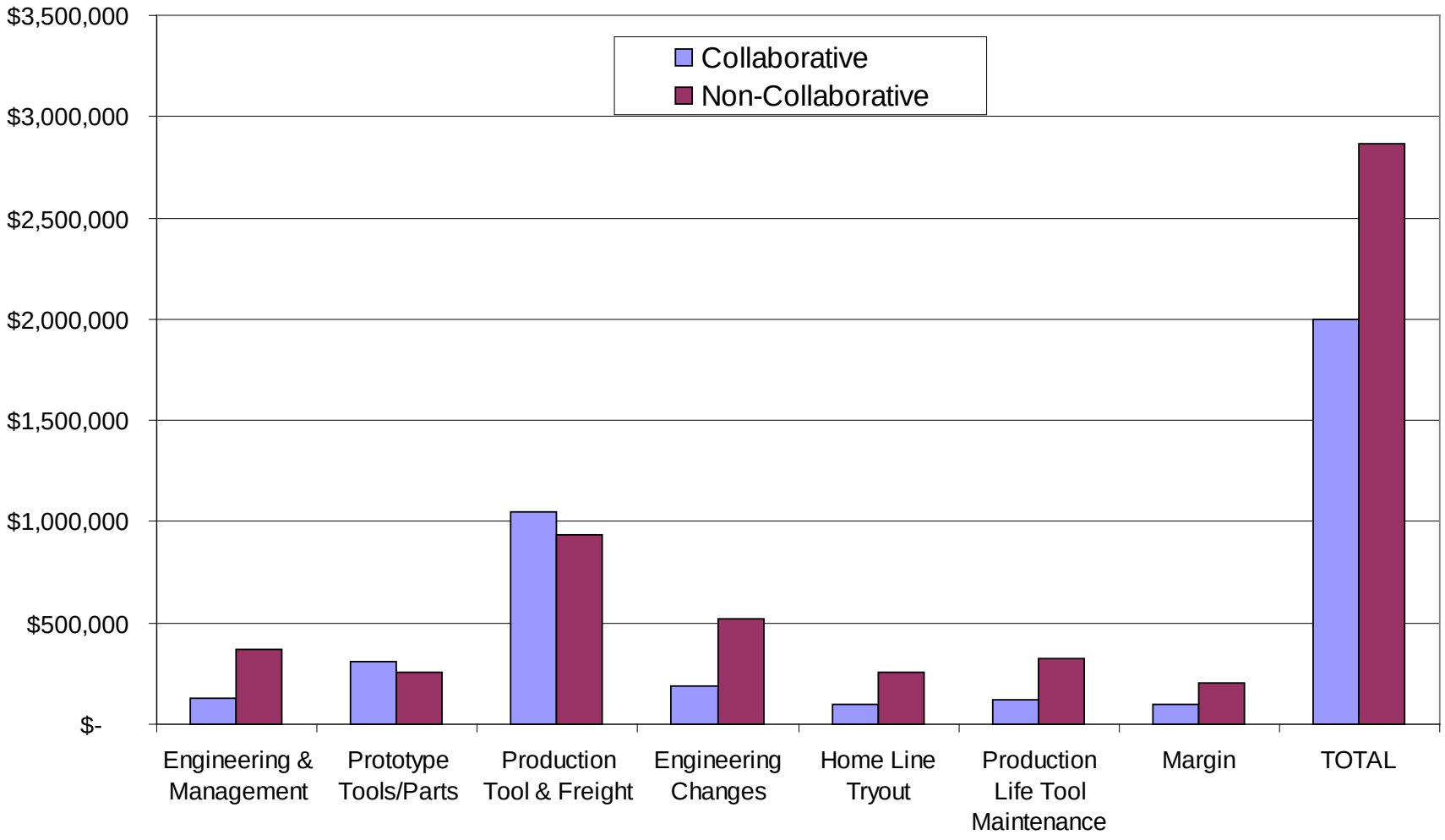
susan.helper@case.edu

Die-making: Japanese approach

- Honda, Toyota in US:
  - Establish target cost based on deviations from previous design
  - Ask shop that made previous design if they can meet the target price
    - Discuss changes to design
  - System cost is less, quality is higher
    - No dies imported from low-wage countries

susan.helper@case.edu

Collaborative Tooling Example
Door Inners – 30% Savings



Source: Forthcoming CAR research

Supply chain as source of opportunity

- Because of Detroit 3 focus on piece price, Tier 1 suppliers have learned to innovate without high fixed costs
- Because of Detroit 3 shrinkage, Tier 1's have gained engineering and design capability
- Some tier 2's have deep knowledge of specialized manufacturing processes

susan.helper@case.edu

Industrial commons

- Relations between customers and suppliers
- Relationships within and between suppliers
- Relationship with government

susan.helper@case.edu

A Key Metric:

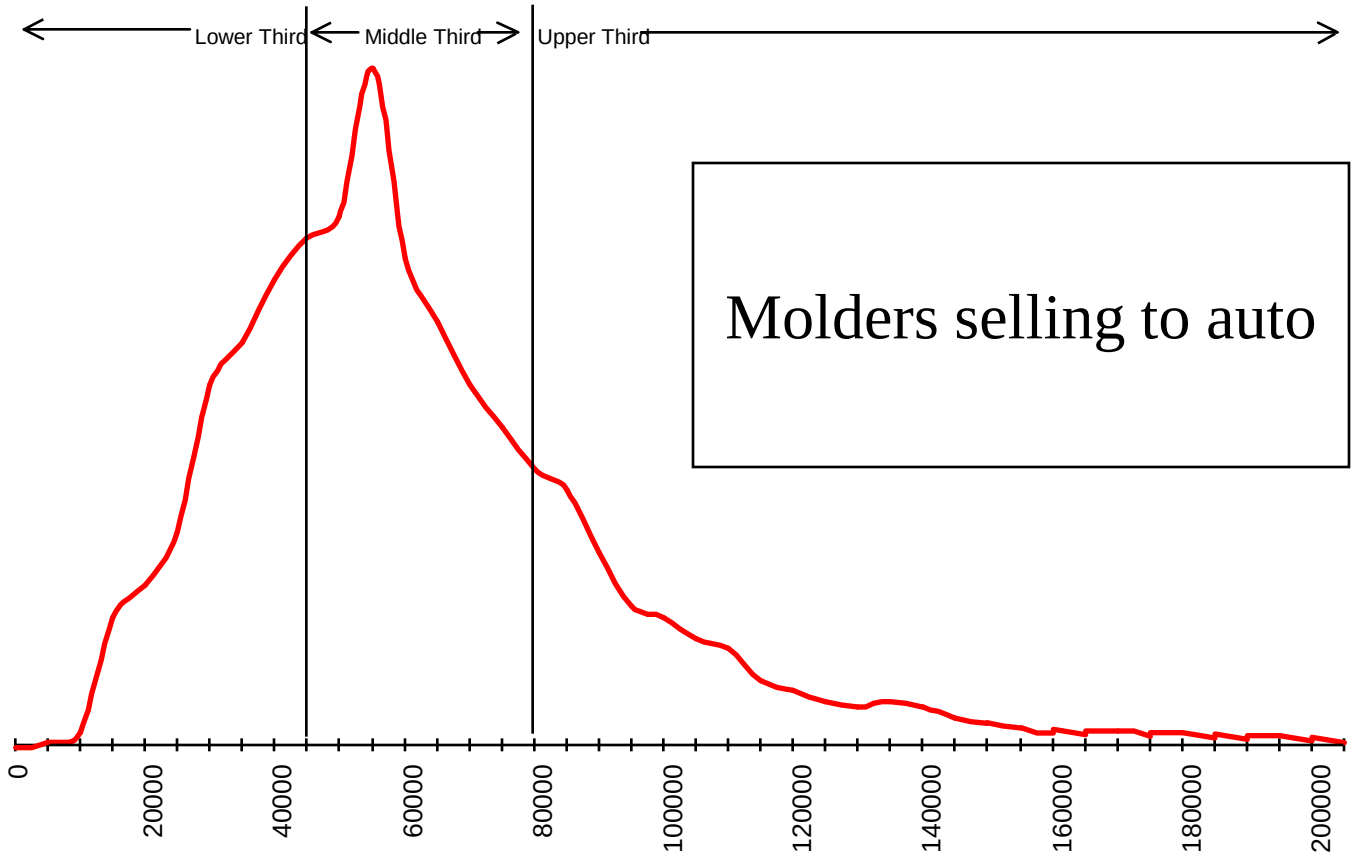
Value-added per Full-time Employee

$$\frac{VA}{FTE} = \frac{Sales - Outside\ Purchases}{Employees \times Hours / 2080}$$

Source: performance benchmarking service, michigan manufacturing technology center

Value-added / FTE is highly skewed:

The top 10% are more than twice as productive as the median shop.



Source: Performance Benchmarking Service: metalworking respondents

Top molders had both higher wages and higher profits

	Mean top 10%	Mean bottom 50%	Top 10% as a % of bottom 50%
Value-Added per Full-Time Employee	$128750	$53325	226%
Gross Margin	48	16	300%
Average Hourly Shop Wage	14.20	9.49	148%
Benefits as a Percent of Labor Costs	27.2	17.9	170%
Performance-Based Pct Payroll	12.1	1.8	735%
Pct Sales to Final Consumers	16.5	2.8	589%
Pct Sales from Make-to-Stock Work	13.0	3.8	342%
Pct Gauges Electronic & Linked Collector	52.5	0.0	
Keyboards/Keypads per Employee	1.06	0.1	1060%
Pct Suppliers Exchg'd EDI Transact Sets	95.0	5.0	1900%
Replacement Value of Equipment per FTE	$129400	$29700	398%
Pct Employees Using Computers	100%	21.4%	467%
Pct of Shop Floor Workers in Teams	100%	0%	
Employee Turnover Rate	9.0%	76.1%	12%

Source : Dan Luria, Michigan Manufacturing Technology Center

Survival strategies

- Develop new products and processes: Build internal and external capability by
  - Networking
    - For single plant firms, move from 25th to 75th percentile on value of social networks increases productivity by >10%.
    - These networks are national and international as well as local.
  - Locating in urban area
    - Move from 25th to 75th percentile on urbanization increases productivity by 10%.
    - Wages *and* profits are higher in more urban areas
    - Why?
      - Urban productivity advantage probably due to increased access to customers, workers with general skills
      - Urban firms get even bigger productivity boost from product design
      - Some evidence that urban location can substitute for customer assistance in yielding productivity increase

Industrial commons

- Relations between customers and suppliers
- Relationships within and between suppliers
- Relationship with government

susan.helper@case.edu

Investments needed for world-class supply chain

Nature of investment, and possible facilitating program

	Within One Firm	**Across Many Firms**
Codified	Suggestion system (MEP)	Just-in-time (Councils)
Not codified	Product innovation (R&D tax credit)	Technology roadmapping (Councils)

Re-building industrial commons: theory

A Comparison of Economic Development Models		
Dimension	**Traditional Economic Development**	**Cluster-based Economic Development**
Economic Doctrine	Neoclassical economics	Innovation and Institutionalist economics
Key Actors	Individual firms	Groups of firms
Key Tools	Policies for the general business environment – tax and regulatory regimes, R&D investments, etc. Policies to benefit individual firms – loan guarantees, targeted procurement policies, etc.	Policies to support clusters, core institutions, network building, etc.
Key Process for Economic Growth	Markets allocating capital and labor inputs efficiently	Regional ecosystems engaging firms, financiers, universities, and other institutions in innovative activity
Role of Government	Provider of inputs and macroeconomic management	Provider of information; facilitator of collaborative, public-private partnerships

Source: Brookings Institution, Information Technology and Innovation Foundation, and Institute for Strategy and Competitiveness

susan.helper@case.edu

Rebuilding: policies

Recent Cluster-Supporting Federal Policy Efforts by the Obama Administration

Lead Agency	Program	Description	Status
Economic Development Administration (EDA)	Regional Innovation Clusters framework	Represents a new cross-agency framework for federal economic development assistance to target and align funding to well-developed regional strategies that prioritize institutional collaboration and leverage core regional strengths.	The first implementation is the Energy Regional Innovation Cluster (E-RIC) program discussed below For more information, see www.eda.gov/AboutEDA/RIC/
EDA	I6 Challenge	Supports entrepreneurs and eliminate barriers to commercialization within regional innovation ecosystems through a $12 million competitive grant administered by the EDA in partnership with the National Institutes of Health and the National Science Foundation (NSF)	Award announcements to occur in Fall 2010 For more information, see www.eda.gov/i6
Small Business Administration (SBA)	Regional Innovation Clusters program	Provides up to $600,000 for business training, technology transfer, and mentoring services to self-identified regional clusters that have in place the partnerships, technical capacity, and other assets necessary for small business growth	Award announcements to occur in Fall 2010 For more information, see www.sba.gov/clusters/
SBA	Advanced Defense Technology program	Awards up to $600,000 to support and grow small businesses in regional innovation clusters focused on advanced robotics, cyber-security, applied lightweight materials, and other critical defense needs identified in conjunction with the Department of Defense	Award announcements to occur in Fall 2010 For more information, see www.sba.gov/clusters/
Department of Energy (DOE)	Energy Efficient Building Systems Regional Innovation Cluster (E-RIC)	Connects DOE, EDA, SBA, NSF, the Department of Commerce's Manufacturing Extension Partnership, the Department of Labor, and the Department of Education in joint funding opportunity of up to $130 million over five years to support a regional research center that develops and commercializes new building energy efficiency technologies and engages partners to promote broader regional energy cluster growth	Award announced in August 2010 to Philadelphia-based research consortium For more information, see http://www.energy.gov/hubs/eric.htm
U.S. Department of Agriculture (USDA)	Rural Innovation Initiative	Seeks to pilot strategic regional planning that connects rural communities to core local and metropolitan assets and opportunities through a $176 million fund that pools and coordinates a share of resources from existing USDA programs	Proposed in the Administration's FY2011 budget request For more information, see p.14 of the USDA budget summary: http://www.obpa.usda.gov/budsum/FY11budsum.pdf
NSF	NSF Innovation Ecosystems	Aims to support regional clusters around universities with $12 million directed at increasing the impact of promising innovations through commercialization, industry alliances, and start-up formation	Proposed in the Administration's FY2011 budget request For more information, see p.4 of the NSF budget summary: http://www.nsf.gov/about/budget/fy2011/pdf/01-Overview_fy2011.pdf

susan.helper@case.edu

Why not let Honda and Toyota restructure US auto industry?

- They won't invest as much in US suppliers as would be efficient
  - Although they spend more on supplier development than do the Detroit 3, Honda and Toyota do worry about others free-riding
- The most advanced processes remain in Japan
  - R&D, advanced product development
  - Close to headquarters and most-skilled supplier production facilities

susan.helper@case.edu

industry councils

- US mfg stuck in middle between high skills of Europe, low wages of China, Mexico
- Rationale: Shared supply chains can be highly productive, *if* they are governed collectively
- Industry council:
  - Industry participants agree on training, standards for investments in computer-aided design, roadmap for tooling new, green powertrains, etc.
  - Government provides grants on competitive basis (to overcome free-rider problems), but does not "pick winners"

susan.helper@case.edu

How could industry councils help?

- Elicit the detailed information necessary to design good policies (overcome bounded rationality)
  - identify blockages that retard innovation.
    - Lack of collaboration
  - identify training needs
    - Codification of processes, handling lightweight ("green") materials
  - manage the design of training for field agents of the Manufacturing Extension Program (MEP) who assist firms in their sector.
- Bring together different interests (overcome opportunism)
  - create social networks that allow firms to learn from each other.
  - make coordinated investments, both subsidized and not.
  - compete for competitive grant programs
    - Government sets terms to incentivize competing on innovation, not low wages
- Thus, avoiding government failure (Rodrik), creating "learning by monitoring" (Sabel)

susan.helper@case.edu

Changes needed to reap opportunity

- Adopt collaborative purchasing practices
  - Measure system cost
  - Adopt ‘value analysis’
    - Rigorous joint analysis of each process step improves systemic properties
- Remedy market failures of shared supply chains
    - US lacks cooperative institutions to help small suppliers
      - Recruit and train workers
      - Make “complementary investments”
        - » To engage in continuous improvement and/or rapidly introduce new products, firms need to make near-simultaneous investments in marketing, information technology, training, and equipment – hard for small firms to plan, implement, and finance this without help
      - Obtain working capital
        - » Banks want to reduce exposure to entire auto sector

susan.helper@case.edu

Research is on-going

- Survey for Department of Labor, Jan 2011
- Suggestions for questions, issues highly welcome!

susan.helper@case.edu

Industrial commons

- Relations between customers and suppliers
- Relationships within and between suppliers
- Relationship with government

susan.helper@case.edu

Back-up slides

susan.helper@case.edu

Innovation Councils for Advanced Manufacturing

Susan Helper

Case Western Reserve University

August 2009

Why a council?

- Because of outsourcing, many more investment decisions are outside the control of an OEM
  - Suppliers as a “public good” for all firms in the industry
    - Tendency for free-riding, underinvestment
- Councils allow for information exchange, networking, agreement on industry needs
  - Not the government “picking winners”

What would a “fuel-efficient” auto council look like?

- Duties
  - Agree on nature of (codified) supplier upgrading necessary
    - MEP and others deliver this training, with partial subsidy
  - Decide on a roadmap for (non-codified) development of industry
    - Development of standards for products such as batteries
  - Design and evaluate competitive grant programs for local networks
- Membership
  - Includes automakers, suppliers, labor, university, finance, government
    - Chosen by same process as used by National Academy of Sciences
    - Rotates every 2-3 years
      - Avoids cronyism, groupthink
- Funding
  - Initial subsidy from federal government for organizational expenses
  - Helps members find existing programs to help

Examples

- From the US:
  - Sematech
    - Helped increase US market yields and market share in semiconductors, and maintain competitive US semiconductor equipment manufacturing
  - Program for Automotive Renaissance in Tooling
- From Europe (ubiquitous)
  - Torino Internazionale
    - Resurgence of Turin, even when Fiat suffering

Conclusions

- Massive outsourcing in US manufacturing has created shared supply chains.
- How can we ensure appropriate investment in new capabilities in this new structure?
  - OEMs need to align internal organization (purchasing,engineering, budgeting) to measure and develop supply chain capabilities
  - OEMs may need to re-integrate a bit
  - These supply chains need explicit governance if we are to overcome free-rider problems that block investments in supplier upgrading
    - Industry councils could play an important role
    - Changed trade policy

susan.helper@case.edu

Question for discussion

- Can a automaker like Fiat engage US suppliers in a way that
  - avoid the challenges
  - and reap the opportunities ?

susan.helper@case.edu

Toyota's troubles

- Did Toyota push suppliers too far on cost?
  - Sticking accelerator pedals
    - made by new supplier (CTS had no Toyota business before 2005)
- From May, 2008 Chunchi newspaper series:
  - A Toyota buyer arrives with stop watch in hand: "Why did you lie?"
    - While the supplier had submitted 40 seconds as the process time on the "Toyota watch" was 30 seconds.
    - "But..." The time he had submitted was based on building in some slack so processes could help each other out when they were behind and still guarantee top quality.
  - *I am a mid-level engineer working for Toyota. The top management… have started a new talent development policy to train new employees to become fully capable engineers in three years. Three years is barely enough to get accustomed to the company and get to know the work flow. People are up in arms about this absurd policy.*

Agenda

- Putting supply chain in a broader frame
  - 1.Broad impact of supply chain factors
    - Key contributor to crisis at GM and Chrysler
  - 2.Supply chain capability has broad determinants
    - A. Supply chains are shared *across* OEMs
      - This sharing poses governance issues for firms—and nations
    - B. Supply chain performance also depends on complementary policies *within* OEMs

susan.helper@case.edu

Changes needed

- Adopt collaborative purchasing practices
  - Measure system cost
  - Adopt ‘value analysis’
    - Rigorous joint analysis of each process step improves systemic properties
- Remedy market failures of shared supply chains
    - Externalities
      - Recruit and train workers
    - Complementarities
      - To engage in continuous improvement and/or rapidly introduce new products, firms need to make near-simultaneous investments in marketing, information technology, training, and equipment
      - Hard for small firms to plan, implement, and finance this without help
        - » Lean production

susan.helper@case.edu

PART

- Program for Automotive Renaissance in Tooling
- Tried to agree on specialization across firms, develop lean capabilities
- Grant funding ran out
- No interest, pressure from OEMs

susan.helper@case.edu