Global Value Chain Analysis: Data Requirements, Gaps & Improvements with New Datasets

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Presentation based on discussion paper prepared by Stacey Frederick, Ph.D., Research Scientist, Duke CGGG

Conference on the Measurement of International Trade and Economic Globalization
September 29-Oct. 1, 2014
Aguascalientes, Mexico
Overview

1) Data needed for GVC studies
   • Value chain model

2) Improvements to GVC analysis with
   • TiVA for Domestic Backward Linkages
   • I-O Tables for VC Mapping
   • Business Functions

3) GVC case study examples
   • Governance Typology
   • Costa Rica Medical Devices GVC
   • Mexico GVC and Clusters Study
   • U.S. Value Chains for Jobs and Wages
Introduction

- Proliferation of research labeled as “GVC” over the last 5-10 years
- All related to production fragmentation, but different motives, approaches and definitions of GVCs
- Three main groups involved
  - Social science & geography academic research centers (originators of GVC and GPN frameworks)
  - Economists & national statistics offices (from original firm-level VC approach to new I-O, DCE, TiVA efforts)
  - International NGOs and national governments (funders/implementers)
- Benefits from combining (a) theoretical insights and industry experience from ‘traditional” GVC researchers and (b) data availability and analysis from economists and statistics agencies
Dimensions of GVC Analysis

For a specific industry, good or service
• Input-output structure (firms and products)
  – Physical transformation (supply chain, end markets)
  – Intangible activities (value-adding activities)
• Geography (countries)
• Governance (lead firms and organizations)
• Industry stakeholders (firms & organizations along chain)
• Institutional context
• Upgrading (functions, products & markets)
Four Parts of Value Chain Model

SUPPLY CHAIN STAGES

Raw Materials | Components | Final Products | Distribution & Sales | Markets

Agriculture, Forestry, & Fishing (A)
Mining & Quarrying (B)
Manufacturing (C)
Manufacturing (C)
Wholesale & Retail Trade (G)
Transport & Storage (H)
Admin & support service activities (N)

KEY VALUE-ADDING ACTIVITIES
Business Functions

Top row: Non-manufacturing activities that account for most “value-added”

Describe by type of market or industry; use ISIC divisions

MARKET
MARKET
MARKET

END MARKETS/BUYERS & SUPPORTING INDUSTRIES

Universities & Education (P)
Utilities (D, E)
Financial and insurance activities (K)
Information and communication (J)
Professional, scientific and technical activities (M)

Source: Frederick, S. (2014). Represents ISIC 4 sections
Data Needed for GVC Analysis

*Country-level data on*

1) Economic activity (industry) of establishments
2) Products/services (traded and domestic)
3) End buyer markets (for intermediates)
4) Supply chain position (input-output flow)
   - Raw materials, intermediates, final products, retail/sales
5) Value-adding activities (or business functions), establishments
6) Occupations (optional)
## GVC Dimensions: Current & Proposed Data Sources

<table>
<thead>
<tr>
<th>GVC Dimensions</th>
<th>Current</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input-output structure</strong></td>
<td>Interviews; secondary lit.</td>
<td>I-O TBLs</td>
</tr>
<tr>
<td>• Physical transformation</td>
<td></td>
<td>Business Functions; input categories in I-O TBLs</td>
</tr>
<tr>
<td>• Value-adding activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Geography</strong></td>
<td>Trade data (UN Comtrade)</td>
<td>Business Functions; AMNE</td>
</tr>
<tr>
<td><strong>Governance</strong></td>
<td>Interviews; market reports</td>
<td>Requires <em>firm-specific</em> data (not focus for this presentation)</td>
</tr>
<tr>
<td>• Lead Firms</td>
<td>Interviews; secondary lit.</td>
<td></td>
</tr>
<tr>
<td>• Institutions</td>
<td></td>
<td></td>
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<tr>
<td><strong>Industry Stakeholders</strong></td>
<td>National I-O &amp; annual surveys</td>
<td></td>
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<tr>
<td><strong>Upgrading</strong></td>
<td>Interviews; secondary lit.</td>
<td>Business Functions</td>
</tr>
<tr>
<td>• Functional</td>
<td>Interviews; secondary lit.</td>
<td>TiVA; DCE; I-O TBLs</td>
</tr>
<tr>
<td>• Linkages</td>
<td>Interviews; secondary lit.</td>
<td>I-O TBLs</td>
</tr>
<tr>
<td>• End markets</td>
<td>Interviews; secondary lit.</td>
<td>Trade data + I-O TBLs; BTDIxE (using EUC)</td>
</tr>
<tr>
<td>• Products</td>
<td>Trade data</td>
<td>--</td>
</tr>
</tbody>
</table>

**Objective:** Quantifying or finding ways to measure “qualitative” analysis.
Apparel Value Chain

Increasing Economic Value-Added

Inputs | Components (Textiles) | Final Products | Distribution, Sourcing & Sales

Natural & Synthetic Fibers
Yarn Production
Fabric Production
Apparel Production (Cut & Sew)

Intermediaries

Lead Firms
Brand Manufacturers
Brand Marketers
Retailers

Trim (Buttons, Zippers, Elastic, etc.)
Equipment & Machinery

“Services” account for 70-80% of value-added – fall outside of ISIC 18 (apparel manufacturing)

Red indicates highest value-added activities + control/power over the chain
Percentages represent relative shares of apparel retail selling price attributed to value-adding activities
**Detail needed to achieve minimum categories**

Level of detail needed can be reached by using **6-digit HS codes or potentially 6-digit NAICS** (more detailed extension of ISIC). However required significant re-categorizing.

Lead firms are either labeled as manufacturers even if they don’t manufacture, or are labeled as generic “wholesale” or “retail”
Purpose of this slide:
(1) Level of detail needed to map an industry’s supply chain (NAICS);
(2) Orange boxes indicate NON-apparel end markets (different ISIC); can identify these using I-O tables
Even the best possible categorizations using ISIC do not provide adequate detail. Textile components are grouped with final products and knit fabric classified at 3-digit level with non-apparel end-uses (and was not separated from knit apparel in ISIC Rev. 3). Also not a connection to upstream and more importantly, downstream segments.
Value Chain Model correlated to ISIC: Value-Adding Activities & Supporting Industries

- **Research & Development**
  - ISIC: 72, 74

- **Design & Development**
  - ISIC: 58, 59, 71, 74

- **Production/Operations/Industries**
  - ISIC: 45-46
  - Goods: 01-03, 05-09, 10-33
  - Services: 41-43, 55-56, 75-77-79, 84-86-88, 90-93; 95-98

- **Distribution & Logistics**
  - ISIC: 73
  - Goods: 7420, 8230
  - Services: 47

- **Sales & Marketing**
  - ISIC: 71

- **Mgmt., Admin Back Office**
  - ISIC: 5820, 64, 65, 66, 69, 7020, 7740, 80, 82
  - ISIC: 7010, 81

- **Infrastructure (Utilities) & Finance**
  - ISIC: 35, 36, 37, 38

- **Trade & Professional Associations**
  - ISIC: 94

- **Information Services**
  - ISIC: 581 5911, 5920 6312 6391 7490 9101

- **ICT Services (Communication, Software & IT-Services)**
  - ISIC: 60, 61 5820 6201 6202 6311 9511 6209

- **Education, Testing & Training**
  - ISIC: 85

ISIC codes linked to value chain reference model; codes in black match S-DOT (traded, potential ICT-enabled supporting industries)

- ISIC loosely represents parts of the VC model, but isn’t industry-specific.
- Industries primarily associated with production & services.
- Further complications with service industries and enabling support services.
**Business Functions & Organizational Decision Matrix in GVCs**

- **Business function classification**
  - 8 activities
    - 1 core + 7 supporting
    - Visual separates activities that relate to “value-adding activities”

- For any of the business functions, a company makes two choices, leading to four potential outcomes
  - Make or buy
  - Domestic or offshore

- Parenthesis indicate supplemental data sources

<table>
<thead>
<tr>
<th>Location/Organization</th>
<th>Domestic</th>
<th>International</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Internal</strong></td>
<td>Make – domestic (in-house) (national surveys)</td>
<td>Make – offshore (FDI) (AMNE)</td>
</tr>
<tr>
<td><strong>External</strong></td>
<td>Outsource – domestic (I-O TBLs)</td>
<td>Outsource – offshore (trade data)</td>
</tr>
</tbody>
</table>

**Business Functions & Organizational Decision Matrix in GVCs**

- **R&D; Design**
- **Marketing & Sales**
- **Distribution & Logistics**
- **Primary Activity**
- **General Mgmt. & Admin**
- **Facilities Maintenance**
- **Customer & After-Sale Service**
- **ICT Services**
Business Functions

- Business function surveys are asking the right questions, but usefulness depends on ability to link to other classification systems.
- Business function results need to be able to be linked to ISIC or CPC.
- As such, they will provide data on where value-adding activities take place (domestic or offshore) and how buyers set up organizational models (make or buy).
- Without links to industries, not a clear way to link data to industry-specific GVC studies.
Conclusions for GVC-ISIC comparison

• New datasets offer improvements to filling data gaps for GVC analysis
• Still need more detailed data and ability to link data along a chain and to other classification systems in more detail for GVC studies
• Usefulness of data will depend on ability to provide more industry-specific data and how business functions linked to ISIC
GVC Case Study Examples

- Governance Typologies
- Costa Rican Medical Devices
- Mexico GVC and Clusters Study (new)
- U.S. Value Chains and Jobs
Five types of global value chain governance

Source: Gereffi at al. [2005]
# Dynamics in Global Value Chain Governance

<table>
<thead>
<tr>
<th>Governance Type</th>
<th>Complexity of transactions</th>
<th>Ability to codify transactions</th>
<th>Capabilities in the supply-base</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Modular</td>
<td>High (1)</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Relational</td>
<td>High</td>
<td>Low</td>
<td>High (5)</td>
</tr>
<tr>
<td>Captive</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Hierarchy</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

1. **Increasing complexity of transactions** (harder to codify transactions; effective decrease in supplier competence)
2. **Decreasing complexity of transactions** (easier to codify transactions; effective increase in supplier competence)
3. **Better codification of transactions** (open or de facto standards, computerization)
4. **De-codification of transactions** (technological change, new products, new processes)
5. **Increasing supplier competence** (decreased complexity, better codification, learning)
6. **Decreasing supplier competence** (increased complexity, new technologies, new entrants)
GVCs in fresh vegetables sector (from Africa to UK)

Source: Dolan and Humphrey [2004]
COSTA RICA’S
MEDICAL DEVICES GVC
Local firms are mainly in packaging & support services (12 of 19) versus 4 in limited role in plastics molding & metal finishing and 1 OEM with exports under $2 million.
EVOLUTION OF COSTA RICAN MEDICAL DEVICE EXPORTS

Costa Rica's Medical Exports by Product Category: 1998-2011

- **Disposables** still the largest product category exported, but no longer a strong growth area.
- Exports in **surgical instruments** have grown steadily since 2005.
- **Therapeutics** has become 2nd largest category since 2008; likely to increase as newly established firms complete transfer of new product lines.
- Limited export of highest value **capital equipment** (eg. Electronic/software devices)
## FIRMS IN COSTA RICA MEDICAL DEVICES SECTOR

<table>
<thead>
<tr>
<th>Entry Year</th>
<th>Firm Characteristics</th>
<th>Main Product Export Category</th>
<th>Core Market Segments</th>
<th>Product Examples</th>
<th>Select Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Up to 2000</strong>&lt;br&gt;24 firms:&lt;br&gt;8 US&lt;br&gt;15 CR&lt;br&gt;1 German</td>
<td>4 OEMs&lt;br&gt;8 Components&lt;br&gt;1 Input distributor&lt;br&gt;7 Packaging&lt;br&gt;1 Finishing&lt;br&gt;3 Support services</td>
<td>Disposables</td>
<td>Drug delivery; Women’s health</td>
<td>Intravenous tubing (I) Mastectomy bra (I)</td>
<td>Hospira; Baxter; Amoena; Corbel</td>
</tr>
<tr>
<td><strong>2001–2004</strong>&lt;br&gt;13 firms:&lt;br&gt;9 US&lt;br&gt;3 CR&lt;br&gt;1 Colombian</td>
<td>3 OEMS&lt;br&gt;6 Components&lt;br&gt;1 Finishing&lt;br&gt;1 Logistics provider&lt;br&gt;2 Support services</td>
<td>Instruments</td>
<td>Endoscopic surgery</td>
<td>Biopsy forceps (II)</td>
<td>Arthrocare; Boston Scientific; Oberg Industries</td>
</tr>
<tr>
<td><strong>2005–2008</strong>&lt;br&gt;8 firms:&lt;br&gt;7 US&lt;br&gt;1 Puerto Rico</td>
<td>2 OEM&lt;br&gt;4 Components&lt;br&gt;1 Packaging&lt;br&gt;1 Finishing</td>
<td>Therapeutics</td>
<td>Cosmetic surgery; Women’s health &amp; urology</td>
<td>Breast implants (III) Minimally invasive devices for uterine surgery (II)</td>
<td>Allergan; Tegra Medical; Specialty Coating Systems</td>
</tr>
<tr>
<td><strong>2009–2012</strong>&lt;br&gt;21 firms:&lt;br&gt;16 US&lt;br&gt;1 CR&lt;br&gt;1 Ireland&lt;br&gt;1 Japan&lt;br&gt;2 Joint ventures (US-CR)</td>
<td>5 OEMS&lt;br&gt;7 Components&lt;br&gt;2 Non-OEM assemblers&lt;br&gt;1 Input Distributor&lt;br&gt;2 Sterilization&lt;br&gt;2 Packaging</td>
<td>Therapeutics Disposables Instruments</td>
<td>Cardiovascular Drug delivery</td>
<td>Heart valves (III) Dialysis catheters (III) Guide wires (III) Compression socks (I)</td>
<td>Abbott Vascular St. Jude Medical Covidien Moog Synergy Health Volcano Corp.</td>
</tr>
</tbody>
</table>
UPGRADING SUCCESS: A LEADING MEDICAL DEVICES MNC IN COSTA RICA

2004
First production plant opens in Costa Rica (10,000m²)

2005
Exports: US$18 million

2008
Second plant opens. (32,000m²)
First plant restructuring

2010
Initial plant reopens after restructuring

2011
Exports: US$120 million

Functional Upgrading
- 2004: Manufacturing functions
- 2012: Engineering for process improvements ➔ Focused on cardiology segment; strategy – to alleviate R&D costs in the US.

Product & Process Upgrading
- Biopsy forceps ➔ Labor intensive, basic metal works & extrusion.
- Urethral stent ➔ Thermoforming, laser marking, coating capabilities.
- Today – CR facilities cover 42 manufacturing processes.

Market Diversification
- Gastroenterology segment ➔ Urology ➔ Cardiovascular

Forward Linkages
- Recent co-location of sterilization vendors will allow the firm to export directly to global distribution centers

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MEXICO STUDY ON GVCs AND CLUSTERS
Mapping of GVCs across four dimensions for each industry...

- Local clusters
- Links to other states and clusters in Mexico
- Links to United States and Canada
- Other International linkages

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## Mexico’s Plan Nacional de Desarrollo, 2013-2018

### Estrategia Sectorial

<table>
<thead>
<tr>
<th>Maduros</th>
<th>Dinámicos</th>
<th>Emergentes</th>
</tr>
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<tbody>
<tr>
<td>Metal mecánico</td>
<td>Automotriz y Autoparte</td>
<td>Biotecnología</td>
</tr>
<tr>
<td>Textil-vestido y cuero-calzado</td>
<td>Aeroespacial</td>
<td>Farmacéutico</td>
</tr>
<tr>
<td>Madera y muebles</td>
<td>Eléctrico</td>
<td>TI</td>
</tr>
<tr>
<td>Siderúrgico</td>
<td>Electrónico</td>
<td>Industrias creativas</td>
</tr>
<tr>
<td>Alimentos y bebidas</td>
<td>Químico</td>
<td>Equipo médico</td>
</tr>
</tbody>
</table>

**Impulsar la productividad**

**Incrementar la competitividad**

**Atraer y fomentar los sectores emergentes**
Pilot Study for 3 Mexican GVCs

Objectives: Design the methodology and measure upgrading and innovation (at the level of clusters, firms and jobs)

- **Mature Sector**
  - Textile-Apparel Industry

- **Dynamic Sector**
  - Aerospace Industry

- **Emergent Sector**
  - Medical Devices Industry
### Automobile production in 2007 and 2011

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<tbody>
<tr>
<td>1 USA TRADITIONAL</td>
<td>3,906,092</td>
<td>114,885</td>
<td>5,168,834</td>
<td>152,025</td>
<td>3,770,521</td>
<td>157,105</td>
<td>1,050,635</td>
<td>262,659</td>
<td>1,487,973</td>
<td>165,330</td>
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<tr>
<td>2 USA NEW</td>
<td></td>
<td></td>
<td>4,732,815</td>
<td>197,201</td>
<td>3,770,521</td>
<td>4,732,815</td>
<td>1,050,635</td>
<td>262,659</td>
<td>1,487,973</td>
<td>165,330</td>
</tr>
<tr>
<td>3 Mexico TRADITIONAL</td>
<td>1,050,635</td>
<td>262,659</td>
<td>52,466</td>
<td>188,117</td>
<td>1,050,635</td>
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<td>262,659</td>
<td>1,487,973</td>
<td>165,330</td>
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<td>4 Mexico NEW</td>
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<td></td>
<td>752,466</td>
<td>188,117</td>
<td>1,487,973</td>
<td>1,275,289</td>
<td>1,487,973</td>
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<td>1,487,973</td>
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<td>5 Ontario CA</td>
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<td>184,587</td>
<td>2,424,480</td>
<td>220,407</td>
<td>2,030,457</td>
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<td>2,424,480</td>
<td>220,407</td>
<td>2,030,457</td>
<td>2,424,480</td>
</tr>
</tbody>
</table>
NC in the Global Economy (NCGE)

- NCGE is a website that provides a web-based value chain analysis of seven key industries in North Carolina
  - Tobacco, textiles & apparel, furniture, IT, biotechnology, banks & finance, hog farming,

- **Goals:** provide useful data and engaging visualizations for better decision making by policy makers, companies and educational institutions leading to more good **jobs** and **innovation**, and improved **competitiveness** in the state
NC Furniture Value Chain - 2012

Furniture design & engineering
Employees: 38
Estbm’t: 23
Avg. wage: 31,326

Wood, metal, leather, plastic, glass & rattan
Employees: 6,434
Estbm’t: 667
Avg. wage: 35,705

Household Furniture
Employees: 21,680
Estbm’t: 356
Avg. wage: 33,116

Furniture Transportation
Employees: 36,633
Estbm’t: 3,043
Avg. wage: 41,679

Furniture Stores
Employees: 7,596
Estbm’t: 895
Avg. wage: 33,803

plywood, cut stock, frame & upholstery
Employees: 9,464
Estbm’t: 176
Avg. wage: 39,397

Office & Institutional Furniture
Employees: 5,403
Estbm’t: 226
Avg. wage: 35,441

Furniture Warehousing
Employees: 17,800
Estbm’t: 414
Avg. wage: 39,675

Furniture related products
Employees: 5,981
Estbm’t: 338
Avg. wage: 37,431

Furniture Wholesale
Employees: 2,531
Estbm’t: 247
Avg. wage: 46,100

Employees: 15,898
Estbm’t: 843
Avg. wage: 37,903

Employees: 33,064
Estbm’t: 920
Avg. wage: 34,276

Employees: 59,964
Estbm’t: 3,704
Avg. wage: 41,249

Employees: 7,596
Estbm’t: 895
Avg. wage: 33,803
Comparing NC’s employment with main US competitors

Top State Furniture Employment, by NAICS Codes: 2012

- **NC**
  - 3371 Household: 2,844
  - 3372 Office: 4,989
  - 3379 Furniture Related: 25,231

- **CA**
  - 3371 Household: 3,682
  - 3372 Office: 7,517
  - 3379 Furniture Related: 19,948

- **TX**
  - 3371 Household: 3,784
  - 3372 Office: 4,351
  - 3379 Furniture Related: 13,858

- **IN**
  - 3371 Household: 1,312
  - 3372 Office: 6,291
  - 3379 Furniture Related: 13,361

- **MI**
  - 3371 Household: 541
  - 3372 Office: 14,556
  - 3379 Furniture Related: 4,465

- **MS**
  - 3371 Household: 712
  - 3372 Office: 1,448
  - 3379 Furniture Related: 15,867
Comparing NC wages with main US competitors

Top Furniture State Average Annual Wages, by NAICS Code: 2012

- 3371 - Household Furniture
- 3372 - Office Furniture
- 3379 - Furniture-Related Products

<table>
<thead>
<tr>
<th>State</th>
<th>Total</th>
<th>3371</th>
<th>3372</th>
<th>3379</th>
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<tbody>
<tr>
<td>CA</td>
<td>38,518</td>
<td>37,199</td>
<td>46,298</td>
<td>46,615</td>
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<tr>
<td>IN</td>
<td>32,659</td>
<td>37,595</td>
<td>36,827</td>
<td>43,709</td>
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<tr>
<td>MI</td>
<td>43,709</td>
<td>46,615</td>
<td>59,241</td>
<td>59,241</td>
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<tr>
<td>MS</td>
<td>33,537</td>
<td>30,393</td>
<td>26,266</td>
<td>33,537</td>
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<tr>
<td>NC</td>
<td>42,508</td>
<td>33,070</td>
<td>35,690</td>
<td>42,508</td>
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<tr>
<td>TX</td>
<td>32,929</td>
<td>37,017</td>
<td>40,557</td>
<td>32,929</td>
</tr>
</tbody>
</table>
Manufacturing workers in North Carolina make, on average, nearly $8,000 less than the U.S. average.

Manufacturing Wages in North Carolina Compared to the National Average

- **North Carolina**: $44,692
- **U.S. Average**: $52,540
- **Gap**: $7,847

Sources of North Carolina’s Manufacturing Wage Gap

Broadly, there are three sources for North Carolina’s manufacturing wage gap:

1. Lower share of employment in high wage industries
2. Greater share of employment in low-wage industries
3. Lower average wage for seemingly similar industries

NC’s Potential Upgrading Strategies

**Future Growth**
- 8.4% of employment
- NC often has numerous scattered firms, but no well-defined cluster

**Strengthen**
- 12.3% of employment
- Existing strengths
- High R&D
- Fill technology gaps or cross-chain upgrading

**Localized**
- 36.5% of employment
- Minimal scope for specialization or upgrading

**Transition**
- 42.9% of employment
- NC's traditional mfg. strengths
- Generally low tech
- Upgrade or mitigate decline

North Carolina’s Industry Mix

- **High Wage, Low Employment**
  - NC Above Nat
  - Employment Share
  - 3344 – Semiconductors
  - 3364 - Aerospace

- **Low Wage, Low Employment**
  - NC Below Nat
  - Employment Share
  - 3231 - Printing
  - 3327 - Machine Shops

- **High Wage, High Employment**
  - High Average Wage
  - 3122 - Tobacco
  - 3254 - Pharma

- **Low Wage, High Employment**
  - NC Below Average Wage
  - 3151 – Knit Apparel
  - 3116 – Animal Slaughtering
  - 3131 – FY&T
  - 3371 - Furniture

Authors’ calculations.
Policy Relevance of GVC Sector Profiles

• Closing North Carolina’s manufacturing wage gap could significantly improve wages and the standard of living in North Carolina

• Higher productivity is the key to doing this, but also a need to improve NC’s industry mix and high wage jobs

• Upgrading strategies are needed to define NC’s investment, employment and innovation priorities

• Intra-U.S. comparisons are relevant, but GVC competitiveness is increasingly defined at the regional level (e.g., North American, East Asia, EU)
THANK YOU

Questions?

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