MEASURING ECONOMIC DIVERSIFICATION USING INPUT-OUTPUT ANALYSIS
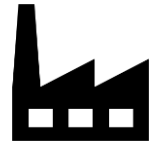
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Economic diversification

Production side

- Industries/products
  - Raw materials (mining, agriculture) / Processed materials / Manufactured products / Services

- Primary inputs
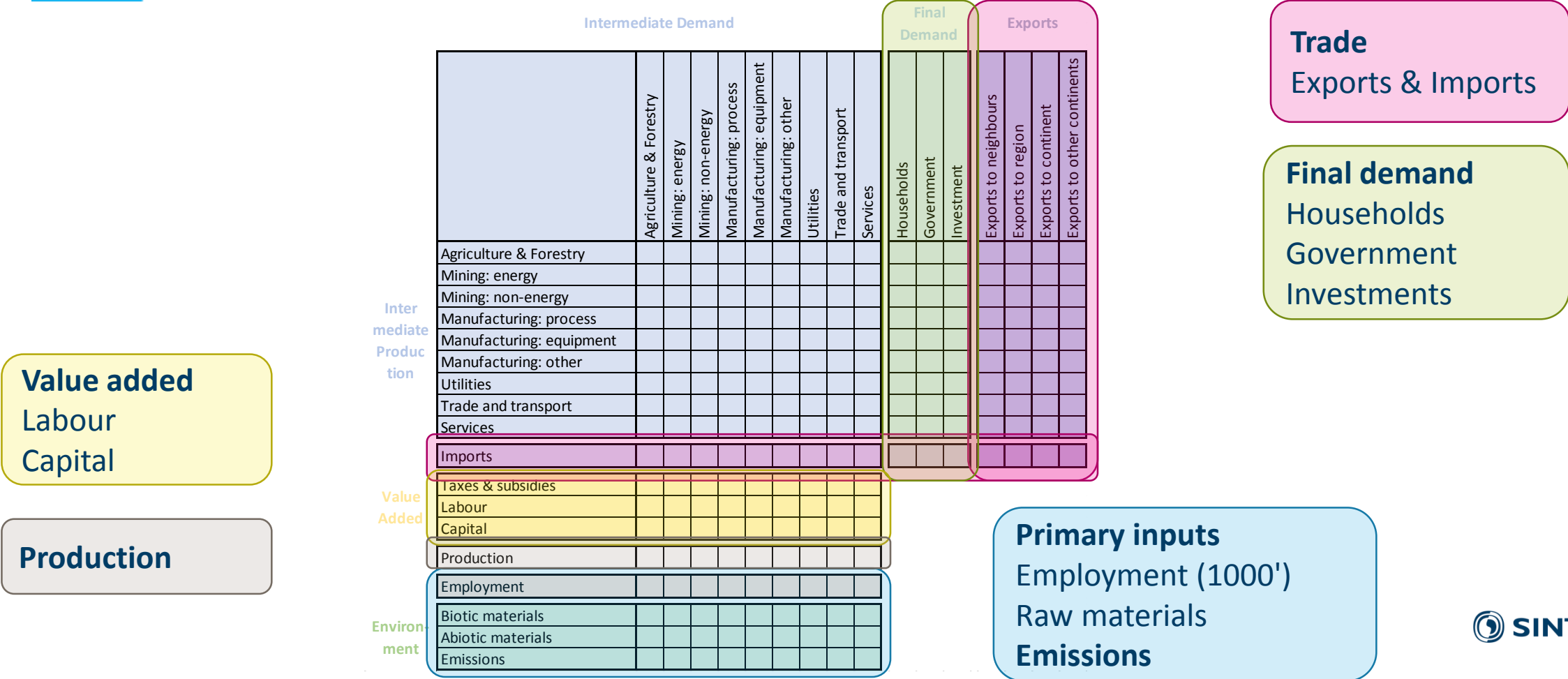 - Capital / labour / nature inputs

Demand side

- Consumer types
  - Households, government, companies (investment/capital goods)

- Markets
  - Domestic / international – regional / global

Existing measures of economic diversification[1]

- Product / industry shares in aggregated economic indicators
  - Exports, production, value added, employment
  - e.g. Herfindahl / Herfindahl-Hirschman Index $\sum s_i^2$, Ogive $\sum \frac{(s_i - 1/N)^2}{1/N}$, Entropy $\sum s_i ln \frac{1}{s_i}$

- Export Concentration Index (ECI) & Export Vulnerability Index (EVI) [2]

- Export sophistication: PRODY and EXPY [3]

- Markowitz' portfolio theory considering uncertainties

- **Input-Output-based measures[4-6]**

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Input-output tables give a detailed snapshot of a country's economic structure

Trade
Exports & Imports

Final demand
Households
Government
Investments

Value added
Labour
Capital

Production

Primary inputs
Employment (1000')
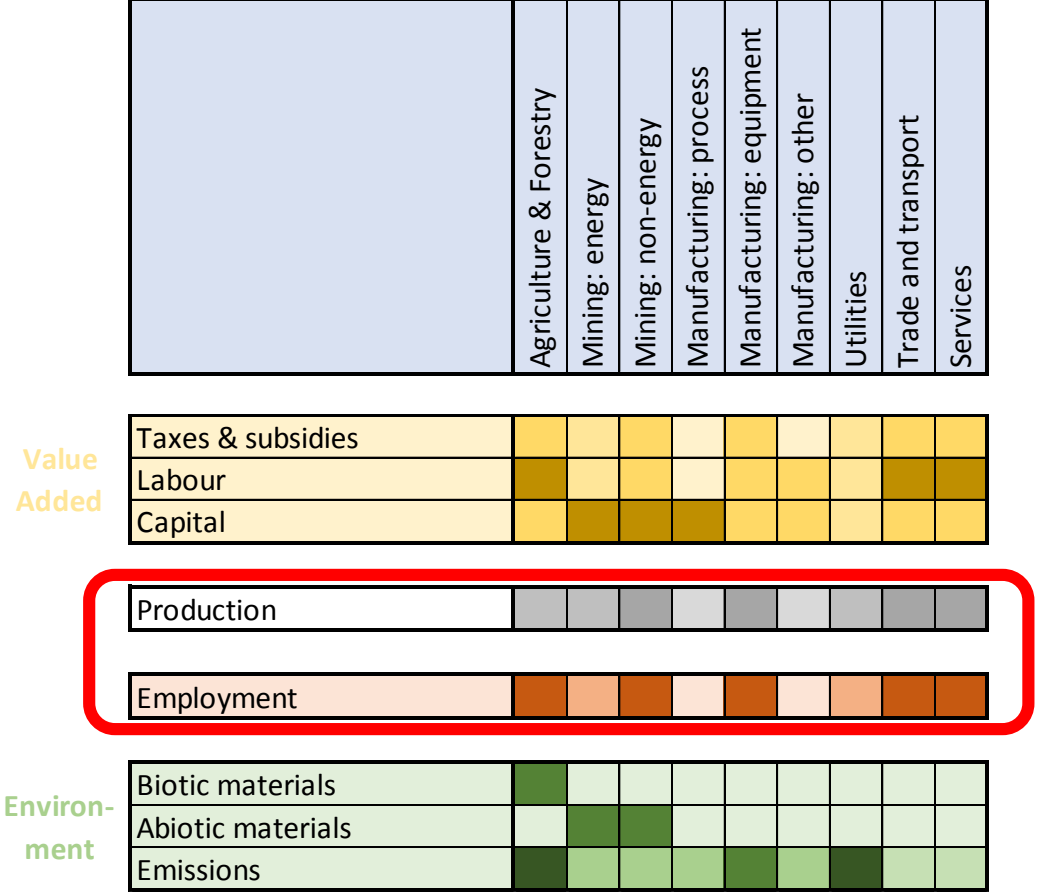Raw materials
Emissions

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Input-output tables give a detailed snapshot of a country's economy

- IO tables are consistent with the System of National Accounts (SNA)
→ Macro-economic aggregates
→ With industry detail
- Production and use of intermediate and final products by industry/economic actor
- Factor input use (e.g. labour, capital) by industry
→ Identification of linkages through production chains/network

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{Y}$$

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Example of a diversified economy - but, is it?

Copper exports

- **Copper** is produced by non-energy mining
- Intermediate inputs
  - Electricity
  - Equipment
  - Transport services
- Primary inputs: all

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Copper exports

- Copper is produced by non-energy mining
- Intermediate inputs
  - **Electricity**
    - Mining: energy
    - Equipment
    - Utilities
  - Equipment
  - Transport services
- Primary inputs: all

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Copper exports

Indirect effects

- **Copper** is produced by non-energy mining
- Intermediate inputs
  - **Electricity**
  - # Mining: energy
    - Equipment
    - Utilities
    - Trade & transport
  - Equipment
  - Utilities
  - Equipment
  - Transport services
- Primary inputs: fossil fuels

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Copper exports

Direct effects

Indirect effects

- **Copper** is produced by non-energy mining
- Intermediate inputs
  - **Electricity**
    - **Mining: energy**
      - **Equipment**
        - Utilities
        - Trade & transport
    - **Equipment**
      - Utilities
  - **Equipment**
    - Transport services
- Primary inputs: all

Intermediate Demand   **Final Demand**   **Exports**

	Agriculture & Forestry	Mining: energy	Mining: non-energy	Manufacturing: process	Manufacturing: equipment	Manufacturing: other	Utilities	Trade and transport	Services	Households	Government	Investment	Exports to neighbours	Exports to region	Exports to continent	Exports to other continents
Agriculture & Forestry																
Mining: energy																
Mining: non-energy																Copper
Manufacturing: process																
Manufacturing: equipment																
Manufacturing: other																
Utilities																
Trade and transport																
Services																
Imports																
Taxes & subsidies																
Labour																
Capital																
Production																
Employment																
Biotic materials																
Abiotic materials																
Emissions																

Intermediate Production

Value Added

Environment

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Copper exports

- **Copper** is produced by non-energy mining
- Intermediate inputs
  - **Electricity**
    - **Mining: energy**
      - **Equipment**
      - Utilities
      - Trade & transport
    - **Equipment**
    - Utilities
  - **Equipment**
  - Transport services
- Primary inputs

  - **Labour → income**

  →Household consumption

Direct effects

Indirect effects

Induced effects

	Intermediate Demand									Final Demand			Exports				
	Agriculture & Forestry	Mining: energy	Mining: non-energy	Manufacturing: process	Manufacturing: equipment	Manufacturing: other	Utilities	Trade and transport	Services	Households	Government	Investment	Exports to neighbours	Exports to region	Exports to continent	Exports to other continents	
Agriculture & Forestry																	Food
Mining: energy																	
Mining: non-energy																	Copper
Manufacturing: process																	
Manufacturing: equipment																	
Manufacturing: other																	Clothes
Utilities																	
Trade and transport																	
Services																	Education
Imports																	
Taxes & subsidies																	
Labour																	
Capital																	
Production																	
Employment																	
Biotic materials																	
Abiotic materials																	
Emissions																	

Inter mediate Production

Value Added

Environ-ment

Social Accounting Matrix / Econometric feedback model

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Copper exports

- **Copper** is produced by non-energy mining
- Intermediate inputs
  - **Electricity**
    - **Mining: energy**
      - **Equipment**
      - Utilities
      - Trade & transport
    - **Equipment**
    - Utilities
  - **Equipment**
  - Transport services
- Primary inputs
  - **Labour → income**
  → **Household consumption**
- **Demand for final goods**

Social Accounting Matrix / Econometric feedback model

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Copper exports

- **Copper** is produced by non-energy mining
- Intermediate inputs
  - **Electricity**
    - **Mining: energy**
      - **Equipment**
      - Utilities
      - Trade & transport
    - **Equipment**
    - Utilities
  - **Equipment**
  - Transport services
- Primary inputs
  - **Labour → income**
→ **Household consumption**
- **Demand for final goods**
- **Intermediate production in all industries**

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Social Accounting Matrix / Econometric feedback model

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Copper exports

Quantifying economic diversification for informing **policy** using IO tools

- Common concentration measures applied to a variety of production and demand side indicators

- IO-specific diversification measures

  - Inverse important coefficient[7-9]:
    Which change in intermediate supply has the largest economy-wide effect?

  - Trade in Value Added (TiVA) indicators: http://oe.cd/tiva

  - Production dependence on demand:
    % of value added and employment depending on the set of largest export goods

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Trade in Value Added (TiVA) indicators
http://oe.cd/tiva

Domestic value added share of gross exports

Legend:
- EU28 average
- G20 average
- China
- Japan
- United States

Source: OECD, Trade in Value Added (TiVA) database, December 2018
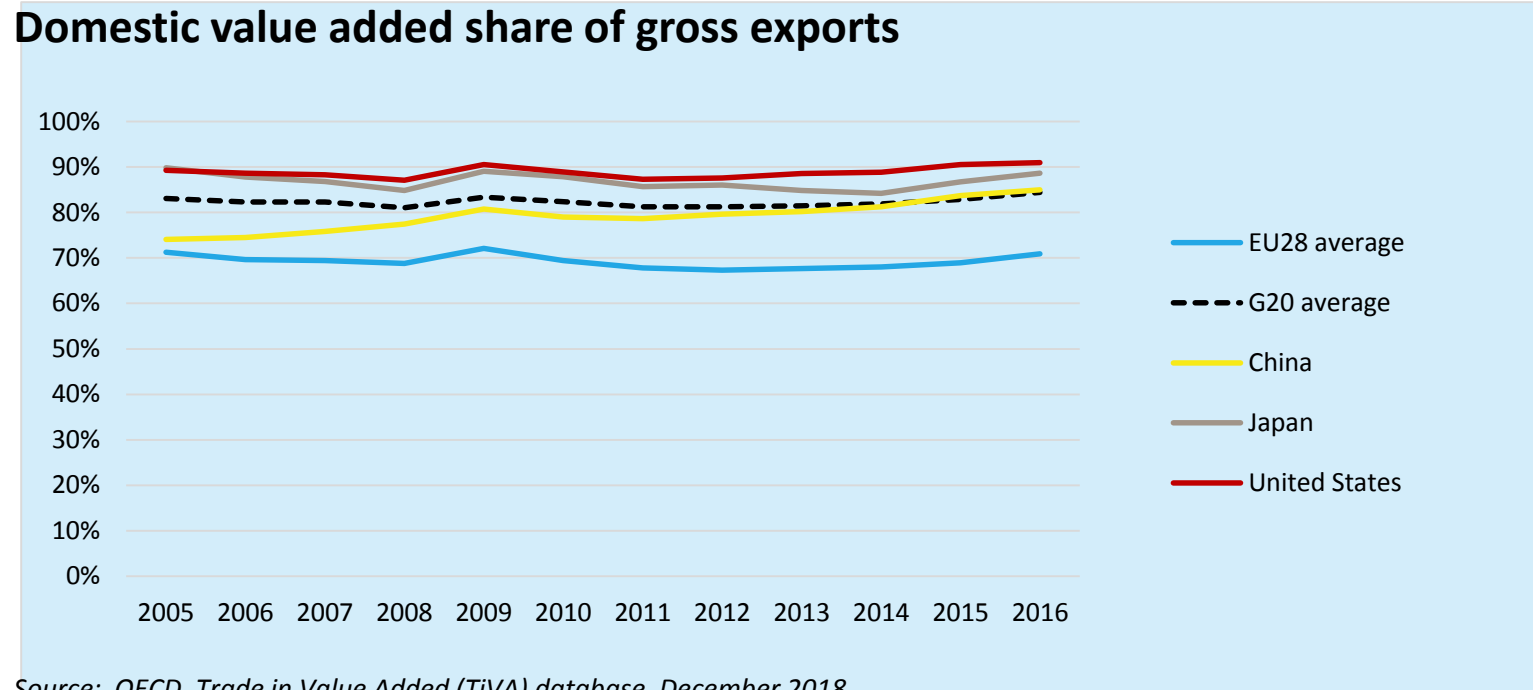
Note:
EU28 and G20 averages are unweighted averages of countries' foreign value added share of gross exports.
Estimates for 2016 are preliminary projections

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Shares of largest exports goods

Share of 5 biggest export goods in total exports

Calculations based on GTAP9 power database

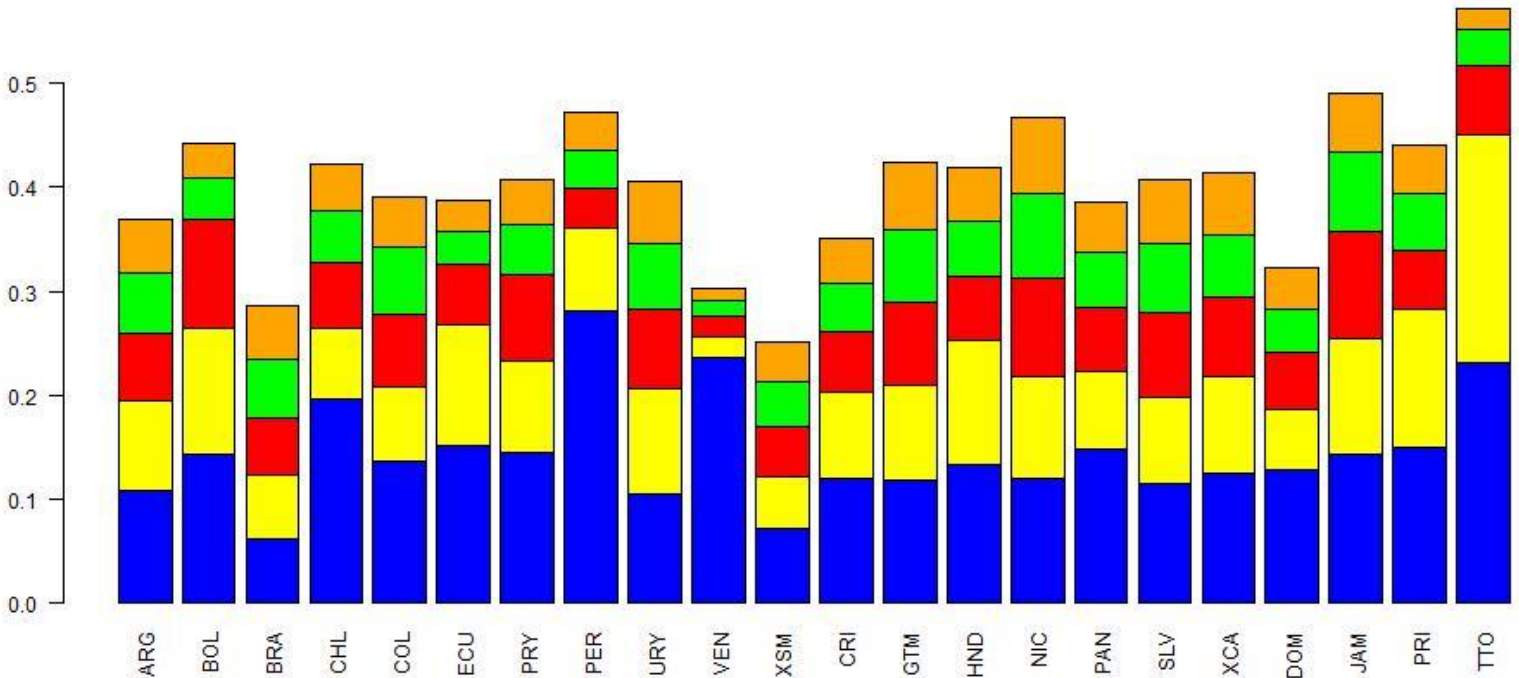|	Argentina	Bolivia	Brazil	Chile	Colombia	Ecuador	Paraguay	Peru	Uruguay	Venezuela	Rest of South America	Costa Rica	Guatemala	Honduras	Nicaragua	Panama	El Salvador	Rest of Central America	Dominican Republic	Jamaica	Puerto Rico	Trinidad & Tobago
5	Vegetable oils and fats	Minerals nec	Minerals nec	Metals nec	Oil	Oil	Oil seeds	Metals nec	Meat: cattle,shee	Oil	Metals nec	Electronic equipment	Crops nec	Textiles	Textiles	Chemical,rubber,plastic	Textiles	Transport nec	Transport nec	Transport nec	Machinery and	Chemical,rubber,plastic
4	Motor vehicles	Metals nec	Oil seeds	Minerals nec	Coal	Food products	Hydroelectric power as	Minerals nec	Chemical,rubber,plastic	Petroleum, coal	Food products	Vegetables, fruit, nuts	Chemical,rubber,plastic	Crops nec	Wearing apparel	Sea transport	Wearing apparel	Wheat	Machinery and	Metals nec	Petroleum, coal	Gas
3	Chemical,rubber,plastic	Vegetable oils and fats	Chemical,rubber,plastic	Food products	Crops nec	Vegetables, fruit, nuts	Meat: cattle,shee	Food products	Transport nec	Chemical,rubber,plastic	Business services nec	Machinery and	Vegetables, fruit, nuts	Crops nec	Wearing apparel	Machinery and	Crops nec	Food products	Textiles	Recreation and other	Chemical,rubber,plastic	Petroleum, coal
2	Oil seeds	Gas	Motor vehicles	Sea transport	Chemical,rubber,plastic	Crops nec	Vegetable oils and fats	Gas	Oil seeds	Minerals nec	Chemical,rubber,plastic	Chemical,rubber,plastic	Textiles	Machinery and	Machinery and	Transport equipment	Chemical,rubber,plastic	Vegetables, fruit, nuts	Chemical,rubber,plastic	Trade	Motor vehicles	Ferrous metals
1	Cereal grains nec	Petroleum, coal	Sugar	Vegetables, fruit, nuts	Metals nec	Petroleum, coal	Transmission and	Crops nec	Paper products,	Ferrous metals	Petroleum, coal	Food products	Minerals nec	Vegetables, fruit, nuts	Air transport	Food products	Motor vehicles	Wearing apparel	Air transport	Business services nec		Oil

% of employment and value added depending on 5 largest export goods

Employment and value added share of 5 biggest export goods in total exports

Calculations based on GTAP9 power database
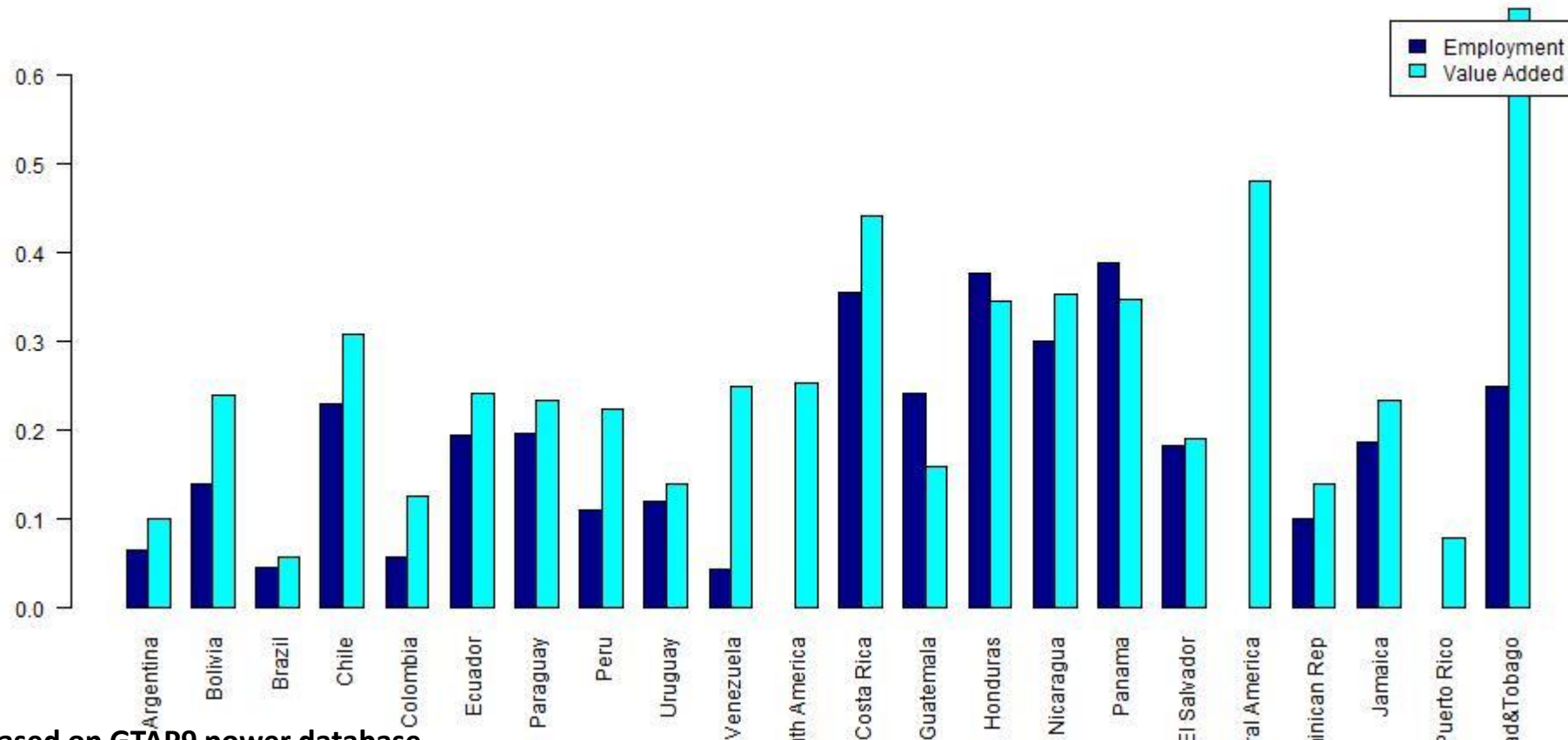
Pros and cons for using IO to measure economic diversification

Pros

- Consistent with SNA

- Consistent production-side and demand-side indicators

- Use of common concentration indicators

- Additional indicators considering indirect effects

Cons

- Timeliness of data availability

- Aggregation level of industries

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Take away
Quantifying economic diversification for informing **policy** using IO tools

Lessons learned

- Calculation of common concentration measures (CCMs) with IO data

- An economy might look diversified when considering only one or two indicators (production & employment) using the CCMs, when it is – in fact – **not**

Using IO analysis tools

- Considering indirect effects

- Simultaneous consideration of markets and products

- Consistent framework for measuring diversification from production- and demand-side for a large variety of indicators

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Literature

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Technology for a better society

Teknologi for et bedre samfunn

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