KLEMS and the U.S. National Accounts

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Introduction

- Long-standing call for statistics on the sources of growth
  - Solow (1957), Denison (1967), Griliches and Jorgenson (1967)
  - Postwar Recovery, Big Slump, IT Boom, the Great Recession, Ongoing Recovery
  - "…differences between the BEA and BLS estimates have led many researchers to construct their own measures …", Jorgenson and Landefeld (2006)

- BEA/BLS Integrated Industry-level production account (KLEMS) available since 2012

- This presentation: Describe this integrated KLEMS account and its relation to the U.S. National Accounts

Integration

- The U.S. statistical system is decentralized
  - BEA, BLS, CENSUS, FRB

- The BEA/BLS industry-level production account is "integrated"
  - Benchmark IO
  - Annual GDP by Industry Accounts
  - Expenditure side GDP
  - BLS measures of capital and labor

Background

- Benchmark I-O accounts:
  - Based on economic census every five years
  - Commodity flow method produces benchmark estimate of final demand
  - Nominal inter-industry transaction tables

- GDP by industry accounts
  - Production approach
  - Quarterly and annual I-O accounts, nominal and chained quantity indexes
  - Annual covers 1947-2016, Quarterly covers 2005-2017Q2

- Expenditure side National Income and Product (NIPA) Accounts:
  - Quarterly and annual, nominal and chained quantity indexes, aggregated from estimates of C, I, G, NX
  - Annual covers 1929-2016; Quarterly covers 1947Q3-2017Q3
  - Used as the official GDP estimate
  - 14 Comprehensive revisions

- Before integration:
  - Benchmark I-O accounts released before the comprehensive revision of the NIPAs and were not revised to reflect the results of comprehensive revisions

- After integration (with release of 2007 benchmark table)
  - Fully integrated with the time series of the NIPAs and the industry economic accounts. For example, 2007 benchmark I-O consistent with the 2013 July 2013 NIPA comprehensive revision

- Yields annual NIPA, GDP by industry, and input-output accounts that are fully consistent with the latest benchmark I-O table

- ## Integrated with the annual GDP by Industry Accounts

Input-output Use Table

Energy, Materials, Services

Capital, Labor

	INDUSTRY		TOTAL INTERME-DIATE	FINAL USES			OUTPUT
	A	B		PCE	INVEN-TORY CHANGE	TOTAL	
Commodity A		35	35	260	10	270	**305**
Commodity B	160		160	0	-8	-8	**152**
Total intermediate	160	35	195				
Total value added	145	117	262				
Compensation	100	20					
Taxes on production and imports less subsidies	5	2					
Gross operating surplus	40	95					
OUTPUT	**305**	**152**		**260**	**2**	**262**	**457**

BEA/BLS Integrated KLEMS Account

Input-output Use Table

Intermediate Input prices are a combination of domestic commodity and import prices

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Producer Price Indexes

-Industry Value- Added Quantity Index measured with "Double Deflation"
-Yields production-based estimate of aggregate VA growth

- Estimation strategies for intermediate input prices
  - Use output prices (PPI) as a proxy for input prices

- Potential problem: Input prices need not track output prices.
  - Recognized example: Import price indexes (IPI's)
  - Research work with Rachel Soloveichik: "Intangibles and the Gap between Export and Domestic Prices: Implications for Measures of Growth and Productivity"

$$P_{YCi}Y_i^C = P_{YCDi}Y_i^{CD} + P_{YCXi}Y_i^{CX}$$

  - Conclusion: Doesn't matter much for U.S. currently, but…

The K&L in KLEMS in the US

- Labor services is the flow of labor hours into production
- Important to account for heterogeneity in hours worked across worker types: Sex, Class (2), Age (8), Education (6), Industry(65)
- Tabulate hours and compensation rates for each cell
- Control Total for Class (1) Labor Compensation from NIPA
- Control Total for hours from the BLS
- Class (2) Wages assumed to be the same as Class(1) by S,A,E,I
- Implementation: U.S. Decennial Census, Annual March Survey from CPS, RAS
- Industry Labor input is a translog index over workers within industry

- Capital services is the flow of capital into production
- Important to account for heterogeneity in asset types: About 105 asset types, including R&D and entertainment originals, land and inventories
- Quantity of capital services by asset is the net productive stock via the perpetual inventory method
- Price of capital services is the rental cost
- Important that prices measured in constant quality units
- Industry capital input is a translog index over assets within industry
- Capital data provided by the BLS

- KLEMS data provides the internally consistent data to do "growth accounting"

- At the industry level (j):

$$\Delta \ln Q_j = \overline{w_{Kj}} \Delta \ln Q_{Kj} + \overline{w_{Lj}} \Delta \ln Q_{Lj} + \overline{w_{Xj}} \Delta \ln Q_{Xj} + \Delta \ln MFP_j$$
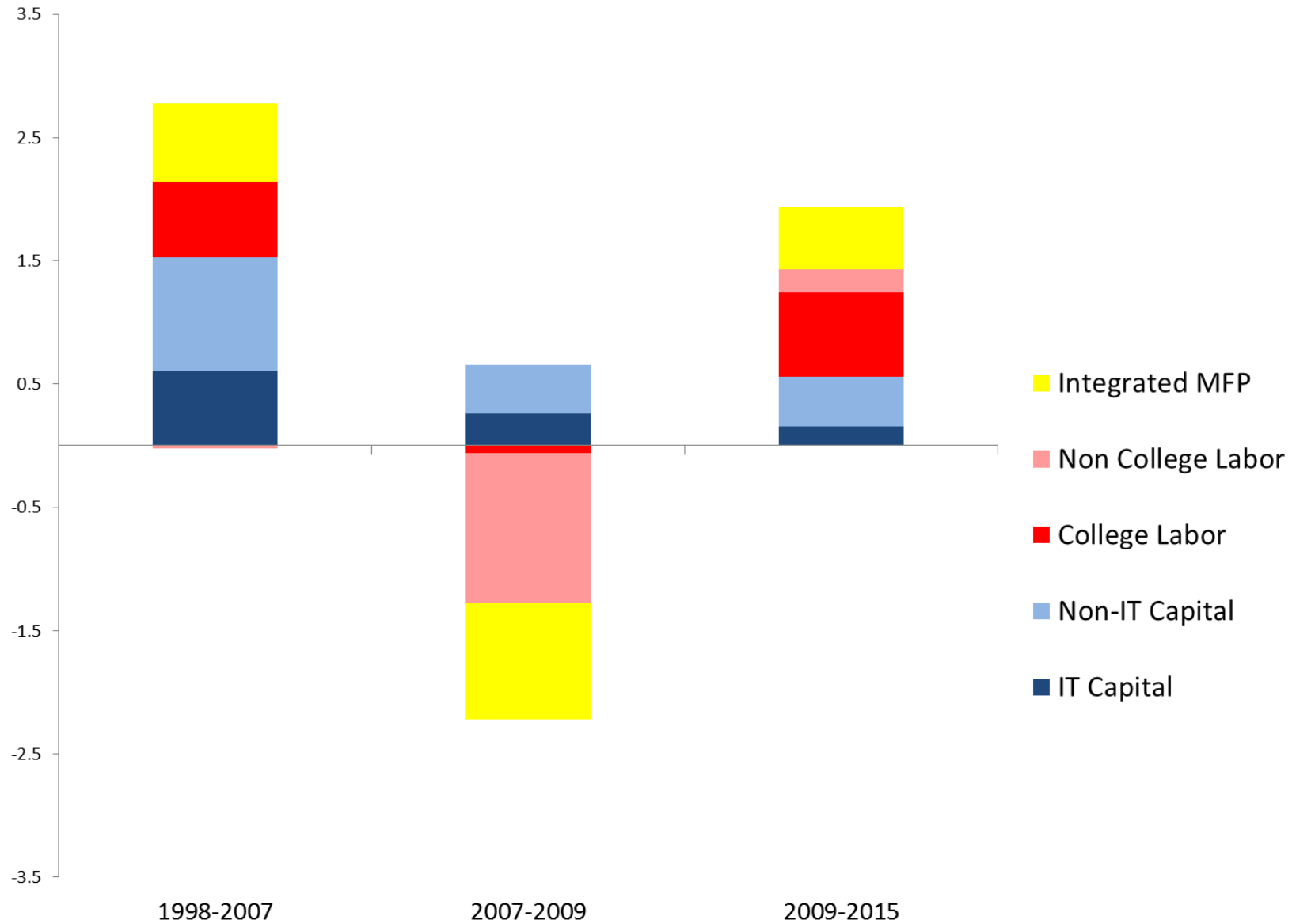
- (Direct) Aggregation across industries:

$$\Delta \ln V = \sum_j \overline{w_j} \frac{\overline{w_{K,j}}}{\overline{w_{V,j}}} \Delta \ln Q_{Kj} + \overline{w_j} \frac{\overline{w_{L,j}}}{\overline{w_{V,j}}} \Delta \ln Q_{Lj} + \overline{w_j} \frac{1}{\overline{w_{V,j}}} \Delta \ln MFP_j$$

- The Aggregate Production Possibility Frontier:

$$\Delta \ln V = \overline{w_{KA}} \Delta \ln Q_{KA} + \overline{w_{LA}} \Delta \ln Q_{LA} + \Delta \ln MFP_A$$
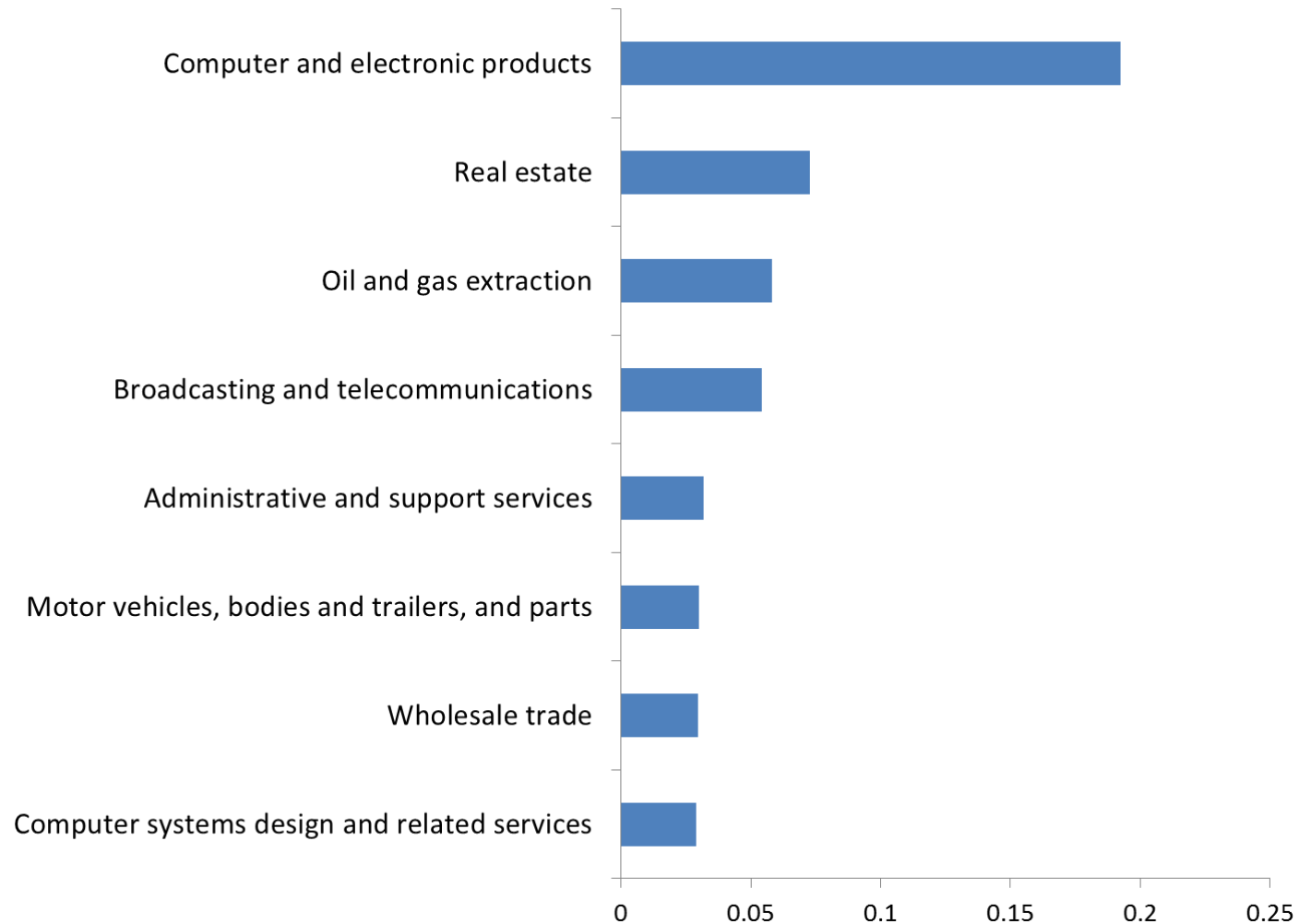
KLEMS and the Sources of U.S. Economic Growth

KLEMS and the Sources of U.S. Economic Growth

Industry Contributions to Aggregate Productivity Growth 1998-2015

- U.N. Manual *in progress:* "Handbook on Accounting for Global Value Chains."

- Chapter 4: "Extended" KLEMS
  - Objective: Industry-level production account for the world economy.
  - "Extended" refers to moving from World KLEMS (individual countries) to Integrated Global Production Account.

- No existing framework covers this for the world economy.
  - But Nomura and Miyagawa (2015) and Jorgenson, Nomura, and Samuels (2017) provide a proof of concept for Japan and the U.S.
  - Chapter 4 advocates for extending these to cover the world economy

- Will require collaboration and coordination

- Volume level index: $VLI_{\theta ijt} = X_{\theta ijtJ} / X_{\theta ijtU}.$

- Productivity level index: $\ln TLI_{jt} = (\ln VLI_{Yjt} - \Sigma_{\theta} w_{\theta jt} \ln VLI_{\theta jt})$

- Interpretation: relative efficiency with which inputs are transformed into output in the two economies; productivity gap

- Industry sources of aggregate TFP gap (Domar weights)

- Consistent with country-level national accounts

Japan-U.S. Aggregate TFP Gap

Legend:
- Contribution of non-Manufacturing
- Contribution of Manufacturing
- ○ TFP Level Index
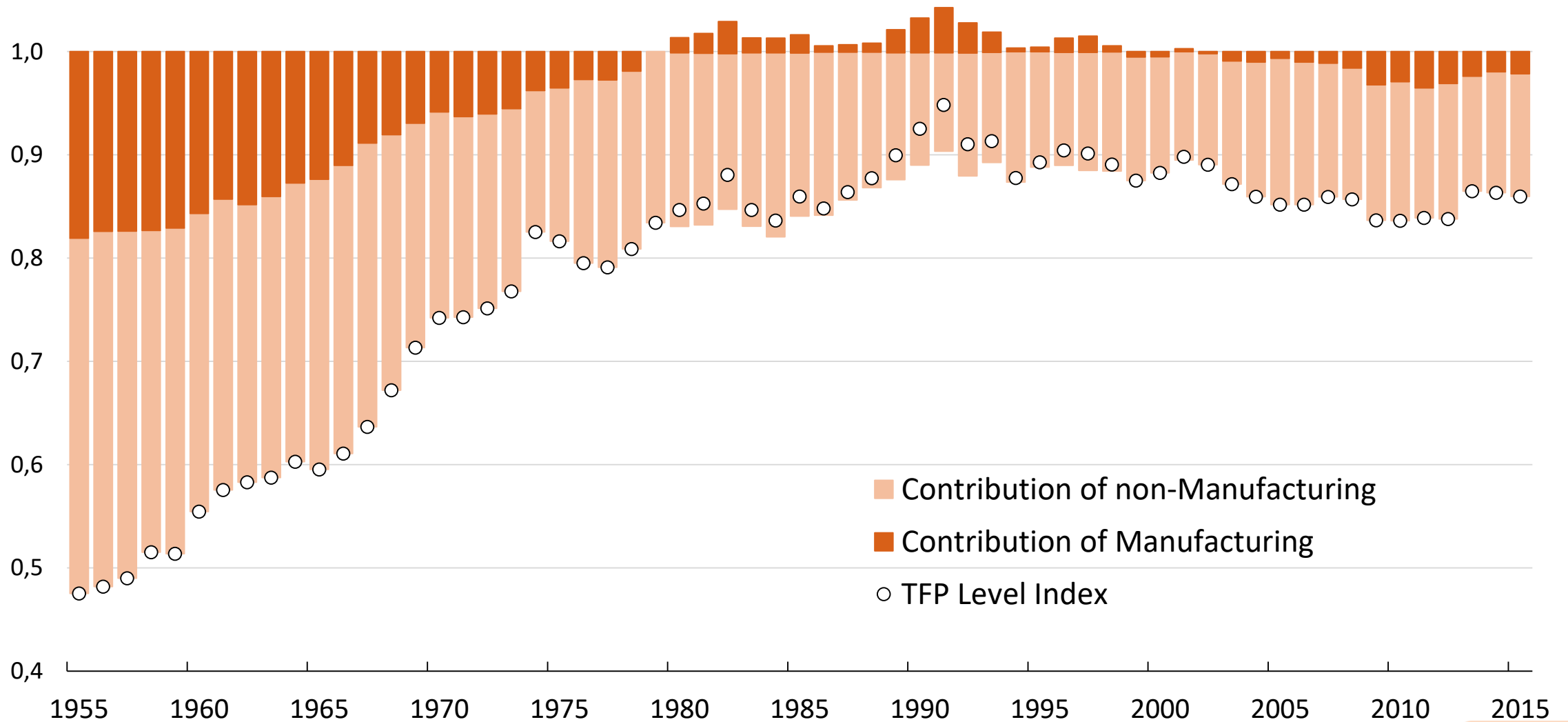
Note: Aggregate TFP is Domar-weighted sum of industry TFP gaps, grouped into Manufacturing (Mnf) and Non-Manufactuing (Non-Mnf)

Industry Origins of Japan-U.S. Aggregate TFP Gap, 2015

bea
Bureau of Economic Analysis
U.S. DEPARTMENT OF COMMERCE

	TFP Level Index		Industry	Industry Contributions
0 ─ 1 ─ 2	1,6		33.Medical Care	4,7
	1,2		27.Communications	0,7
	1,0		3.Construction	0,4
	1,1		19.Motor Vehicles	0,4
	1,2		18.Other Electrical Machinery	0,4
	1,1		11.Chemical Products	0,3
	1,1		14.Primary Metal	0,2
	1,1		21.Misc Manufacturing	0,1
	1,0		13.Stone, Clay, Glass	0,0
	1,1		32.Education	0,0
	1,0		9.Paper and Pulp	0,0
	1,0		5.Textile	0,0
	1,0		35.Public Administration	0,0
	1,0		36.Household	0,0

Note: Industry contribution is Domar-weighted TFP gap.

Industry Origins of Japan-U.S. Aggregate TFP Gap, 2015
Continued

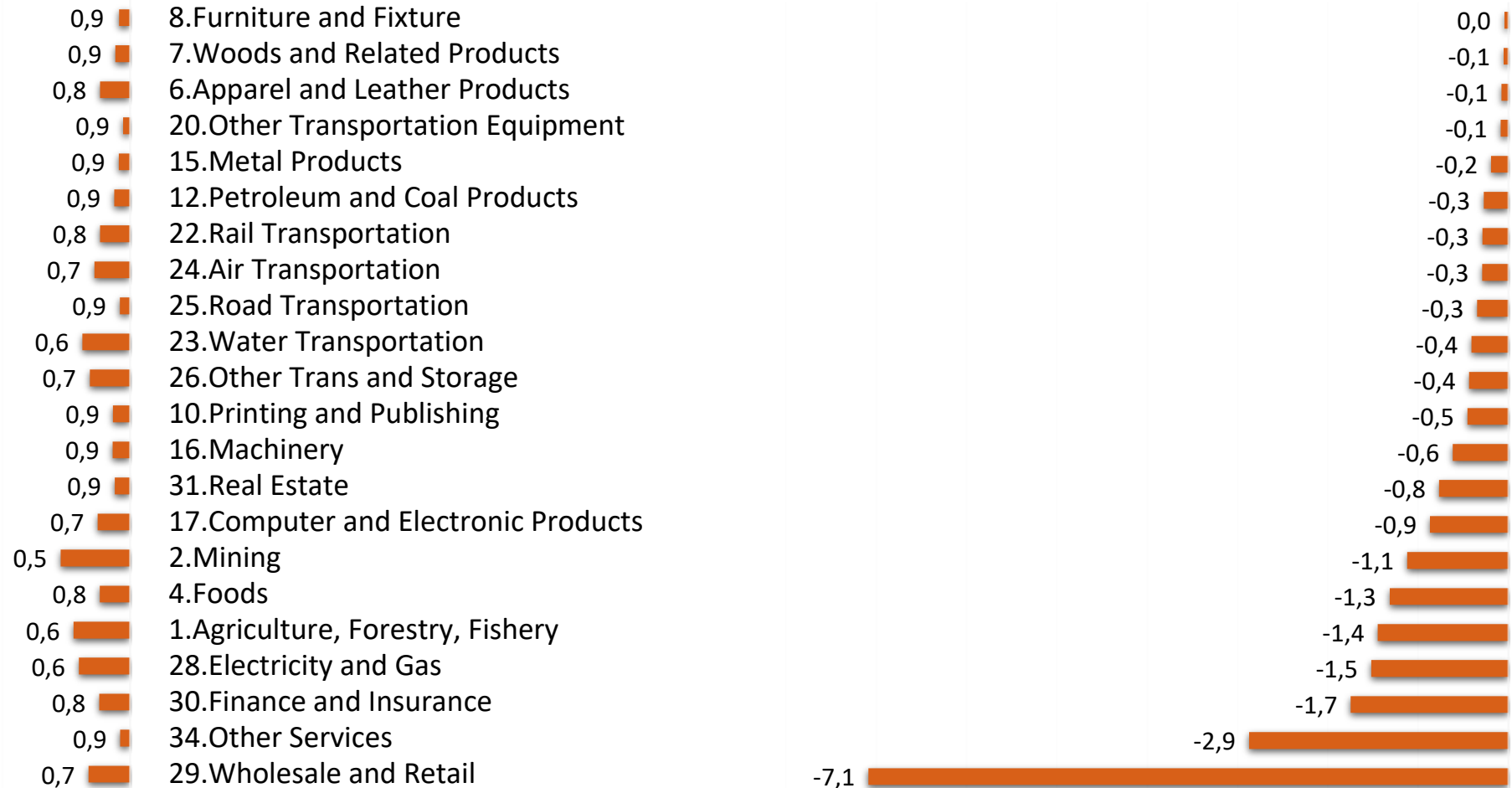**TFP Level Index**

Industry Contributions

TFP Level	Industry	Contribution
0,9	8.Furniture and Fixture	0,0
0,9	7.Woods and Related Products	-0,1
0,8	6.Apparel and Leather Products	-0,1
0,9	20.Other Transportation Equipment	-0,1
0,9	15.Metal Products	-0,2
0,9	12.Petroleum and Coal Products	-0,3
0,8	22.Rail Transportation	-0,3
0,7	24.Air Transportation	-0,3
0,9	25.Road Transportation	-0,3
0,6	23.Water Transportation	-0,4
0,7	26.Other Trans and Storage	-0,4
0,9	10.Printing and Publishing	-0,5
0,9	16.Machinery	-0,6
0,9	31.Real Estate	-0,8
0,7	17.Computer and Electronic Products	-0,9
0,5	2.Mining	-1,1
0,8	4.Foods	-1,3
0,6	1.Agriculture, Forestry, Fishery	-1,4
0,6	28.Electricity and Gas	-1,5
0,8	30.Finance and Insurance	-1,7
0,9	34.Other Services	-2,9
0,7	29.Wholesale and Retail	-7,1

Note: Industry contribution is Domar-weighted TFP gap.

- The BEA/BLS Integrated Industry- level production account provides official statistics on the sources of growth that are updated annually

- Ongoing work to provide historical data, first back to 1987

- Ongoing measurement challenges related to globalization and the digital economy

- Future direction for KLEMS community: World Production Account