"Micro and Macro Data Integration: The Case of Capital"

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Motivation

- Ideally, micro/macro data integration would be complete
  - Establishment level measures of outputs, inputs, and prices that aggregate to key national aggregates.
- Micro/macro integration important
  - Understanding macro aggregates requires building up from micro evidence:
    - Smooth macro, lumpy micro
    - Entry/Exit and reallocation
  - Flexible aggregation and analysis of measurement issues
  - Microanalytic research – representative samples and consistent measurement methodology?

Motivation continued

- In practice, ideal is not close to being realized
  - Closest are employment, payroll, nominal gross output
  - Real outputs and inputs at micro and macro level are constructed from a variety of sources on the basis of very strong (and different) assumptions.
  - Methods differ at micro and macro levels.
- Focus in this paper is on capital measurement (i.e., micro and macro integration of capital and investment measures)
- Capital measurement obviously important and among the most challenging at both the micro and macro levels

Brief Review of Current Measurement

- Capital Aggregates: Top Down
  - Reasonable measures of investment by asset-type using supply side approach (output, export/import data of relatively high quality)
  - Capital stocks by asset type and in aggregate are subject to potential measurement error given difficulty of measuring deflators and depreciation.
    - One neglected area important for micro/macro – role of establishment entrants and exits
  - Allocation to industry is even more problematic
    - Little direct information is collected on asset use by industry
    - Very strong assumptions used to construct capital flow tables.
    - Some hope for improvement from ACES

Brief Review of Current Measurement

- Micro Capital measurement (Bottom up):
  - Historically, limited information on book values, expenditures (new and used), sales and retirements
    - During late 1980s and beyond, limitations exacerbated as even less data collected.
  - Panel rotation in key surveys (ASM) makes perpetual inventory difficult
  - Lack of annual data makes this impossible for many sectors (e.g., services)
    - ACES offers some hope for improving matters here…
  - Deflators and depreciation rates are at industry level at best
  - Establishment vs. firm data

Overview of Paper

- Review current measurement methodology and identification of strengths/weaknesses
- Evaluation of key areas of concern:
  - Asset by industry data:
    - Capital Flow Data based upon strong assumptions
    - Alternatively, ACES has limitations as measurement of use/expenditures is difficult
    - Micro/macro integration cannot be achieved without accurate data on industry investment by asset type
  - Properties of micro estimates of I and K
    - Aggregate properties of micro estimates vs. properties of macro estimates?
    - Alternative measures (book vs. perpetual inventory)
      - Relevance for micro/macro productivity analysis

Today: Two Illustrative Data Exercises

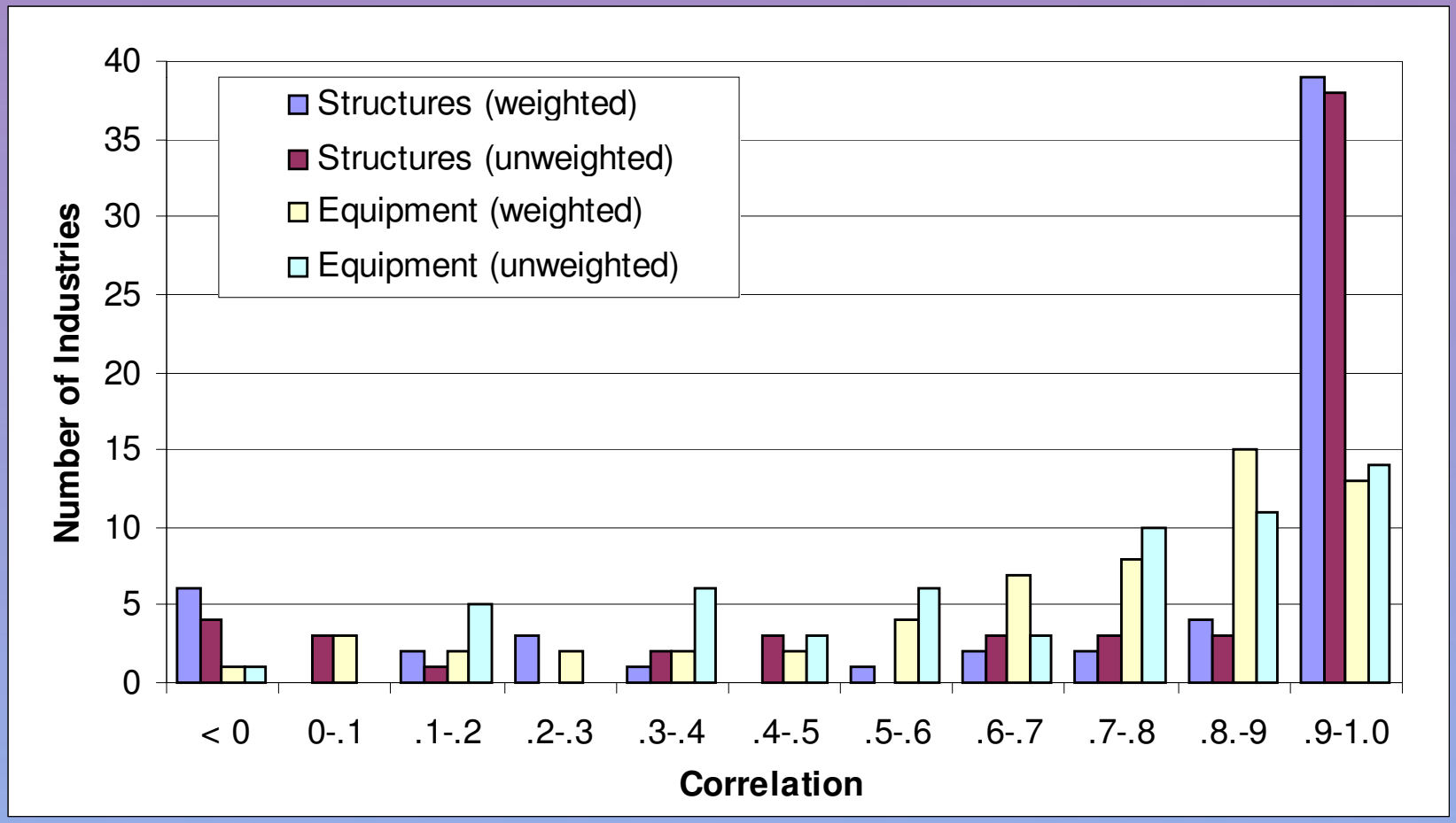
I. Compare BEA Capital Flow Tables to ACES detail

II. Redistribute ACES investment by industry

First Exercise

- Compare asset-by-industry investment expenditures from BEA (Capital Flow) and ACES
- Capital Flow based upon occupational distribution.
- ACES measures detailed asset expenditures directly:
  - Periodically (1994, 1998, 2003?)
  - Firm level:
    - Industry coverage vs. reportability
  - Expensing/leasing/scope/non-employer issues
- 60 comparable industries and 39 asset types (16 equipment, 23 structures)
- ACES yields low total investment

Distribution of Correlations Between BEA and ACES Investment Shares in 1998



Correlation Summary Statistics

	Equipment		Structures	
	Unweighted	Weighted	Unweighted	Weighted
Mean	0.68	0.85	0.76	0.82
Median	0.78	0.96	0.96	1.00
Weighted Mean	0.71	0.84	0.74	0.81
90-10 Difference	0.80	0.60	0.99	0.89

Note: ACES asset-type totals scaled to equal BEA totals from "supply-side". Each industry's weights are that industry's investment shares across asset types.

Selected Equipment – ACES vs. BEA

Equipment type	Ratio of BEA to ACES	Weighted correlation	Unweighted correlation	Aggregate BEA Share	Aggregate ACES Share
Computer and Peripheral Equipment	1.02	0.80	0.60	0.13	0.14
Office Equip. Except Computers and Peripherals	2.06	0.78	0.54	0.03	0.02
Navigational, Measuring, Electromedical, and Control Instruments	6.95	0.28	0.17	0.04	0.01
Capitalized Software Purchased Separately	4.09	0.63	0.42	0.07	0.02
Fabricated Metal Products	1.45	0.31	0.25	0.02	0.01
Cars and Light Trucks	0.13	0.85	0.61	0.02	0.18
Heavy Duty Trucks	6.30	0.88	0.67	0.14	0.03
Aerospace Products and Parts	0.92	1.00	0.97	0.03	0.04
Engines, Turbines, and Related Equipment	0.83	0.91	0.37	0.01	0.01
Mean (of all 16 equipment types)		0.77	0.60		
Median		0.88	0.61		

Selected Structures – ACES vs. BEA

Structure type	Ratio of BEA to ACES	Weighted correlation	Unweighted correlation	Agg. BEA Share	Agg. ACES Share
Manufactured (Mobile) Homes	9.06	0.31	0.05	0.00	0.00
Warehouses and Distribution Centers	1.69	0.86	0.56	0.07	0.04
Other Commercial Stores/Buildings, NEC	8.62	0.86	0.59	0.15	0.02
Air, Land, and Water Transportation Facilities	0.67	0.80	0.57	0.02	0.04
Telecommunications Facilities	0.44	1.00	1.00	0.04	0.08
Electric, Nuclear, and Other Power Facilities	1.28	0.97	0.95	0.12	0.08
"Manufacturing, Processing, and Assembly Plants" and "Industrial Nonbuilding Structures"	0.89	0.77	0.71	0.15	0.18
"Office, Bank, and Professional Buildings" and "Medical Offices"	1.13	0.76	0.59	0.20	0.18
"Hospitals" and "Special Care Facilities"	0.61	0.80	0.59	0.07	0.09
Schools and Education Facilities	1.02	1.00	0.97	0.05	0.05
"Mine Shafts" and "Other Mining and Well Construction"	0.07	0.16	0.26	0.01	0.09
Mean (of all 23 structure types)		0.74	0.59		
Median		0.84	0.59		

ACES-BEA similarity over time

Comparing Correlations using 1980 vs. 2001 Asset-Type Weights (from BEA)

	Equipment		Structures	
	1980 Weights	**2001** Weights	**1980** Weights	**2001** Weights
Mean Correlation	0.81	0.77	0.78	0.64
Median Correlation	0.91	0.86	0.99	0.79
Weighted Mean Correlation	0.81	0.74	0.74	0.62

Note: Correlations were computed using "scaled" investment shares. Results were similar using unscaled shares.

Main Findings from the First Exercise

- Average correlation high but far from one.
  - Average correlation higher for structures than equipment
  - Weighting helps: relationship better for more important capital types
- Substantial variation across industries and assets.
  - Especially weak relationship for some industries:
    - Petroleum refining, pipelines, financial brokerages, health services
  - Especially weak relationship for some capital types:
    - Mine shafts, hospital/health care facilities, electromedical, fabricated metal products
- High tech capital about at median
  - Software purchased separately below median
- Distribution of assets increasingly shifting towards assets where ACES and BEA differ

Second Exercise: Redistribute ACES Investment by Industry

- There is evidence that firms provided insufficient industry detail on the ACES (e.g., 1995):
  - On average, firms acknowledge 1.4 industries while the Business Register (BR) recognizes 1.9.
    - The excluded industries tend to be less important, containing only 8% of weighted payroll.
  - For firms that operate in more than one industry (according to the BR):
    - Firms acknowledge 2.2 industries, on average, while the BR recognizes 3.8.
    - Excluded industries account for 13% of their weighted payroll.
- Ramifications:
  - For aggregate statistics: ACES may imprecisely distribute capital expenditures across industries.
  - For microdata: ACES may imprecisely distribute firm-level capital expenditures across industries.

Correction to Industry Detail

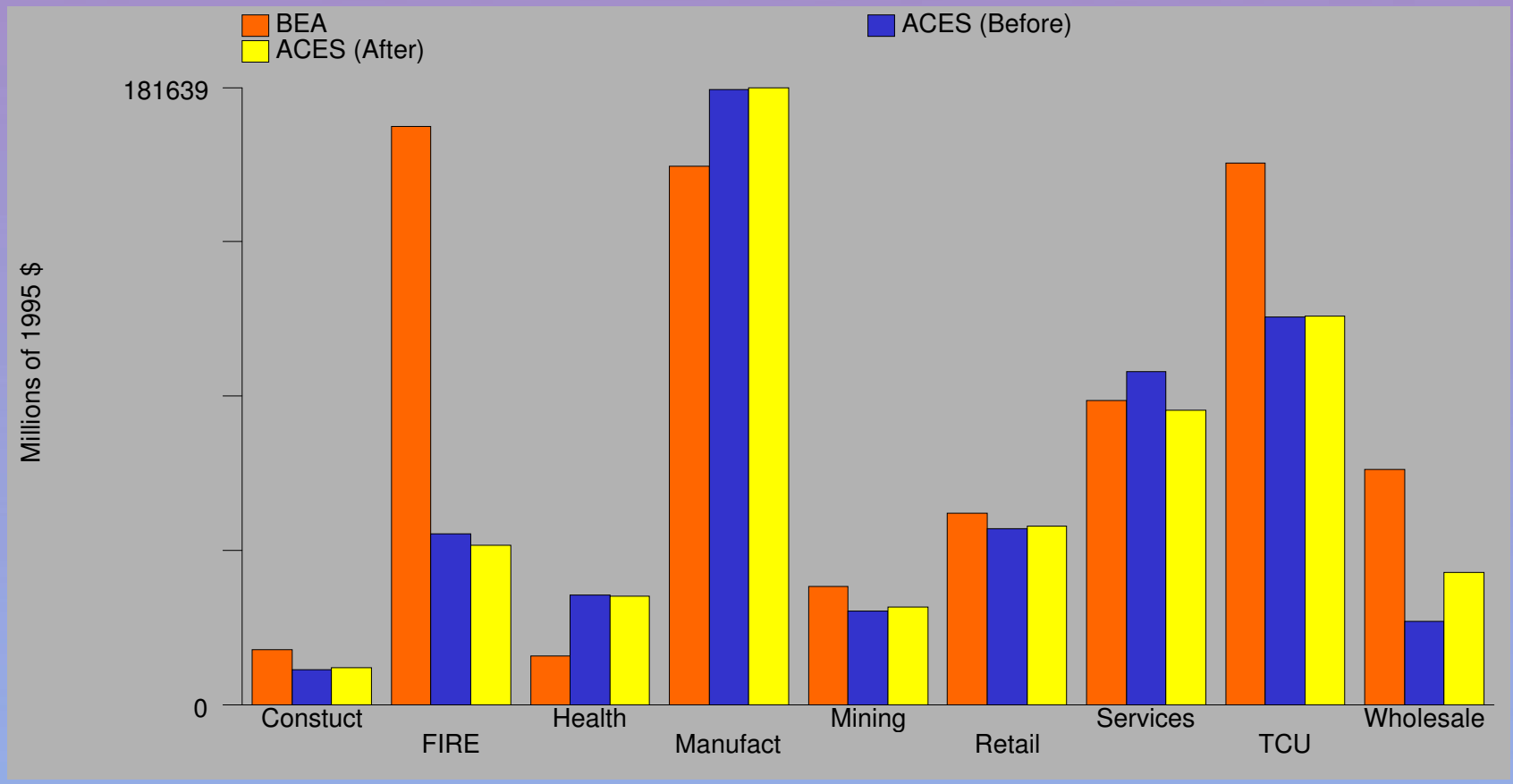
- Assume that the Business Register (BR) correctly reflects a firm's industrial composition.
- For firms that *correctly* report industry detail, compute probability of non-zero investment and investment-to-payroll ratios by industry and size class.
- Apply probabilities and ratios to firms reporting *incorrect* industry detail to reallocate firm-level investment across industries.
- Ran ten separate times and took mean of outcomes.
- Done separately for each of the six asset categories (equipment/structures/other by new/used).
- Algorithm maintains a desirable microdata property: occurrences of zero investment.

Reallocation of Investment Across Sectors

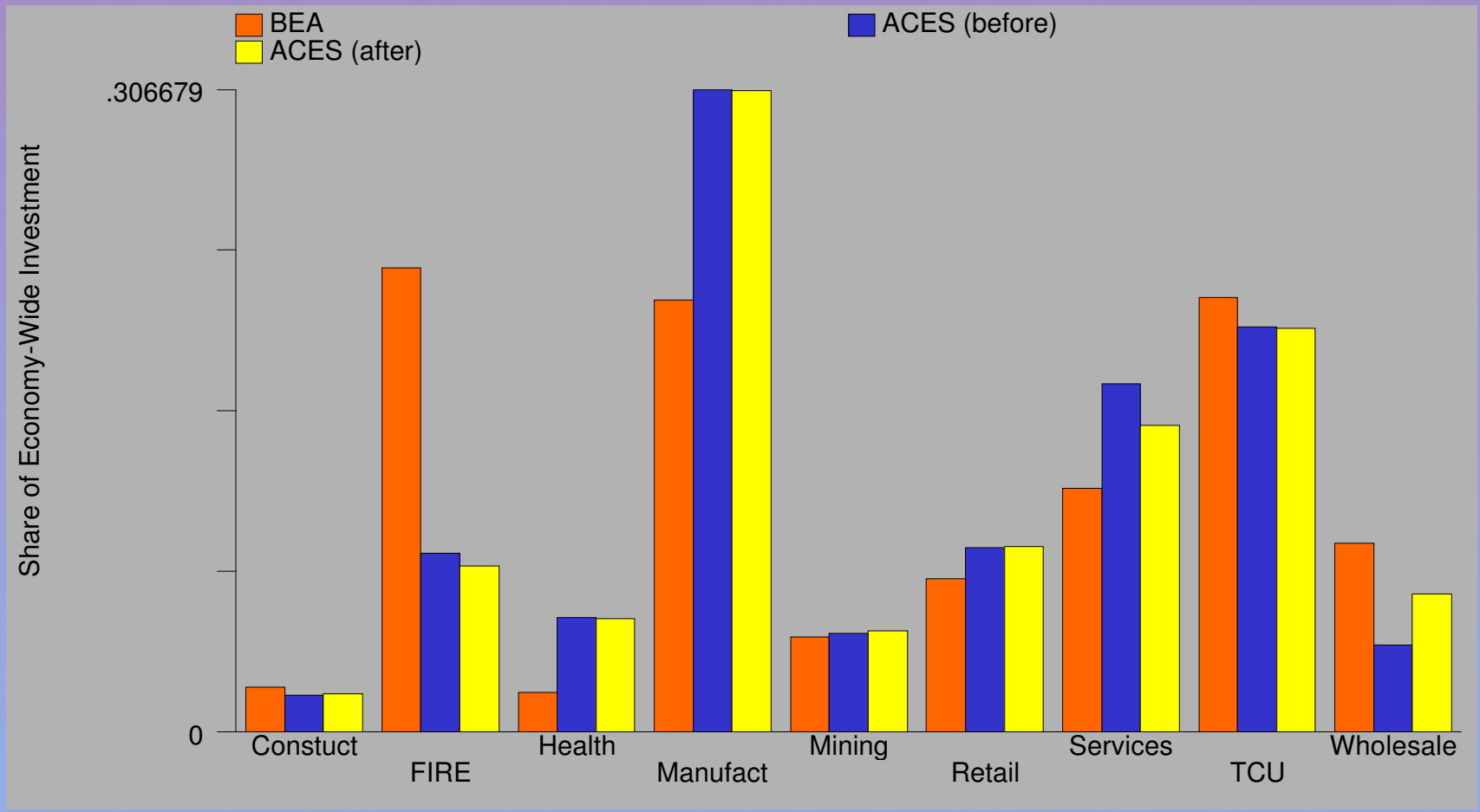
(in millions of 1995 dollars)

Sector	Net Change in Investment
Agriculture, Forestry, and Fishing	– 48
Mining	+ 1,038
Construction	+ 454
Manufacturing	+ 655
Transportation, Communications, and Utilities	– 306
Wholesale Trade	+ 14,494
Retail Trade	+ 649
Finance, Insurance, and Real Estate	– 3,243
Health Services	– 230
Services (except Health Services)	– 11,343
Unallocated	– 2,116

Impact of Correction across Sectors
Investment Levels

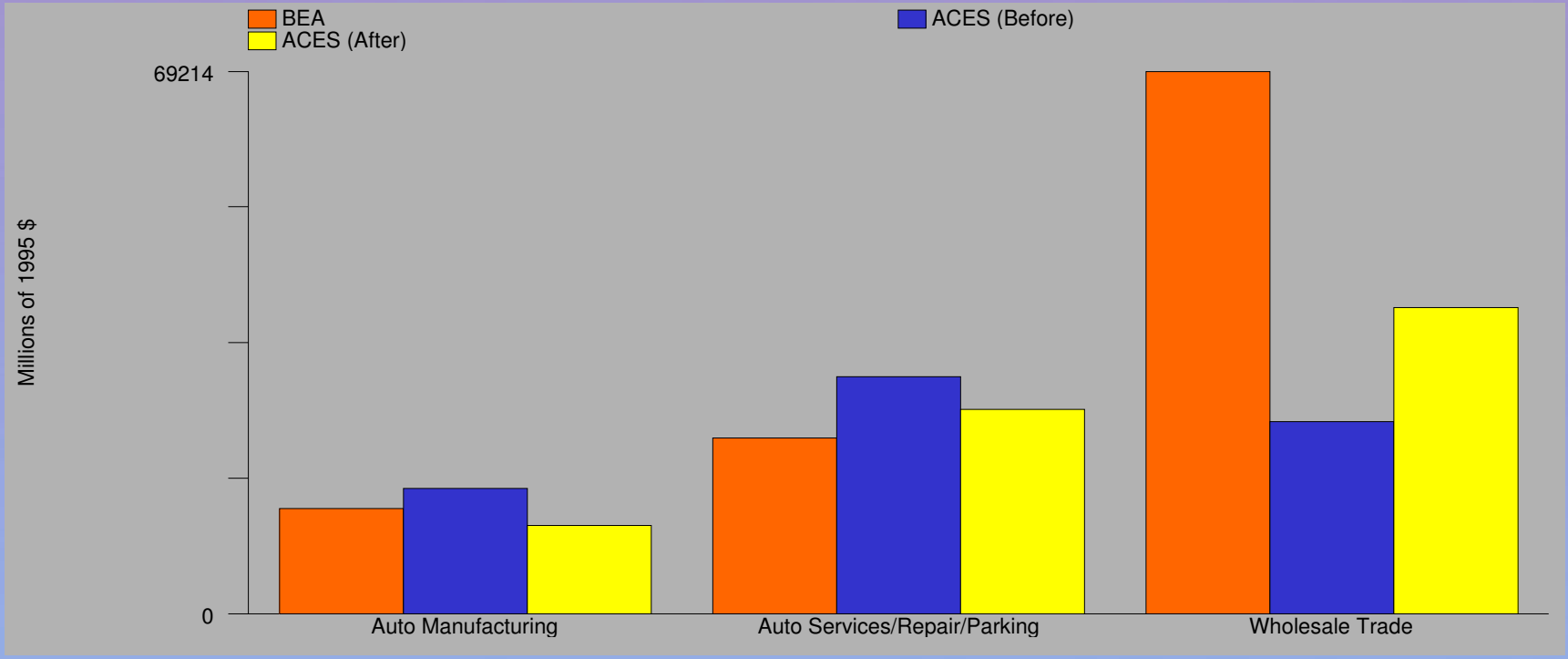


Impact of Correction across Sectors
Shares of Economy-Wide Investment



Example of Some Interesting Changes at the Industry Level

- 501 Wholesale Trade of Motor Vehicles, Parts, and Supplies + 11,539
- 371 Manufacturing of Motor Vehicles and Equipment – 4,713
- 751 Automotive and Truck Rental and Leasing Services – 4,187



Improved Correlation Between Industries' Share of Total Investment According to BEA and ACES

	Publication	Research sample	
		Before	*After*
Total investment	0.741	0.746	0.778
Equipment	0.755	0.761	0.801
Structures	0.738	0.738	0.736

Main Findings of the Second Exercise

- ACES has industry coverage limitations
- Algorithm for reallocating investment at the micro level using business register "successfully" moves ACES industry allocation closer to BEA for broad asset classes.
- Measurement Challenges:
  - Can a firm-based survey allocate accurately across industries?
  - Can a reliable algorithm be developed to overcome this limitation?
  - What does this imply about using ACES for improving capital flows?
  - What does this imply about using ACES at the micro level?

Stay tuned…

- Assimilating data from ACES, ASM, AES, and Compustat
  - Micro estimates of I and K developed using "best practice" in the literature
  - What are relationships across alternatives and to key measures at micro level (e.g., productivity)?
  - What are the aggregate properties of alternative micro estimates? How do they compare to published aggregates derived from top down approach?
  - Can we relate discrepancies to top down vs. bottom up methodologies?