

A Balanced System of Industry Accounts for the U.S. and Structural Estimation of Statistical Discrepancy

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BEA Advisory Committee Meeting
May 19, 2006

Measuring the Nation's Economy



OUTLINE

1. Introduction
 - Motivation
 - Alternative method of reconciliation
 - Application of the proposed method
2. Identification of Major Data Problems
3. GLS Reconciliation Model
4. Reliabilities of Initial Estimates
5. Balanced Industry Accounts and Estimates of Statistical Discrepancy (SD) by Industry
6. Conclusion

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1. Introduction

- Motivation:

The desire to find a statistically sound method that can efficiently incorporate information on reliability of initial source data in compiling a consistent set of accounts.

- Some facts:

- Inconsistency exists in the two estimates of GDP.
- Inconsistency is crucially due to sources of errors in initial source data.
- Currently there are no estimates of statistical discrepancy by industry or by expenditure category.
- Lack of such information makes it difficult to identify improvements needed in source data and in estimation methods.

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Introduction (cont.)

- Objective of this study:

To propose a Generalized Least Square (GLS) reconciliation method that

- Can correctly estimate industry distribution of SD according to reliabilities of initial data, and
- Can accurately reconcile initial I-O and Income-by-industry data with expenditure-based estimate of GDP.

- Empirical advantages of the proposed GLS method:

- Has firm Bayesian foundation.
- Provides flexibility to balancing process.

- GLS reconciliation methods have been studied extensively.

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Introduction (cont.)

- Application of GLS reconciliation method

Data to be reconciled:

- 1997 I-O and Income-by-industry data, 2003 benchmark GDP.
- Aggregation: 65 industries, 69 commodities, 13 expenditures.

Data:

- Initial output and input data from benchmark I-O accounts database;
- Initial VA from Income-by-industry prior to allocation of aggregate SD;
- Final expenditure estimates from 2003 NIPA benchmark revision;
- Coefficient of variation (CV) from Census and IRS.

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2. Four Major Data Problems Identified

a. Differences in sources of data used.

I-O accounts: Economic Census, BES & annual surveys from Census, federal agencies, Federal Reserve, IRS, and trade companies.

Income-by-industry: IRS, BEA, BLS, Federal Reserve, Census Bureau, regulatory agencies, Federal, state & local governments, and trade companies.

b. Sampling errors in source data.

c. Non-sampling errors:

Double-counting, misallocation, misreporting, misspecification, omission, or simple mistakes.

d. Official residual errors: Aggregate SD.

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3. GLS Accounts Reconciliation Model

- The Reconciliation Model:

(1) Minimize the sum of reliability weighted squares of adjustments in Initial gross output, intermediate inputs, & value added estimates, subject to

(2)&(3) 65/69 Industry/commodity adding-up constraints,

(4) VA of 65 industries sum up to GDP.

Initial conditions satisfy:

(5) VA of 65 industries sum up to GDI,

(6) Final expenditures sum up to GDP.

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4. Reliability of Initial Data

- Source data often needs adjustment due to non-sampling errors

- Decomposition of initial estimates into two components:

Initial estimate = source data + adjustments

- Categories of adjustments in descending reliability:

Adjustment data from

- a. Census, IRS, other administrative or regulatory agencies;
- b. Established procedures or from fairly reliable sources;
- c. Incomplete data or analysts' judgments.

- Subjective relative standard errors assigned to adjustments:

CV = (10%, 20%, 30%) for categories a, b, c.

- Measure of reliability of initial data by estimated variances:

$\text{var}(\text{Initial est.}) = \text{var}(\text{source data}) + \text{var}(\text{adjustments})$.

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5. Balanced Estimates and Distribution of SD

- Two sets of balanced estimates using weights derived from:
 - a. Reliability (var(initial estimate))
 - b. Neutral variant (abs(initial estimate))
- Summary of Results:
 - GLS model produced balanced estimates & removed aggregate SD.
 - Using reliability: Relative reliabilities of initial estimates significantly determine adjustments and industry distribution of SD.
 - Using neutral variant: Relative sizes of initial estimates and VA/GDP by industry significantly determine adjustments and industry distribution of SD.
 - Sizes of initial gap between estimates from I-O and Income-by-industry affect sizes of adjustments.

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Table 1: Initial and Balanced Estimates for 65 Industries
(Billions of Dollars)

Pub Code	Initial Estimates				Balanced Estimates: (Reliability)				Balanced Estimates(Neutral variant)			
	Gross output	Inter. Inputs	VA	(output-inputs)%	Gross Output	Inter. Inputs	VA	Output-input	Gross output	Inter. input	VA	Output-input
...
322	149	98	51	0.32	149	96	53	0	150	98	52	0
335	109	67	78	-33.18	109	65	44	0	118	55	63	0
531	1260	319	883	4.62	1257	340	917	0	1248	328	920	0
532RL	176	32	73	40.31	165	32	133	0	142	43	99	0
...
Sum	15218	6917	8258		15201	6897	8304	0	15184	6880	8304	0

322: Paper; **335:** Elec. Equipment; **531:** Real Estata; **532RL:** Rental & Leasing

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Table 2: Initial and Balanced Estimates of 69 Commodities
(Billions of Dollars)

Com Code	Initial Estimates			Balanced Estimates (Reliability)				Balanced Estimates (Neutral Variant)			
	Com. output	Com total use	(output input) %	Com. output	Com inter. inputs	Final uses	output-inputs	Com. output	Com inter. inputs	Final uses	output-inputs
...
3364OT	148	151	-1.53	149	64	85	0	149	64	85	0
42	736	737	-0.03	745	365	380	0	744	364	380	0
481	124	114	8.65	115	55	60	0	121	61	60	0
487OS	84	89	-6.65	84	67	16	0	88	72	16	0
...
Sum	15218	15221		15201	6897	8304	0	15184	6880	8304	0

3364OT: Other transportation equipment; 42: Retail; 481: Air transportation; 487OS: Other transportation

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• Deviation between Initial and Balanced Estimates (Reliability)

Figure 2: Histograms of % Adjustment

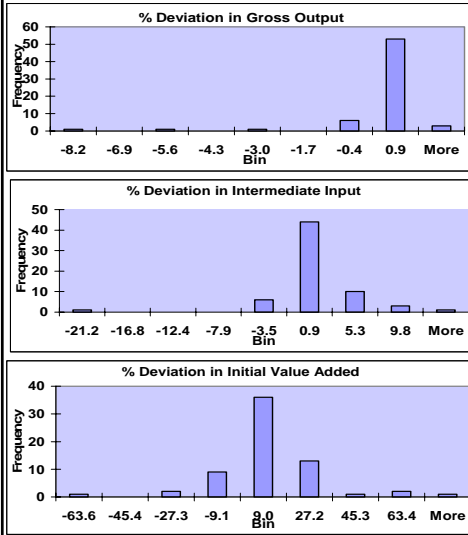


Table 3: Statistics of % Adjustments

% Adjustments in Initial Gross Output	
Mean	-0.23
Median	0.00
Stdv	1.43
% Adjustments in Initial Intermediate Inputs	
Mean	-0.31
Median	-0.04
Stdv	4.08
% Adjustments in Initial Value Added	
Mean	1.89
Median	1.72
Stdv	19.92

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• Deviation between Initial and Balanced Estimates (Neutral Variant)

Figure3: Histograms of % Adjustment

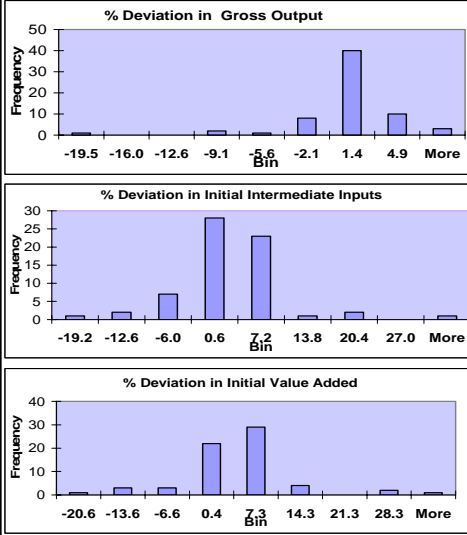


Table 4: Statistics of % Adjustments

% Adjustments in Initial Gross Output	
Mean	-0.38
Median	-0.02
Stdv	3.83
% Adjustments in Initial Intermediate Inputs	
Mean	-0.11
Median	0.10
Stdv	7.81
% Adjustments in Initial Value Added	
Mean	0.76
Median	0.71
Stdv	8.88

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Table 5: Estimates of SD by Industry Using Relative Reliability and Neutral Variant Weights

Pub Code	Initial Gap VA(IO)-VA(GDI)	Estimated SD by Industry (Reliability)				Estimated SD by industry(Neutral variant)			
		SDi'	SDi'/SD	var(VA(GDI))/var(VA(IO))	VA'/GDP	SDi'	SDi'/SD	VA(GDI)/VA(IO)	VA'/GDP
...
324	-43	-42	-91.13	82.03	0.29	-14	-29.6	2.83	0.64
334	33	17	37.36	0.44	1.94	12	24.94	0.81	1.87
531	58	34	72.97	0.82	11.04	37	78.3	0.94	11.07
532RL	72	60	128.6	0.09	1.6	26	55.72	0.51	1.2
...
Sum	42	47	1		1	47	1		1

324: Petroleum; 334: Computer & electronic; 531: Real Estate; 532RL: Rental & Leasing

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• Estimates and Statistics of SD by Industry (Relative Reliability)

Figure 4-a: SD by Industry Estimates

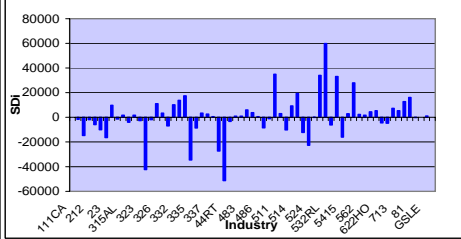


Figure 4-b: Histogram of SD by Industry

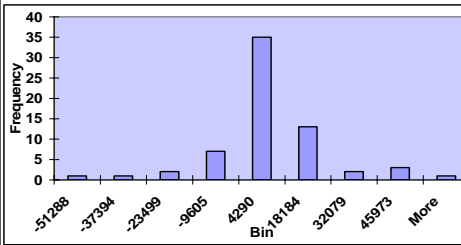


Table 6: Analysis of SD Estimates

OLS Regression of SD by Industry

Summary statistics: $R^2 = .96$

Std Err = 3367

Coefficient Estimation

Variable	Coef.	t	P-Value
$VA(IO^0) - VA(GDI^0)$	0.749	39	0.000
$var(VA(GDI))/var(VA(IO))$	0.317	3.29	0.002
VAI/GDP	-0.053	-0.245	0.771

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• Estimates and Statistics of SD by Industry (Neutral variant)

Figure 5-a: SD by Industry Estimates

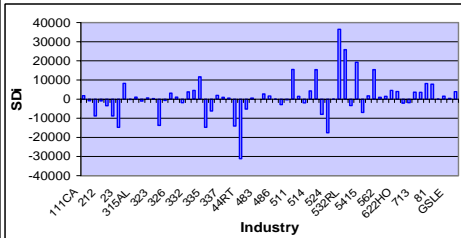


Figure 5-b: Histogram of SD by Industry

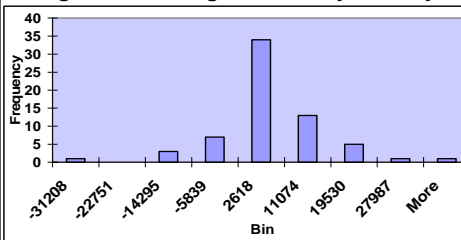


Table 7: Analysis of SD Estimates

OLS Regression of SD Estimates:

Summary statistics: $R^2 = .97$

Std Err = 1805

Coefficient Estimation

Variable	Coef.	t	P-Value
$VA(IO^0) - VA(GDI^0)$	0.458	34.8	0.000
$VA(GDI)/VA(IO)$	3747	3.90	0.002
VA_i/GDP	718	6.27	0.000

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6. Conclusion

- Contributions of this study:

- Reconciled disaggregated industry accounts with benchmark GDP.
- Shown that using relative reliability to remove inconsistency produces statistically meaningful results.
- Identified problems in source data and estimation methods.
- Demonstrated that reconciling disaggregated accounts is empirically feasible and computationally efficient.

- Future research:

- Continue to improve reliability measures.
- Allow for unallocated or unobserved initial estimates.
- Extend to full reconciliation of national and industry accounts.

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Questions

1. Given the current budget climate, how do you see the 2007 Economic Census tradeoff between further expansion of final demand information and coverage of detailed industries and inputs?
2. Is the GLS reconciliation method presented here leading to the right direction for BEA to achieve internal integration of national and industry accounts?
3. Quantifying uncertainty in the adjustment data is a real challenge. How can we better improve our assessment of uncertainty in the adjustment data?

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