

Import Matrixes, IOTs, Coefficients



Gabriel Medeiros

International Workshop on Supply and Use Tables
Beijing, China, Sept 11-13

Outline



- Import Use Tables
 - BEA Methodology
 - BEC Methodology
 - MNES
- Domestic Use
- From SUT to a Symmetric System
 - Producer Value SUT
 - Redefinitions
- Requirements
 - Industry Technology Assumptions
 - Limitations
- Conclusions



Why Compile Imports Matrix



- Real estimates
 - Useful when import prices available.
- Modeling and policy
 - Domestic impact analysis, trade in value added, etc.



- In U.S., data are not directly available on the use of imports by establishment industries
- However, good data are collected on the total value of intermediate expenses by establishments ...
 - NAICS 4-to-6 digit level in the economic census for 25 categories
 - NAICS 3-digit on surveys of manufactures and services for about 10 categories
- And, economic census product detail allows for distinctions to be made between intermediate, personal consumption, and investment goods
 - About 5,000 products by 900 industries

- Allocation of imports: Import Proportionality Assumption
 - Industries use imports of products in the same proportion as the product’s import share of domestic supply
 - Homogeneity in import use across industries but heterogeneous input structures
- At BEA “working level,” imports are allocated across 1,800 products and 900 industries
- Given the indirect techniques, it’s important to understand how different alternatives compare

Import Proportionality

Given use table purchases along product row that sum up to domestic supply for product i

$$\sum_j u_j^i = S^i$$

and given imports by product; M^i

Calculate import purchases by product and industry:

$$m_j^i = u_j^i \times \frac{M^i}{S^i}$$

Import use tables – BEC methodology



- Use broad economic categories (BEC) to do initial allocation of imports to intermediate and other
- Goods only
- Scale industries proportionally to match this item-level allocation
- Produces BEC-based Import Use table 1998-2011
- Implication: Alternative estimates of intermediate input and VA quantities, and MFP growth by industry
 - Intuition: Price index for intermediate input reflects BEC-based import share of intermediate use by item by industry

Samuels, Howells III, Russell, Strassner (2015) "Import Allocations across Industries, Import Prices across Countries, and Estimates of Industry Growth and Productivity," in *Measuring Globalization: Better Trade Statistics for Better Policy*. Houseman and Mandel, editors.

BEC-based allocations



Table: Share of Imports Allocated to Intermediate Inputs by Commodity 2007

	Baseline	BEC-based Allocation	Difference (Absolute Value)
Forestry, fishing, and related activities	0.85	0.24	0.61
Utilities	0.45	1.00	0.55
Food and beverage and tobacco products	0.48	0.13	0.35
Textile mills and textile product mills	0.53	0.37	0.16
Publishing industries (includes software)	0.15	0.02	0.14
Chemical products	0.51	0.64	0.14
Miscellaneous manufacturing	0.16	0.28	0.12
Plastics and rubber products	0.72	0.83	0.11
Printing and related support activities	0.82	0.72	0.11
Machinery	0.42	0.48	0.06
Furniture and related products	0.15	0.10	0.04
Computer and electronic products	0.36	0.39	0.03

Samuels, Howells III, Russell, Strassner (2015) "Import Allocations across Industries, Import Prices across Countries, and Estimates of Industry Growth and Productivity," in *Measuring Globalization: Better Trade Statistics for Better Policy*. Houseman and Mandel, editors.

BEC-based industry import shares



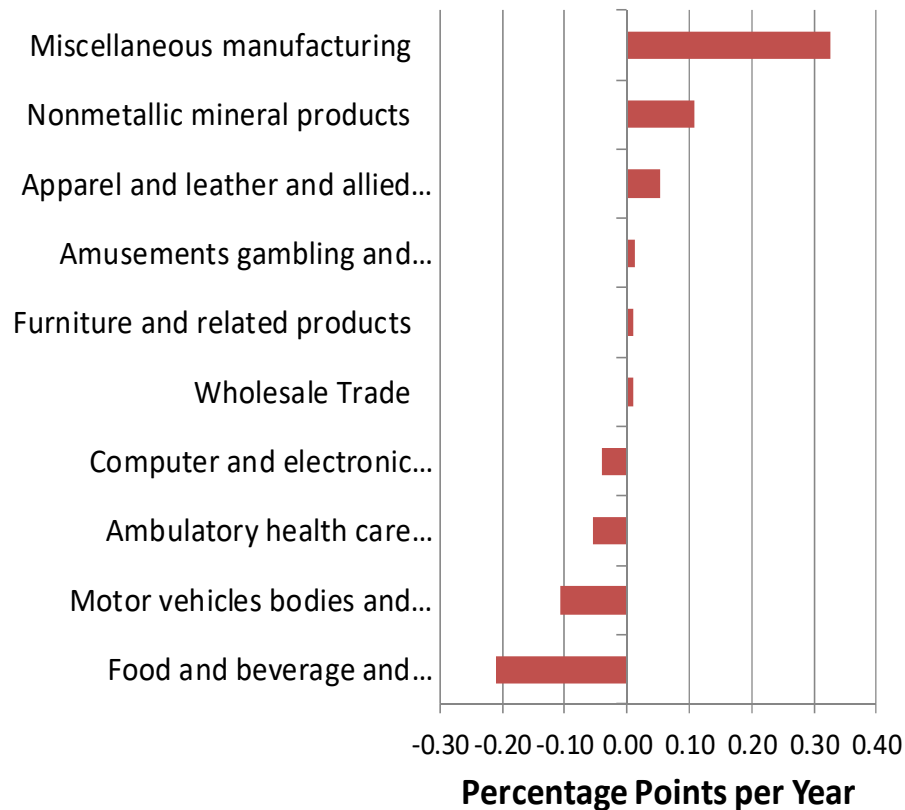
Table: Share of Imports in Total Industry Intermediate Use 2007

	Baseline	BEC- based Allocation	Difference (Absolute Value)
Miscellaneous manufacturing	0.15	0.26	0.11
Food services and drinking places	0.09	0.04	0.05
Ambulatory health care services	0.08	0.12	0.04
Food and beverage and tobacco products	0.10	0.06	0.04
Nonmetallic mineral products	0.10	0.14	0.04
Computer and electronic products	0.23	0.26	0.03
Furniture and related products	0.19	0.17	0.03

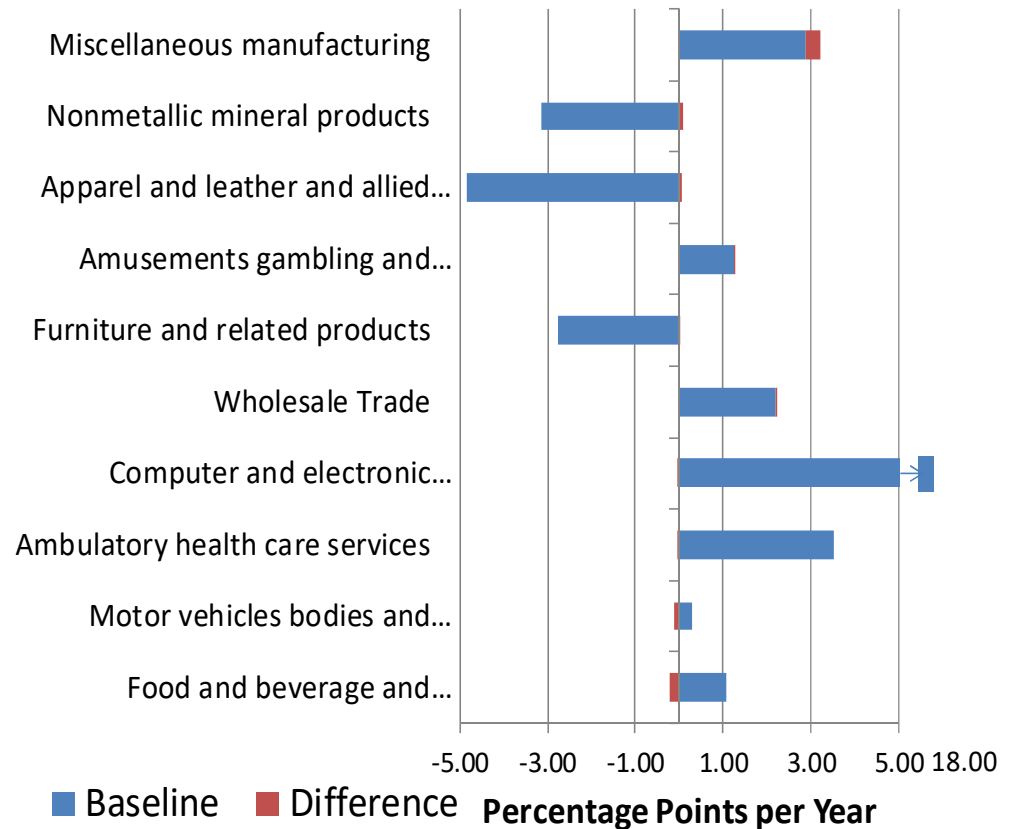
Samuels, Howells III, Russell, Strassner (2015) "Import Allocations across Industries, Import Prices across Countries, and Estimates of Industry Growth and Productivity," in *Measuring Globalization: Better Trade Statistics for Better Policy*. Houseman and Mandel, editors.

BEC-based allocations

Differences in VA Growth 1998-2011



VA Growth 1998-2011



Samuels, Howells III, Russell, Strassner (2015) "Import Allocations across Industries, Import Prices across Countries, and Estimates of Industry Growth and Productivity," in *Measuring Globalization: Better Trade Statistics for Better Policy*. Houseman and Mandel, editors.

BEC-based value added contributions



Table: Sector Contributions to VA Growth 1998-2011

	Baseline	BEC-based Import Allocation
VA Growth	1.87	1.87
Agriculture, Forestry, Fishing, Hunting, and Mining	0.02	0.02
Transportation, Warehousing, Utilities	0.10	0.10
Construction	-0.10	-0.10
Manufacturing	0.25	0.25
Durable Goods	0.25	0.25
Nondurable Goods	0.00	0.00
Trade	0.23	0.23
Information	0.21	0.21
Finance, Insurance, Real Estate, Rental and leasing	0.51	0.51
Other Services	0.54	0.54
Government	0.11	0.11

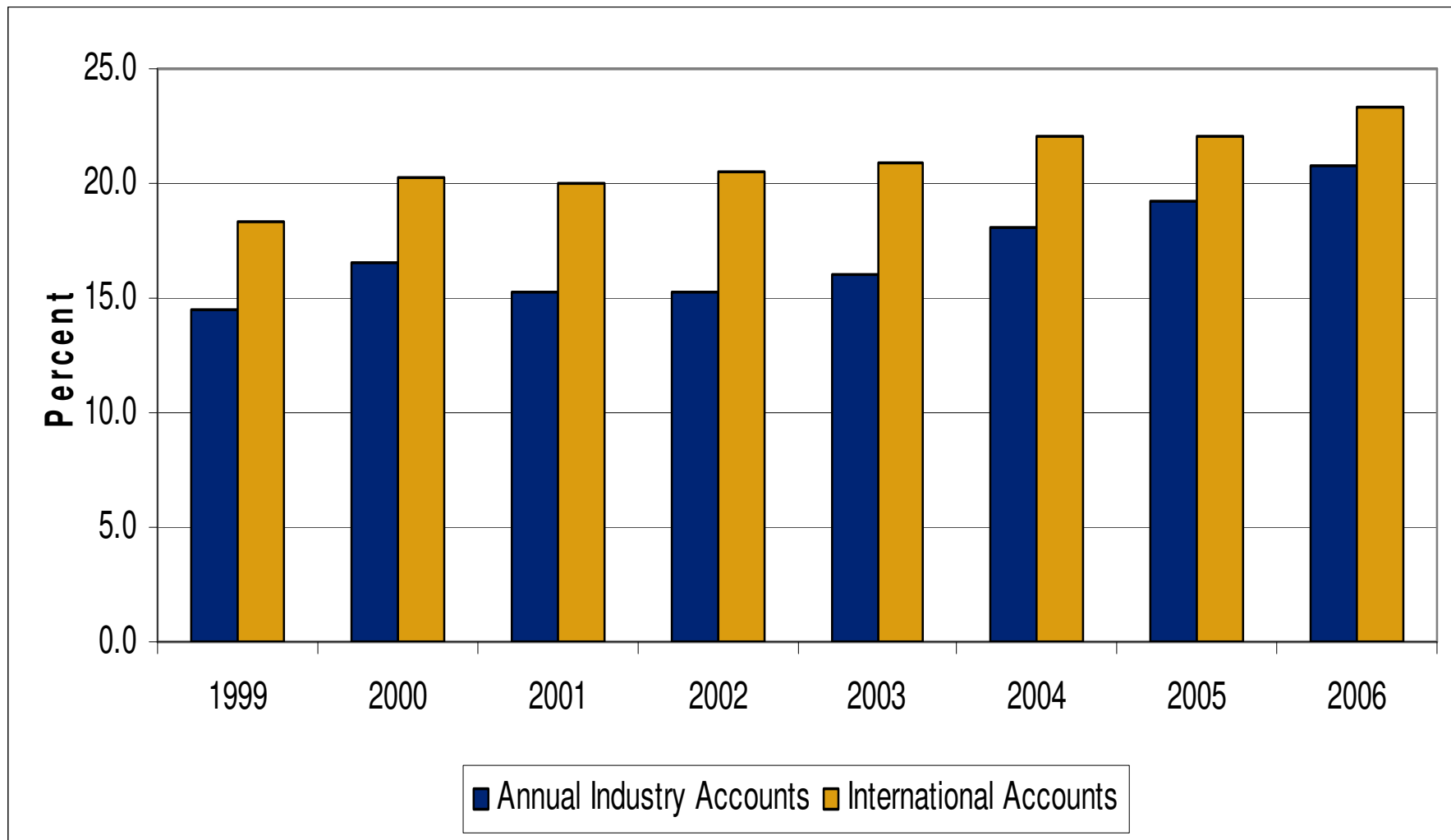
Import use tables – MNEs



- MNE data provide information on total imports by U.S. parent firms
 - Accounts for about 60-65% of all imported intermediates
- Link foreign affiliates to U.S. parents for industry and commodity classification
 - Industry (commodity) classification based on ISI of the U.S. parent (foreign affiliate)
 - Imports from unaffiliated firms assumed to resemble affiliates

Strassner, Lee, Yuskavage (2010) "Imported Inputs and Industry Contributions to Economic Growth," in *Measurement Issues Arising from the Growth of Globalization*. Houseman and Ryder, editors.

Imported materials inputs as a share of intermediates, manufacturing



Strassner, Lee, Yuskavage (2010) "Imported Inputs and Industry Contributions to Economic Growth," in *Measurement Issues Arising from the Growth of Globalization*. Houseman and Ryder, editors.

Import shares by industry, 2002 [percent]



Industry Group	International Accounts	Annual Industry Accounts
Manufacturing	20.7	16.8
Distributive services/1/	3.3	7.0
Information	4.2	5.3
Finance, insurance, real estate, rental, and leasing	0.9	5.0
Professional and business services	2.3	3.9
Other industries/2/	6.5	6.4
Addenda		
Private goods-producing industries/3/	17.7	14.9
Private services-producing industries/4/	3.5	5.4

/1/ Consists of wholesale trade; retail trade; transportation and warehousing

/2/ Consists of agriculture, forestry, fishing, and hunting; mining; construction; educational services; health care and social assistance; arts, entertainment, and recreation; accommodation and food services; and other services, except government

/3/ Consists of agriculture, forestry, fishing, and hunting; mining; construction; and manufacturing.

/4/ Consists of utilities; wholesale trade; retail trade; transportation and warehousing; information; finance and insurance; real estate and rental and leasing; professional, scientific and technical services; management of companies and enterprises; administrative and waste management services; educational services; health care and social assistance; arts, entertainment, and recreation; accommodation and food services; and other services, except government.

Strassner, Lee, Yuskavage (2010) "Imported Inputs and Industry Contributions to Economic Growth," in *Measurement Issues Arising from the Growth of Globalization*. Houseman and Ryder, editors.

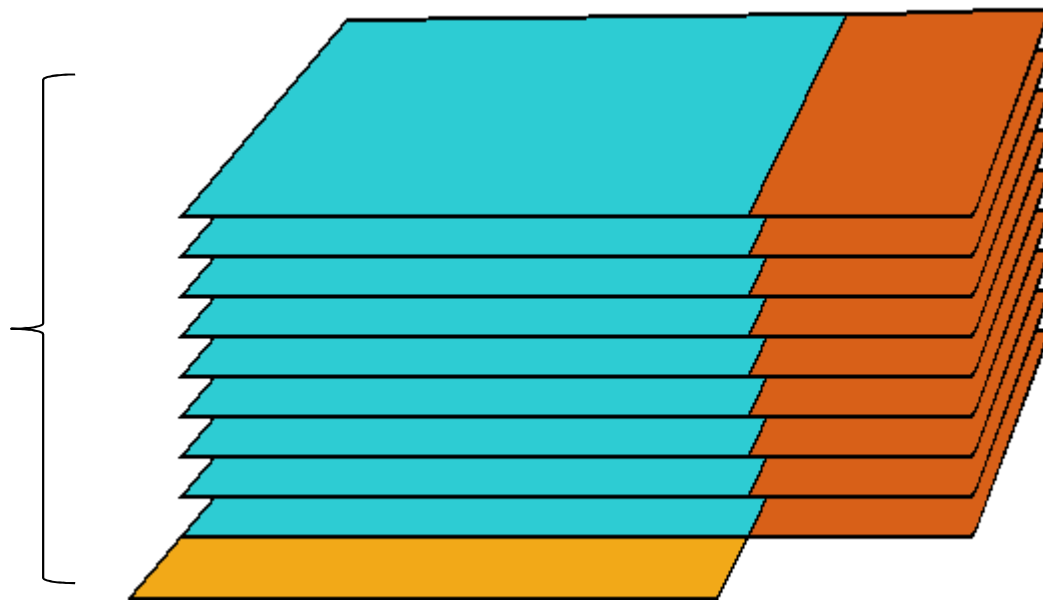
New projects related to Import table



- Converting trade classification to industrial classification is more straightforward when the description of the trade in goods and/or services is detailed and precise
- Major challenge is in the allocation of imports to intermediate and final use
 - No direct data collection in this area
- Efforts continue on research to import use, primarily through microdata efforts
 - Current efforts focused on microdata work for extended supply-use table development

Domestic Use Table

Purchaser Price Matrix



- Retail Markup
- Wholesale Markup
- Air, Rail, Truck, Water, and Pipe Transportation
- Taxes on Products
- Basic Price* Matrix

From Supply-Use to Symmetric System



Producer Value Supply-Use

	Commodities 1 2 ... m	Industries 1 2 ... n	Final Demand 1 2 ... k	Total Output
Commodities 1 2 ... m		Use Table Intermediates U	F	q
Industries 1 2 ... n	Make Table V			g
Value Added		W		
Total Output	q'	g'		



Approaches to Create Symmetric Tables

- Mathematical Approaches:
 - Industry Technology Assumption (ITA)
 - Commodity Technology Assumption (CTA)
- Production-based Approaches:
 - Redefinitions
 - Transfer Methods

BEA utilizes a hybrid approach that combines ITA and Redefinitions.



From Supply-Use to Symmetric System



Redefinitions

	Industry X Before Redefinitions	Industry Y Before Redefinitions
Input A	102	40
Input B	53	60
Input C	34	80
Value Added	102	40
OUTPUT	291	220



From Supply-Use to Symmetric System



Redefinitions

	Industry X Primary	Industry X Secondary	Industry Y Primary
Input A	100	2	40
Input B	50	3	60
Input C	30	4	80
Value Added	100	2	40
OUTPUT	280	11	220



From Supply-Use to Symmetric System



Redefinitions

	Industry X Primary	Industry Y Primary + Industry X Secondary
Input A	100	40 + 2
Input B	50	60 + 3
Input C	30	80 + 4
Value Added	100	40 + 2
OUTPUT	280	220 + 11

From Supply-Use to Symmetric System



Redefinitions

	Industry X After Redefinitions	Industry Y After Redefinitions
Input A	100	42
Input B	50	63
Input C	30	84
Value Added	100	42
OUTPUT	280	231



Industry Technology Assumption Math

- Domestic Use Table U_d results from subtracting import matrix from use table in basic prices
- Direct Requirements Matrix, Commodity by Industry:

$$B_d = U_d \hat{g}^{-1}$$

- Market Share Matrix, Industry by Commodity:

$$D = V \hat{q}^{-1}$$



Leontief (Symmetric) System

Deriving Domestic Requirements

$$q = (I - B_d D)^{-1} e_d$$

commodity-by-commodity domestic requirements matrix * column vector FD by Commodity

$$g = (I - D B_d)^{-1} D e_d$$

industry-by-industry domestic requirements matrix * column vector FD by Industry

$$g = D (I - B_d D)^{-1} e_d$$

industry-by-commodity domestic requirements matrix * column vector FD by Commodity

Industry Technology Assumption Math

- Symmetric Input-Output Matrix:
 - Industry-by-Industry: $L_{ixi} = D U$
 - Commodity-by-commodity: $L_{cxc} = U D$
- Symmetric Direct Requirements Matrices
 - Industry-by-Industry: $A_{ixi} = D B$
 - Commodity-by-Commodity: $A_{cxc} = B D$
- Total Requirements Matrices
 - Industry-by-Industry: $T_{ixi} = [I - A_{ixi}]^{-1}$
 - Commodity-by-Commodity: $T_{cxc} = [I - A_{cxc}]^{-1}$
 - Industry-by-Commodity: $T_{ixc} = D [I - A_{cxc}]^{-1}$

Leontief (Symmetric) System

Explaining Total Requirements

Define K , such that

$$K = I + A + A^2 + A^3 + A^4 + \dots + A^n + \dots (n \rightarrow \infty)$$

Multiply both sides by $(I - A)$

$$(I - A)K = \lim_{n \rightarrow \infty} I - A^{n+1}$$

Provided column sums of A are less than 1 the above limit equals

$$\begin{aligned}(I - A)K &= I \\ \Rightarrow K &= (I - A)^{-1}\end{aligned}$$



Slide 26

NC2

I dont know how to convert this slide to direct requirements

Nelson, Chelsea, 05/09/2018

Leontief (Symmetric) System



Limitations of Total Requirements

- Linear
- Constant returns to scale
- No capacity constraints

