The Effects of Imported Intermediate Inputs on Productivity

Lucy P. Eldridge and Michael J. Harper
BLS Office of Productivity and Technology

Conference on Measurement Issues Arising from the Growth of Globalization
November 6, 2009

BLS
U.S. BUREAU OF LABOR STATISTICS
125 YEARS

www.bls.gov

BLS Productivity Measures

- U.S. Private Business Sector
- U.S. Manufacturing Sector
- Influence of Import Prices

125 YEARS
BLS

Private Business Sector Output

- GDP less:
  - General government
  - Private households
  - Nonprofit institutions
  - Owner-occupied housing and the rental value of buildings and equipment of nonprofits
- GDP = C + I + G +(Exports-imports)
- Imports are removed from output

125 YEARS BLS

BLS Multifactor Productivity *(MFP)* for the U.S. Private Business Sector

$$dln\ A_{BLS} = dln\ Y_{BLS} - w_L\ dln\ L - w_K\ dln\ K$$

- dln - difference in logarithms for successive years
- Y_{BLS} - real private business sector output
- $w_{L,K}$ - average cost shares for labor and capital

125 YEARS BLS

Sectoral Output

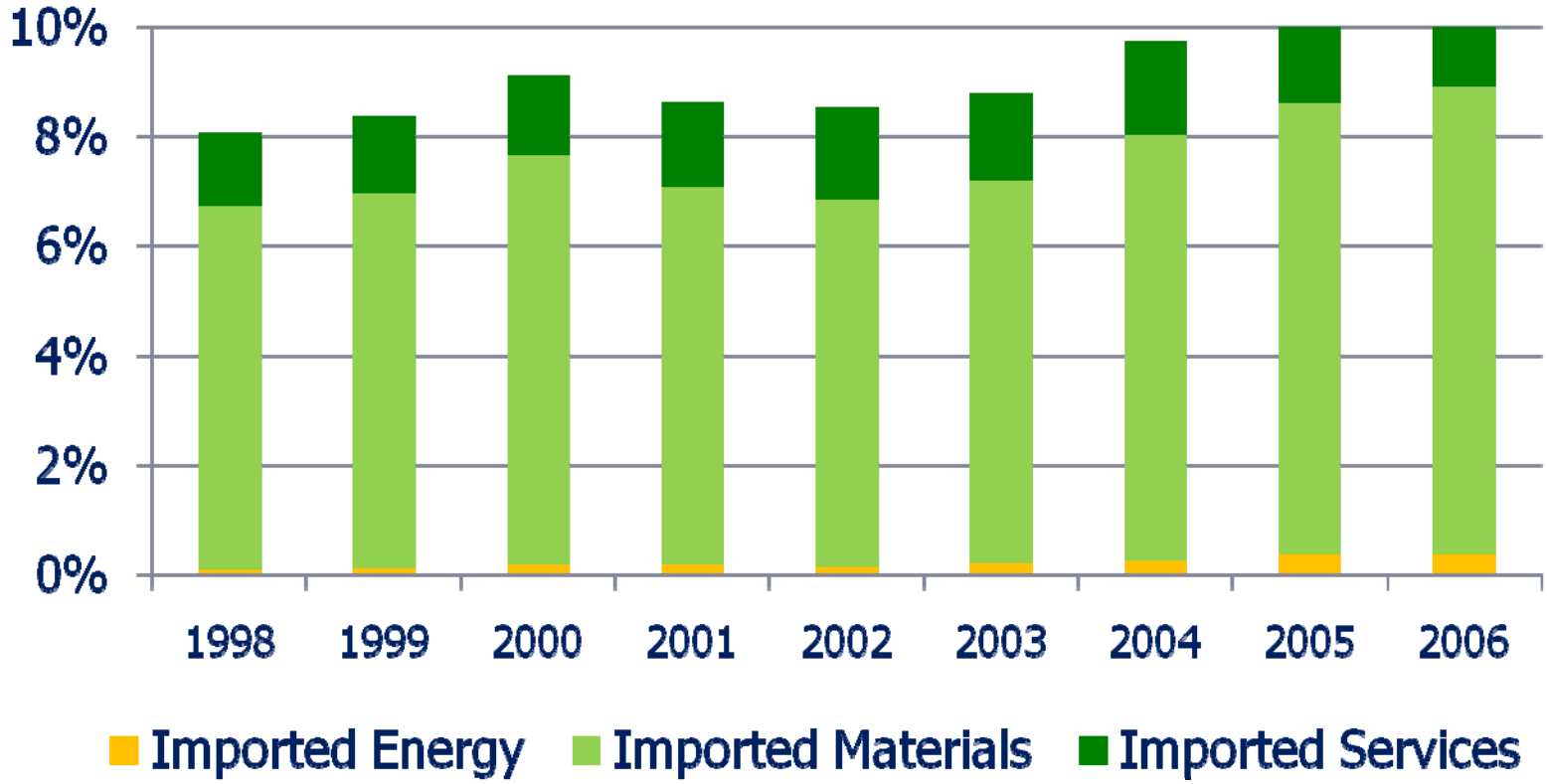
- Final demand less intermediate inputs produced within the sector
- Intermediates produced outside the sector (imports) are not removed
- BEA data on imported intermediate inputs

125 YEARS BLS

Imported Intermediate Inputs Share of Total Intermediates, by type of input

(Text Figure 1)

percent for all private industries 1998-2006



Source: Bureau of Economic Analysis

Multifactor Productivity Adjusted to Include Imported Intermediates

$$dlnA_S = dlnY_S - \theta\, w_L\, dlnL - \theta\, w_K\, dlnK - \sum_j (w_j\, dlnII_j)$$

- Y_s - real private business sector output plus imported intermediate inputs (II)
- θ - adjustment factor used to correct the weights on labor and capital, Y^N_{BLS}/Y^N_S
- w_j - cost share weights for imported intermediates of energy, materials, and services

125 YEARS BLS

Effects of Imported Intermediate Inputs on Multifactor Productivity

$$dln\ A_{BLS} = dln\ Y_{BLS} - \ w_L\ dln\ L - w_K\ dln\ K$$

$$dlnA_S = dlnY_S - \theta w_L\ dlnL - \theta w_K\ dlnK - \sum_j (w_j\ dlnII_j)$$

$$dln\ A_S = \ \theta\ dln\ A_{BLS}$$

$$where\ \ \theta = \frac{Y^N_{BLS}}{Y^N_{BLS} + II^N}$$

125 YEARS BLS

Private Business Sector Multifactor Productivity, with and without imports, 1997 to 2006

(Text Table 2)

	BLS MFP	MFP including Imports	difference
annual growth from previous year			
1997	0.94%	0.87%	-0.07%
1998	1.30%	1.20%	-0.10%
1999	1.29%	1.19%	-0.10%
2000	1.28%	1.18%	-0.10%
2001	0.11%	0.10%	-0.01%
2002	1.65%	1.53%	-0.13%
2003	2.63%	2.43%	-0.20%
2004	2.49%	2.28%	-0.20%
2005	1.63%	1.48%	-0.15%
2006	0.54%	0.49%	-0.05%
annual average growth			
1997-2006	1.43%	1.31%	-0.12%

125 YEARS BLS

Substitution of Imported Intermediates for U.S. labor

$$dlnY_S - dlnL =$$

$$dlnA_S + \theta\, w_K (dlnK - dlnL) +$$

MFP *contribution of capital*

$$\sum_j \{w_j (dlnII_j - dlnL)\}$$

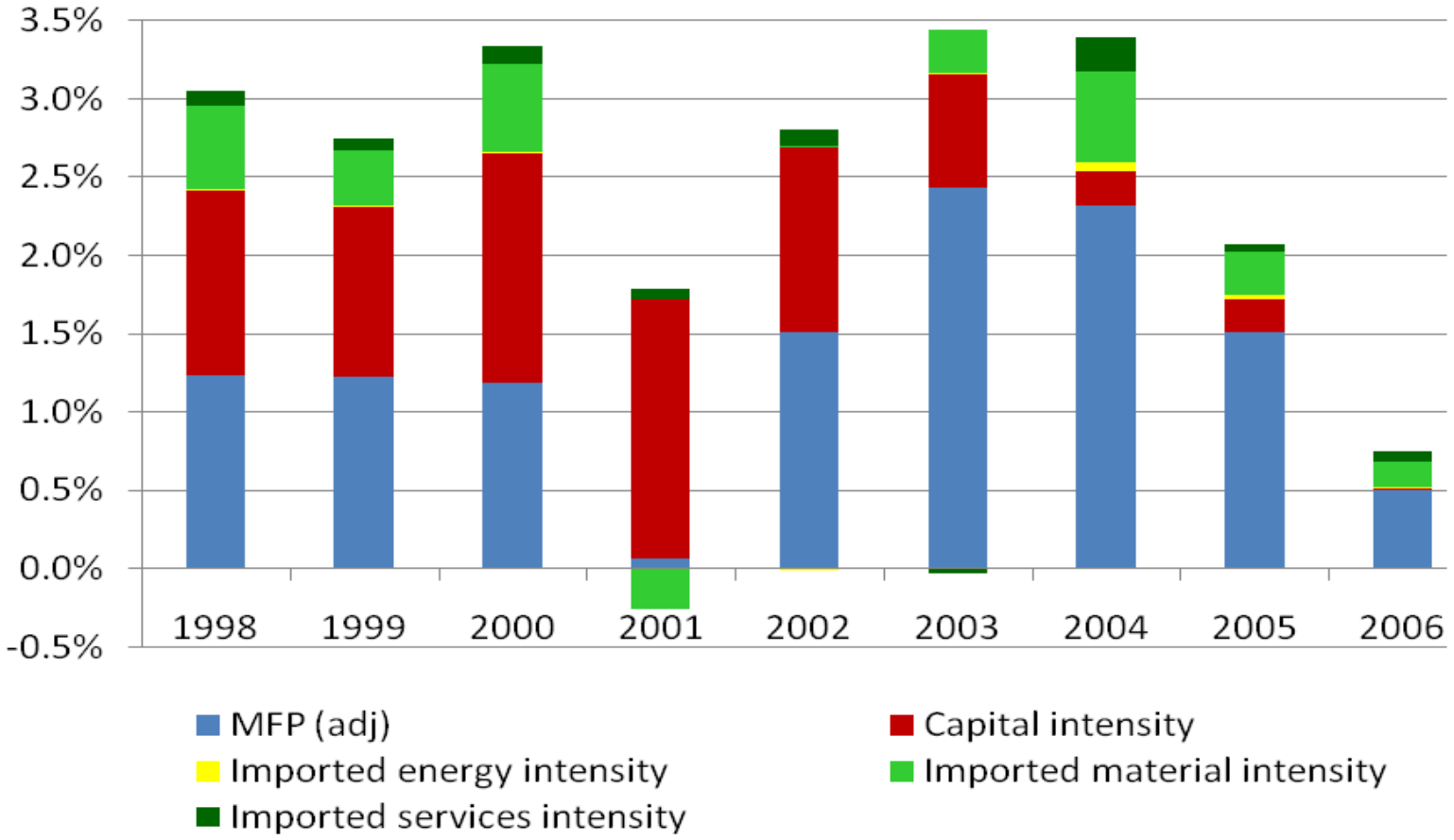
contribution of imported intermediates

125 YEARS BLS

Private Business Sector Labor Productivity Growth by Contributing Factor Inputs

(Text Figure 2)

average annual growth rates



125 YEARS BLS

Source: Bureau of Labor Statistics and Bureau of Economic Analysis

Contributions to Labor Productivity in the U.S. Private Business Sector 1997-2006

(Text Table 3)

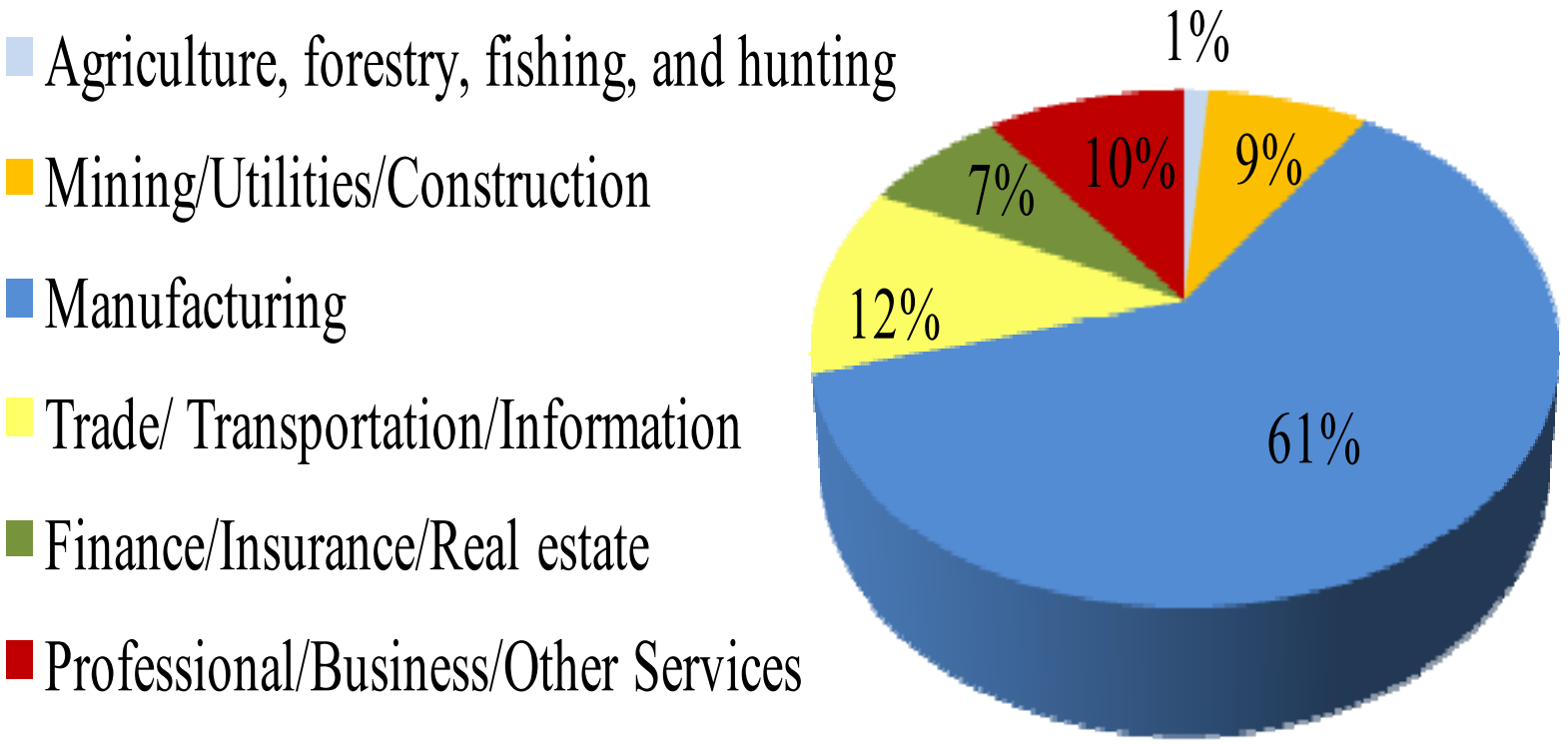
average annual growth

Output per unit of labor (includes imports)	2.6%
Multifactor Productivity (includes imports)	1.31%
Contribution of capital intensity	0.88%
Contribution of imported intermediates	0.37%
Contribution of imported materials	0.27%
Contribution of imported services	0.09%
Contribution of imported energy	0.01%
Output per unit of labor (without imports)	2.4%

125 YEARS BLS

Percent of Imported Intermediate Inputs Used by Private Industries, 2006

(Text Figure 3)



Source: Bureau of Economic Analysis

125 YEARS BLS

BLS Multifactor Productivity *(MFP)* for the Manufacturing Sector

$$dln\ A_G = dln\ Y_G - w_L\ dln\ L - w_K\ dln\ K - w_I\ dln\ I$$

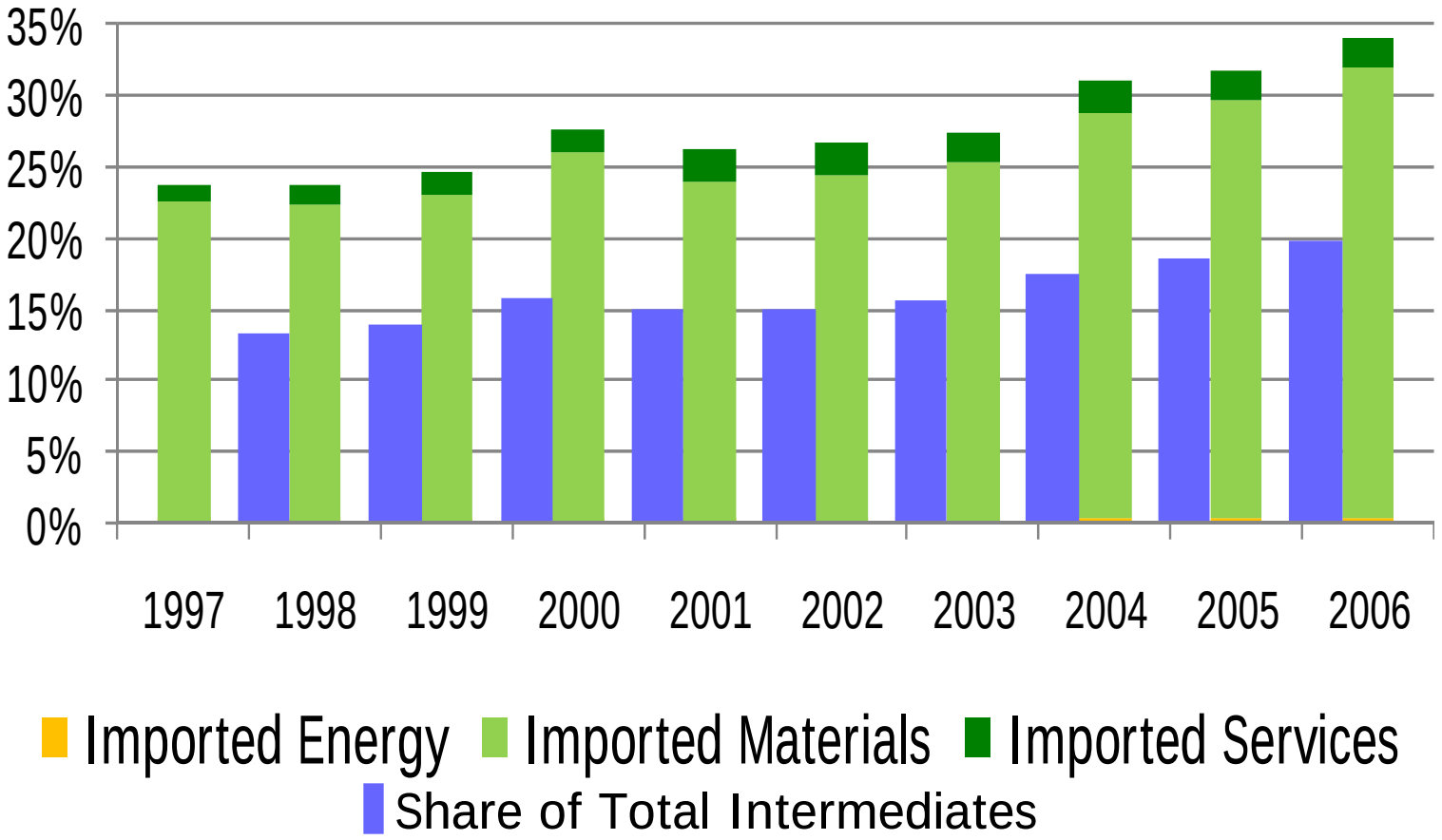
- dln - difference in logarithms for successive years
- Y_G - real manufacturing sectoral output
- $w_{L,K,I}$ - average cost shares for labor, capital, intermediate inputs (E,M,S)
- Intermediate inputs are both domestic and imported

125 YEARS BLS

Imports Share of Sectoral Intermediate Inputs, by type of input, 1997-2006

(Text Figure 4)

percent for U.S. manufacturing sector



Source: Bureau of Labor Statistics and Bureau of Economic Analysis

Manufacturing Sector Multifactor Productivity and Components, 1997-2006

(Text Table 4)

	Sectoral Output	Labor	Capital	Domestic Intermediates	Imported Intermediates	MFP
Annual growth						
1998	5.2%	-0.2%	5.0%	2.3%	9.6%	2.30%
1999	3.8%	-0.7%	4.1%	4.2%	7.1%	0.80%
2000	2.7%	-1.3%	3.1%	-4.1%	5.5%	3.50%
2001	-5.1%	-6.5%	1.5%	-3.0%	-4.9%	-1.30%
2002	-0.7%	-7.1%	0.6%	-4.4%	-2.1%	3.70%
2003	1.0%	-4.9%	0.0%	-1.3%	2.6%	2.80%
2004	1.7%	-0.5%	-0.6%	-5.2%	8.7%	2.60%
2005	3.7%	-1.1%	0.0%	7.7%	4.9%	0.40%
2006	1.8%	0.6%	0.5%	-2.0%	4.3%	1.60%
Annual average growth						
1997-2006	1.53%	-2.44%	1.57%	-0.74%	3.88%	1.79%

125 YEARS BLS

Growth of Imported and Domestic Intermediate Inputs, U.S. Manufacturing Sector, 1997-2006

(Part of Text Table 5)

average annual growth rates

	Domestic	Imported
Total Intermediates	-0.74%	3.88%
Energy	-2.94%	5.34%
Materials	-3.93%	3.49%
Services	1.36%	8.13%

125 YEARS BLS

Substitution of Imported Intermediates for U.S. labor

$$dlnY_G - dlnL = dlnA_G + w_K (dlnK - dlnL) +$$

MFP *contribution of capital*

$$\sum_j \{ w_{Dj} (dlnDI_j - dlnL) +$$

contribution of domestic intermediates

$$\sum_j \{ w_{Ij} (dlnII_j - dlnL) \} \}$$

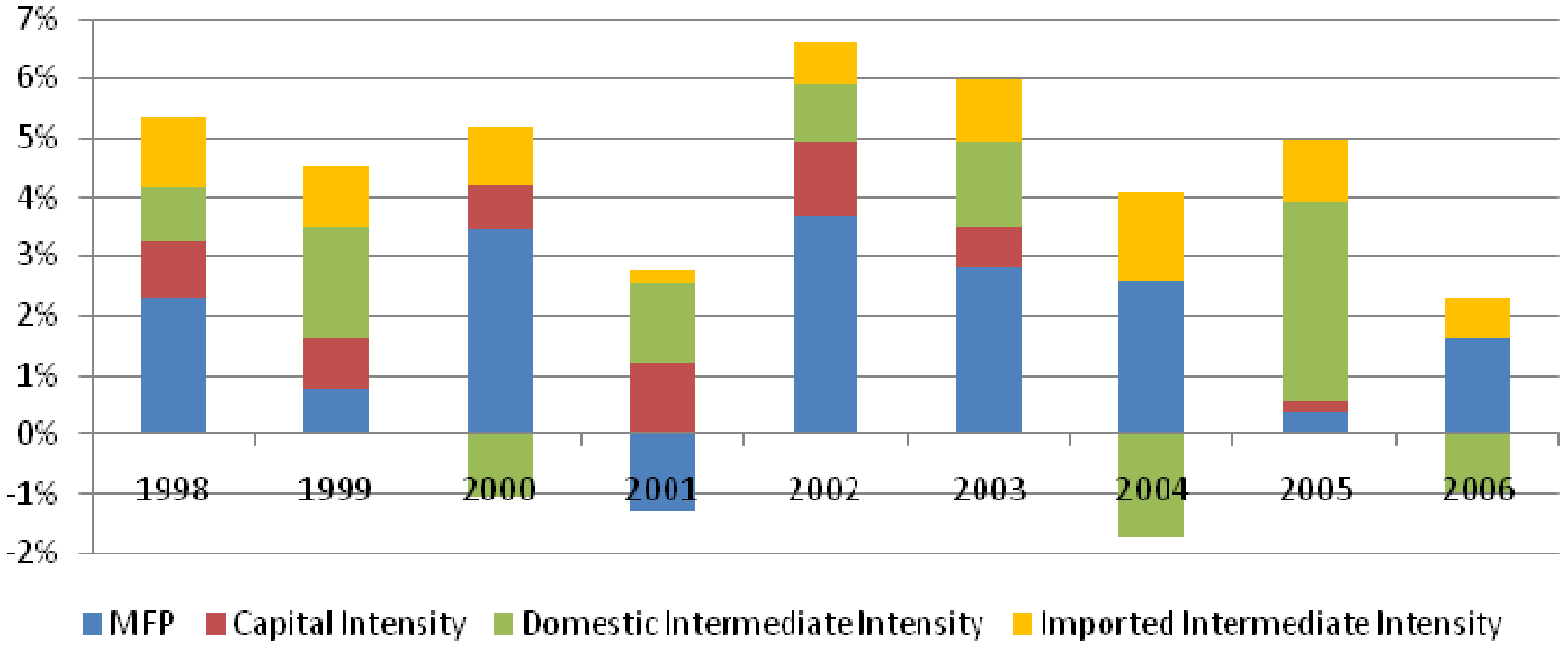
contribution of imported intermediates

125 YEARS BLS

Manufacturing Sector Labor Productivity Growth by Contributing Factor Inputs

(Text Figure 6)

annual growth rates, 1998-2006



Source: Bureau of Labor Statistics and Bureau of Economic Analysis

125 YEARS BLS

Contributions to Labor Productivity in the Manufacturing Sector 1997-2006

(Text Table 6)

average annual growth rates

Output per unit of labor	3.96%
Multifactor Productivity	1.79%
Contribution of capital intensity	0.64%
Contribution of domestic intermediates	0.65%
Contribution of imported intermediates	0.92%
Contribution of imported materials	0.80%
Contribution of imported services	0.10%
Contribution of imported energy	0.01%

125 YEARS BLS

Influence of Import Prices on BLS Private Business Sector Productivity

- Assume domestic inputs are measured precisely
- $dlnA_{BLS} - dlnA_{Price*} = dlnY_{BLS} - dlnY_{Price*}$
- Assume other components of output are measured precisely
- $dlnA_{BLS} - dlnA_{Price*} = -s_I\,(dlnII_{BEA} - dlnII_{Price*})$

where $s_I = 1/2 * \left(\frac{I_t^N}{Y_{BLS,t}^N} + \frac{I_{t-1}^N}{Y_{BLS,t-1}^N} \right)$

125 YEARS BLS

Influence of Import Prices on BLS Private Business Sector Productivity

- No difference in nominal intermediate inputs

- $$dlnA_{BLS} - dlnA_{Price*} = s_I \left(dlnP^I_{BEA} - dlnP^I_{Price*} \right)$$

where

$$s_I = 1/2 * \left(\frac{I^N_t}{Y^N_{BLS,t}} + \frac{I^N_{t-1}}{Y^N_{BLS,t-1}} \right)$$

125 YEARS BLS

Influence of Import Prices on Private Business Sector MFP that includes Imported Intermediate Inputs

- $dlnA_S - dlnA_{Price*} = dlnY_S - dlnY_{Price*} - w_{II}(dlnII_{BEA} - dlnII_{Price*})$
- Reduce influence on output and add influence on inputs
- $= \sum w^I_i (dlnP^I_{BEA,i} - dlnP^I_{Price*,i}) + \sum w^I_j (dlnP^I_{BEA,j} - dlnP^I_{Price*,j})$

final demand

intermediates

where $w_{x=i,j} = 1/2 * \left(\frac{I^N_{x,t}}{Y^N_{S,t}} + \frac{I^N_{x,t-1}}{Y^N_{S,t-1}} \right)$

125 YEARS BLS

Imported Intermediate Inputs Share of Aggregate Output, 1997-2006

(Text Table 7)

	Private Business Sector	
	BLS Output Share, s^{I}	Sectoral Output Share, w^{II}
1998	8.05%	7.45%
1999	8.07%	7.47%
2000	8.76%	8.05%
2001	8.84%	8.12%
2002	8.25%	7.62%
2003	8.25%	7.62%
2004	8.98%	8.23%
2005	10.03%	9.11%
2006	10.77%	9.72%

Influence of an Individual Imported Commodity's Price on Aggregate Productivity

imported commodity's share of imports weighted by imports share of output

$$c_j^I = 1/2 * \left(\frac{I_{j,t}^N}{Y_t^N} \frac{C_{j,t}^N}{I_{j,t}^N} + \frac{I_{j,t-1}^N}{Y_{t-1}^N} \frac{C_{j,t-1}^N}{I_{j,t-1}^N} \right)$$

Influence of Import Prices on Manufacturing Sector Productivity

- Assume that output and domestic inputs are measured precisely

- $$dlnA_{BLS} - dlnA_{Price*} = - w_{II}(dlnII_{BEA} - dlnII_{Price*})$$

  where $$w_{x=IE,IM,IS} = 1/2 * \left(\frac{I^N_{x,t}}{Y^N_{G,t}} + \frac{I^N_{x,t-1}}{Y^N_{G,t-1}} \right)$$

- $$dlnA_{BLS} - dlnA_{Price*} = \sum w^I_i \, (dlnP^I_{BEA,i} - dlnP^I_{Price*,i})$$

125 YEARS BLS

Imported Intermediate Inputs Share of Aggregate Output, 1997-2006

(Text Table 8)

	Private Business Sector		Manufacturing Sector
	BLS Output, s^I	Sectoral Output, w^{II}	BLS Output, w^I
1998	8.05%	7.45%	12.24%
1999	8.07%	7.47%	12.39%
2000	8.76%	8.05%	13.53%
2001	8.84%	8.12%	13.97%
2002	8.25%	7.62%	13.57%
2003	8.25%	7.62%	13.86%
2004	8.98%	8.23%	15.24%
2005	10.03%	9.11%	16.94%
2006	10.77%	9.72%	18.33%

125 YEARS BLS

Conclusions: Private Business Sector

- Introducing imported intermediates in MFP model reduces measured MFP 0.1-0.2% per year
- Growth in imported intermediate inputs would contribute 14% to labor productivity growth if included in the model
- Although effects of imported intermediates on the US economy can be captured in the multifactor productivity model, it would not be wise to include them in labor productivity model

125 YEARS BLS

Conclusions: Manufacturing Sector

- 60% of imported intermediate inputs are used by the manufacturing sector
- Imported intermediates have grown as a share of total intermediates 1997-2006
- Growth in imported intermediate inputs contribute 23% to labor productivity growth

125 YEARS BLS

Conclusions: Import Prices

- Import prices impact productivity statistics
- Size of impact will be weighted by imported intermediate inputs share of output
- An individual commodity's price growth will impact productivity by commodity's share of imports times imports share of output

125 YEARS BLS

Contact Information

Office of Productivity and Technology

multifactor productivity: *www.bls.gov/mfp/*
labor productivity: *www.bls.gov/lpc/*

Lucy P. Eldridge
202-691-6598
eldridge.lucy@bls.gov

Michael J. Harper
202-691-5600
harper.michael@bls.gov

BLS
U.S. BUREAU OF LABOR STATISTICS
125 YEARS

www.bls.gov

Input Costs for the Manufacturing Sector, by input type 1998-2006

(Text figure 5)