

The Right Price?

Prices in a Dynamic Input-Output Model

23rd INFORUM World Conference

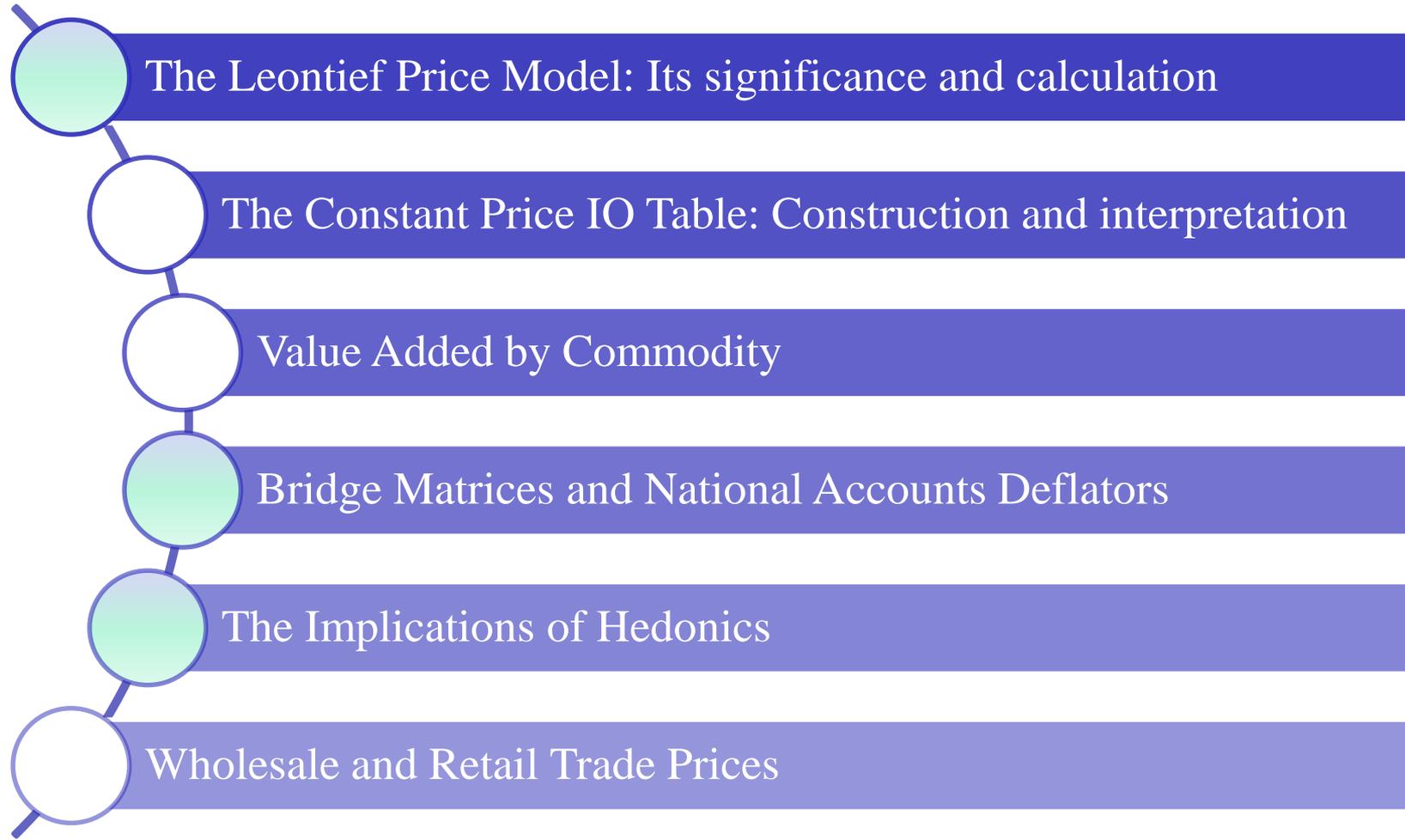
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Overview of Topics





The Leontief Price Model

$$p' = p'A + v'$$

Dual to the quantity model

Has generally received less attention

Shows interrelationships of costs, value added and prices

Useful for understanding differential price impacts by industry

In an extended IO model, prices are used in other econometric equations

Thinking about the price relationships should aid in developing national accounts

Calculation of Prices: Gauss-Seidel Iteration

$$p_j = \sum_{i=1}^n a_{ij} p_i + v_j$$

$$p_j^k = \sum_{i=1}^{i < j} a_{ij} p_i^k + a_{jj} p_j^k + \sum_{i=j+1}^n a_{ij} p_i^{k-1} + v_j$$

$$p_j^k = \frac{\sum_{i=1}^{i < j} a_{ij} p_i^k + \sum_{i=j+1}^n a_{ij} p_i^{k-1} + v_j}{1 - a_{jj}}$$

Note that the a 's and v 's may both vary, and may be determined within, or prior to, the Gauss-Seidel iteration.

This technique is fast, and there is no need to calculate and store a Leontief inverse.

The Constant Price IO (CPIO) Table

Necessary to make valid comparisons over time (history or forecast) with changing prices.

Comes closest to Leontief's view of the IO table as a relationship between physical quantities.

Simplest approach: deflated input divided by deflated output.

Tables balanced in current prices, when properly deflated, yield the actual historical prices using the Leontief price calculation.

Deflation of IO Table with Imports

In current prices, the identity is

$$pd'q = pd'A^d q + pm'A^m q + pd'of^d + pm'of^m - pm'm \quad (7)$$

In constant prices

$$q = A^d q + A^m q + of^d + of^m - m \quad (8)$$

where:

of^d = other (non-imported) final demand satisfied by domestic production

of^m = other final demand satisfied by imports

A^d = domestic direct requirements matrix

A^m = imported direct requirements matrix

Note that since

$$m = A^m q + of^m$$

The imported and domestic components of intermediate and final demand can be separately deflated, and there is no additional complication in computing the domestic price.

Two Views on Deflation

1. Constant Price IO table should only balance to constant price output across the row.
2. Table should also balance down the column, and value added should be deflated so that the column sums agree with constant price output.

It seems that version 2 is incorrect, at least not consistent with Leontief's concept of the constant price table working like physical units.

One row is constant price apples, another is constant price oranges.

Note that the unit value added v' needed for the price identity is current price.

Value Added by Commodity

Symmetric commodity-by-commodity table has value added by commodity, and the price identity is then calculated by commodity.



Conceptually, this is the labor and capital income, and commodity tax allocated to each commodity produced by an industry.



Value added data are collected only by industry.



If forecasts of value added are also made by industry, a bridge matrix (similar to a make table) needs to be developed to convert from industry to commodity and back.



Bridge Matrices and National Accounts Deflators

Final Demand Bridges

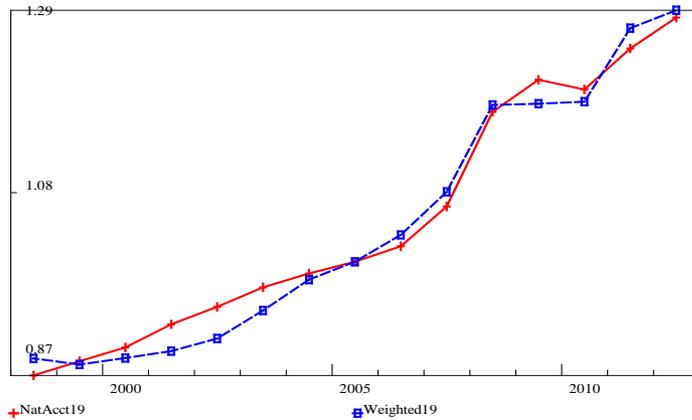
- Consumption bridge: Relates consumption by category in purchasers' prices to commodity final demand.
- Investment bridge: Relates investment by purchasing industry to commodities which make up the asset types.

National Accounts Personal Consumption and Investment Deflators

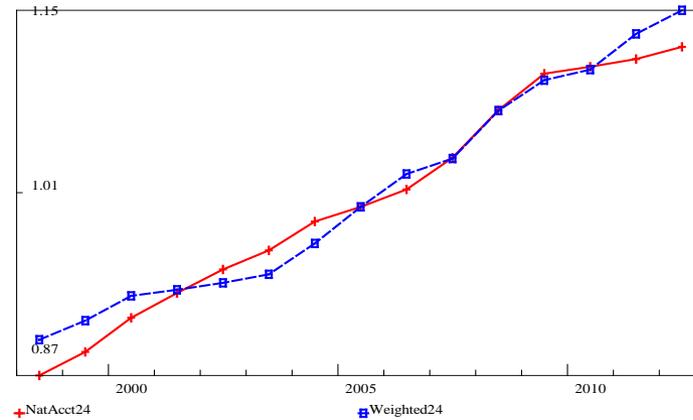
- Prices by consumption category and for total investment by industry are published in the national accounts. In the U.S., these are the prices used to build up the aggregate GDP deflator.
- If the bridge matrix in flows is normalized to sum to 1.0 down the column, these coefficients should serve as weights to form the consumption or investment deflator as a weighted average of the composite commodity deflators.
- How well do the two estimates of price correspond? The next slides compare a few selected Personal consumption categories.

Consumption Deflators: The Good

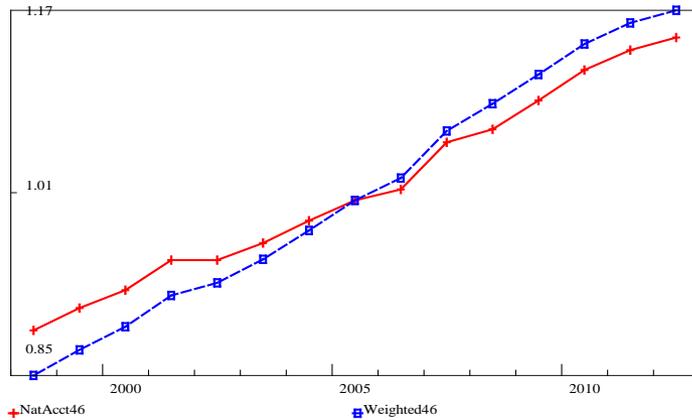
19 Cereals and bakery products



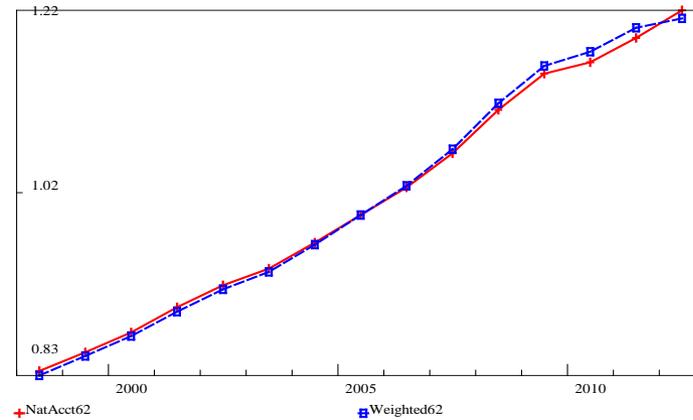
24 Alcohol purchased for off-premise consumption



46 Physicians

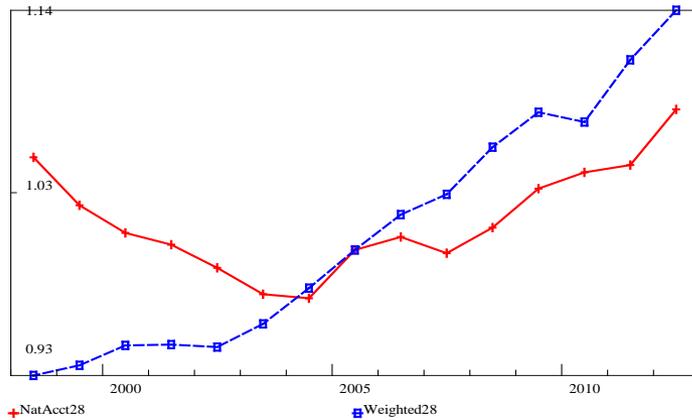


62 Eating and drinking places

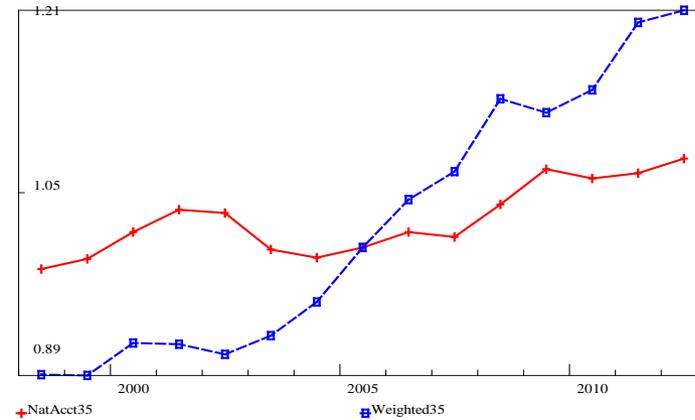


Consumption Deflators: The Bad

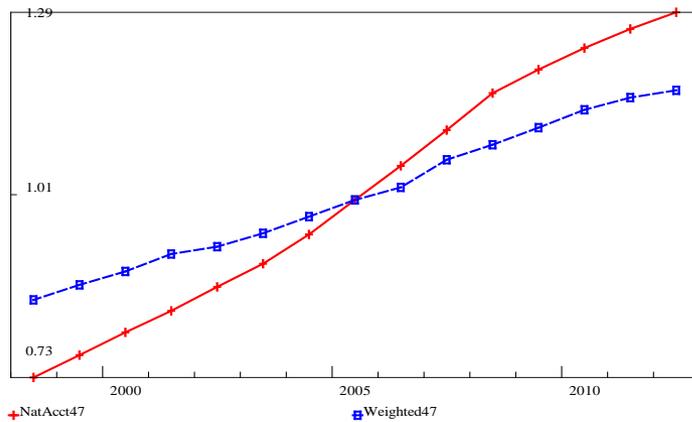
28 Footwear



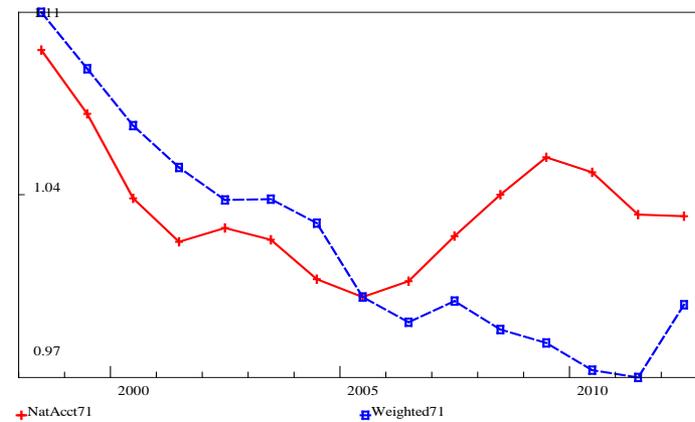
35 Household supplies



47 Dentists

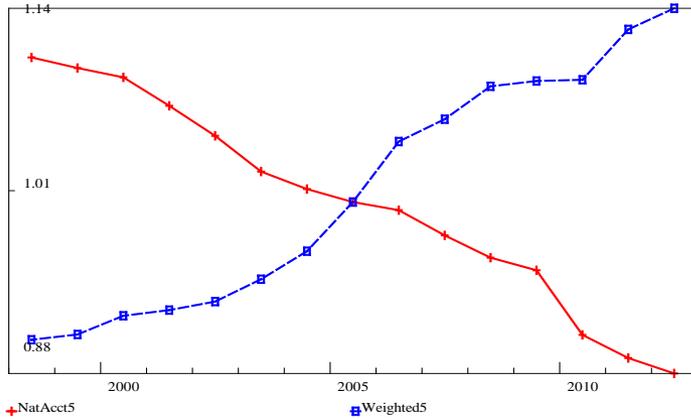


71 Telecommunications services

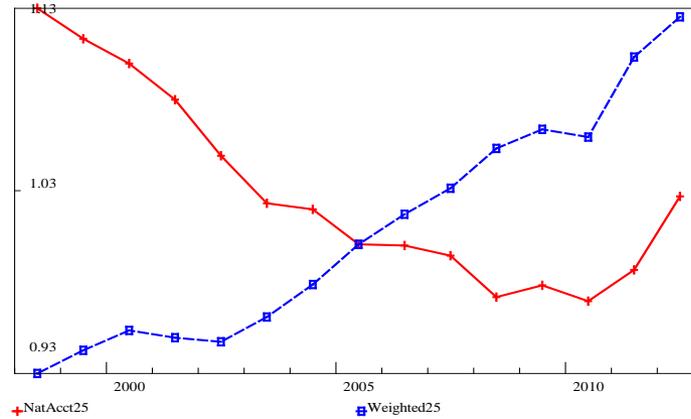


Consumption Deflators: The Ugly

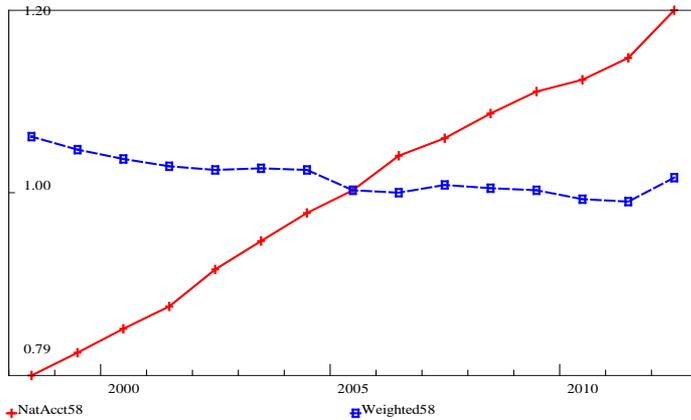
5 Furniture and furnishings



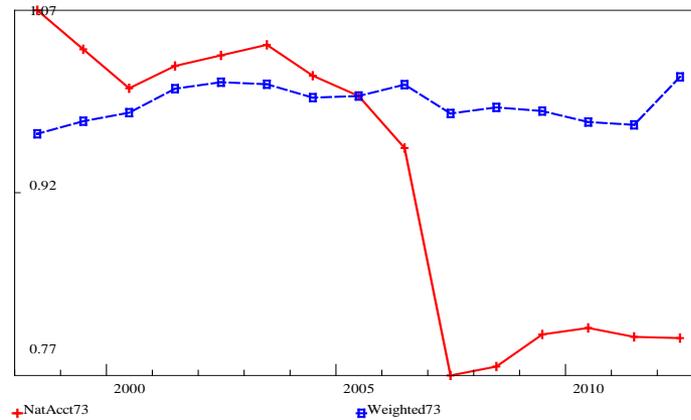
25 Clothing, women's and children's



58 Cable and satellite TV, video rental



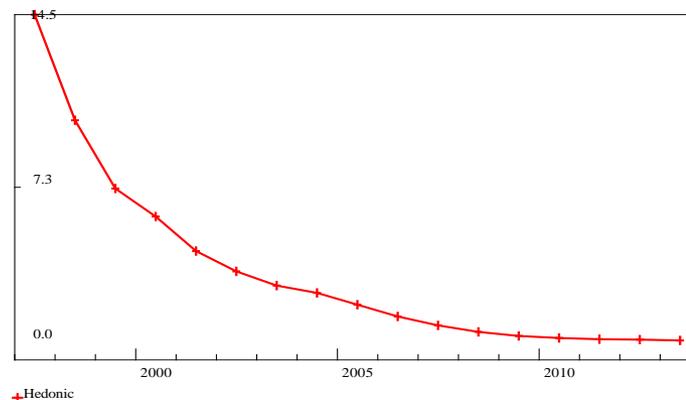
73 Internet access



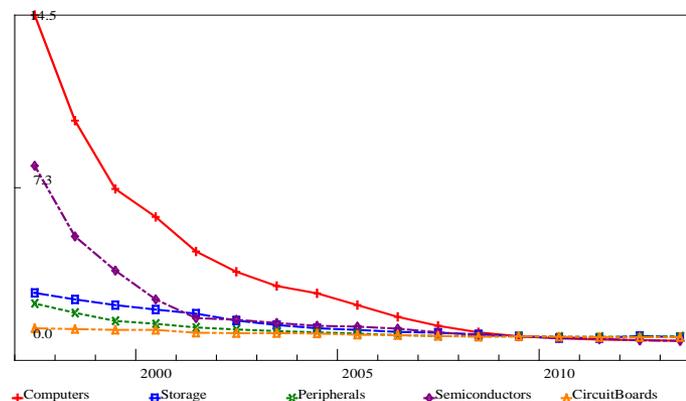
IO and Hedonic Price Indexes

- The deflator for computers declines from 14.5 to 0.8 from 1997 to 2013, a factor of 18.
- Time series of CPIO tables use deflated input over deflated output.
- Largest inputs into computers:
 - 1. Storage devices
 - 2. Peripherals
 - 3. Semiconductors
 - 4. Printed circuit board assemblies
- Also hedonically deflated, but don't fall as rapidly.
- Other inputs have rising prices.
- So, IO coefficients in the computer column (and unit value added) should also fall rapidly.

BEA Computer Deflator
2009 = 1.0

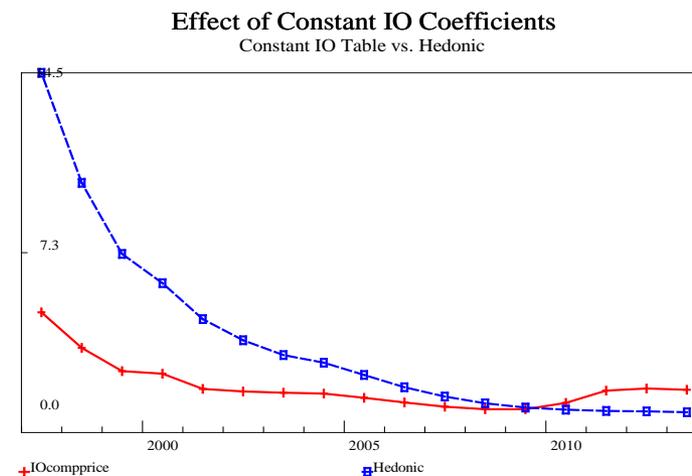


Prices of Largest Computer Inputs
2009 = 1.0



IO and Hedonic Price Indexes

- The graph at the right shows approximately the price that would be calculated from the input costs with an unchanging IO matrix.
- The red line reflects the average change in the cost of inputs, weighted by the coefficients of the base year. The blue line shows the actual computer deflator.
- Note that the falling computer deflator also implies a declining level of nominal wages to real output, and rapidly increasing labor productivity.
- In forecasting the IO column and value added, one must rely on the projection of the computer deflator.



Prices of Wholesale and Retail Trade

Where Are the Margins Distributed?

NAICS	Description	Intermediate	Personal				Government	Commodity Output
			Consumption	Investment	Exports	Imports		
<i>Trade Margin</i>								
420000	Wholesale trade	542,438	393,725	137,939	125,573	28,773	15,502	1,243,950
441000	Motor vehicle and parts dealers	10,827	119,068	12,213	-	-	-	142,108
445000	Food and beverage stores	1,336	161,338	587	-	-	-	163,261
452000	General merchandise stores	4,701	174,799	3,104	-	-	-	182,604
4A0000	Other retail	103,616	583,929	31,240	-	-	-	718,785
<i>Percent Shares by Destination</i>								
	Wholesale trade	43.6	31.7	11.1	10.1	2.3	1.2	
	Motor vehicle and parts dealers	7.6	83.8	8.6	-	-	-	
	Food and beverage stores	0.8	98.8	0.4	-	-	-	
	General merchandise stores	2.6	95.7	1.7	-	-	-	
	Other retail	14.4	81.2	4.3	-	-	-	

Trade margins from the 2007 Benchmark IO Table

- **Wholesale trade margins are dominant in intermediate, but also important for Personal consumption, investment and exports.**
- **Retail margins are mostly in Personal consumption, but Other retail is important for intermediate as well.**

Prices of Wholesale and Retail Trade

How Are They Defined?

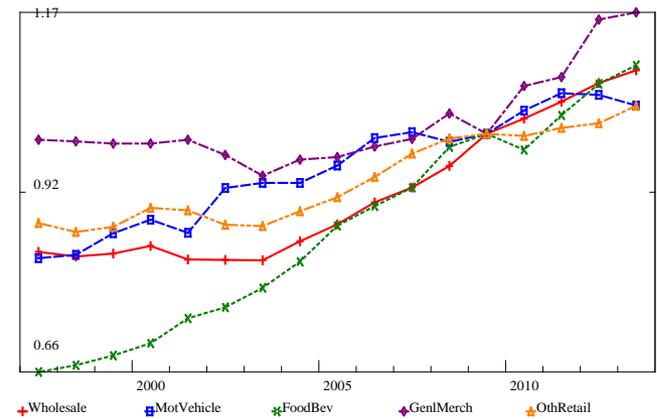
- Trade output consists of margin and non-margin components.
- Margin output is defined as gross margin (sales less cost of goods sold) with several adjustments.
- It represents services valued by consumer or purchaser, which cost resources to produce.
- The margin price should represent the costliness of these services, but should also reflect the input cost.
- Several methods have been suggested:
 1. Sales price indices, matched to detailed merchandise lines.
 2. Direct price indices for the deflation of gross margin.
 3. Double-deflation, using the difference in sales prices and purchase prices
 4. Margin price measurement, using real and nominal margin rates.
 5. Cost based: use weighted changes of input costs.

Prices of Wholesale and Retail Trade

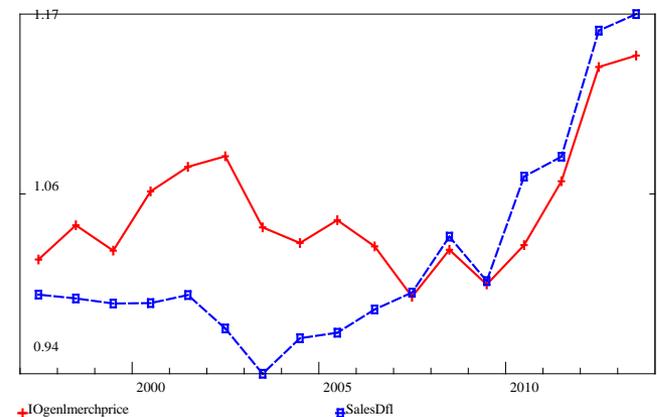
Some Examples

- The first figure on the right compares gross output deflators constructed for wholesale trade, and 4 categories of retail trade.
- The relative flatness of several series in the 1997 to 2004 period may be related to declining imports prices, and reflect the low inflation of goods being sold.
- The second graph compares an input-cost based price with the actual price, for General merchandise stores. The series track well after 2007, but diverge before that.

Wholesale and Retail Gross Output Deflators
2009 = 1.0



Genl Merchandise: Effect of Constant IO Coefficients
Constant IO Table vs. Sales Deflators



Parting Comments

- An important contribution by Leontief was the recognition of the interdependence of prices across industries, and with incomes.
- More attention to IO price relationships could benefit the construction of constant price IO tables and national accounts.
- Issues related to the deflation of margins and the use of hedonic indices may both be related to inconsistencies found with consumption deflators.
- Viewing prices as an interrelated system poses a counterweight to the method of hedonics, where prices are defined as costs of characteristics valued by users. Cost of production is also important.

Thank you!
Feel free to contact me at
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