BEA
BUREAU OF ECONOMIC ANALYSIS
U.S. DEPARTMENT OF COMMERCE

Price Indexes for IT Goods

Ana Aizcorbe (BEA)

World KLEMS Conference

August 19, 2010

Overview

- Price indexes play an important role in KLEMS to deflate:
  - Output
  - Materials
  - Capital

- Price indexes for IT goods are numerically important
  - Rapid rates of quality increase translate into substantial contributions to real GDP growth

- Today:
  - Basics of price measurement
  - IT prices currently used in the national accounts

Price indexes provide a better decomposition of spending growth.

Crude decomposition:

CHANGE IN SPENDING (or REVENUES, or COST)	**= CHANGE IN AVERAGE PRICE**	**+ CHANGE IN QUANTITY**

Accounting for Quality:

CHANGE IN AVERAGE PRICE	**= CHANGE IN "CONSTANT-QUALITY" PRICES**	**+ CHANGE IN "QUALITY"**

Better decomposition:

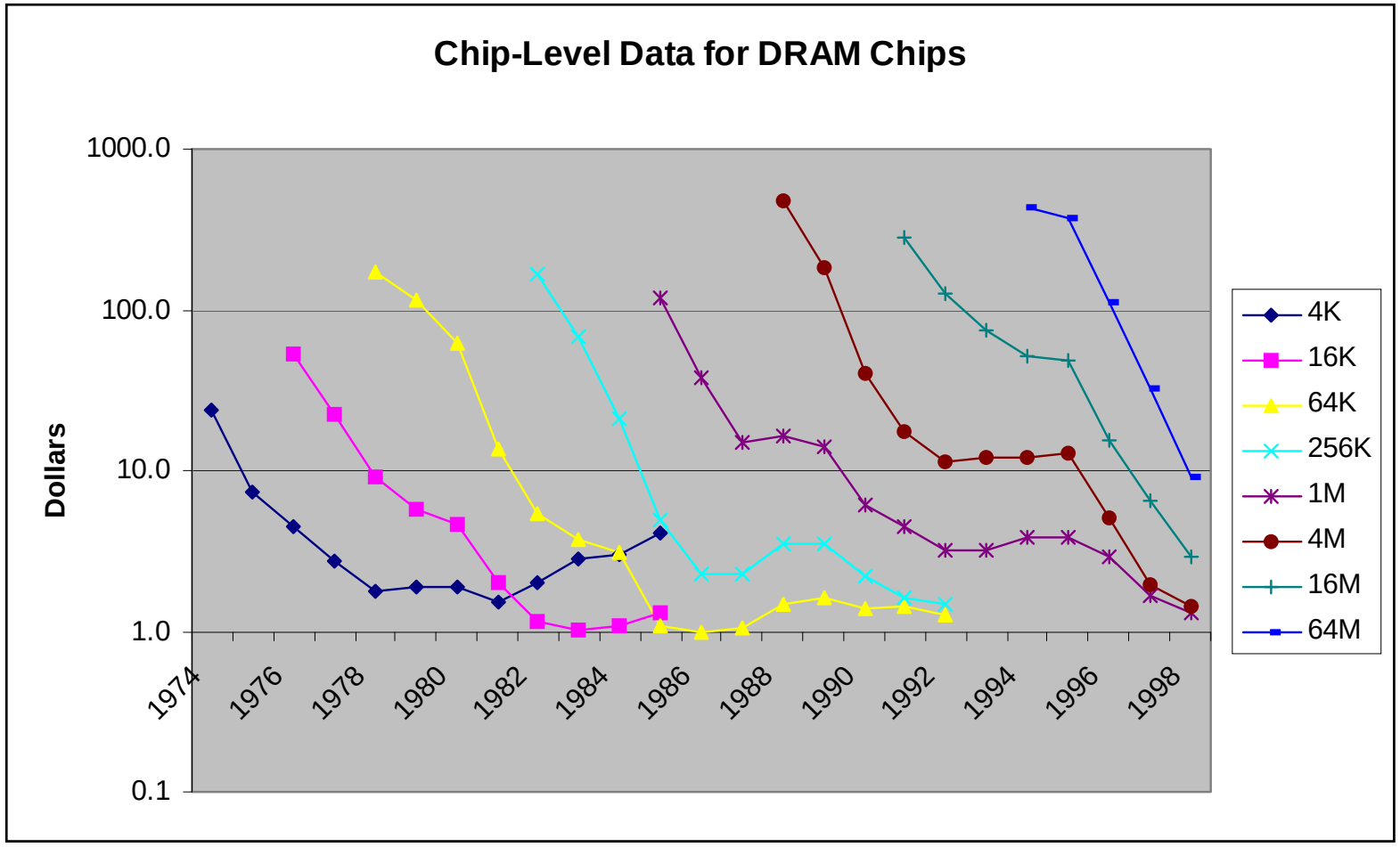
CHANGE IN SPENDING	**= CHANGE IN "CONSTANT-QUALITY" PRICES**	**+ CHANGE IN QUANTITY** **+ CHANGE IN "QUALITY"**

There are two methods for obtaining constant-quality price indexes.

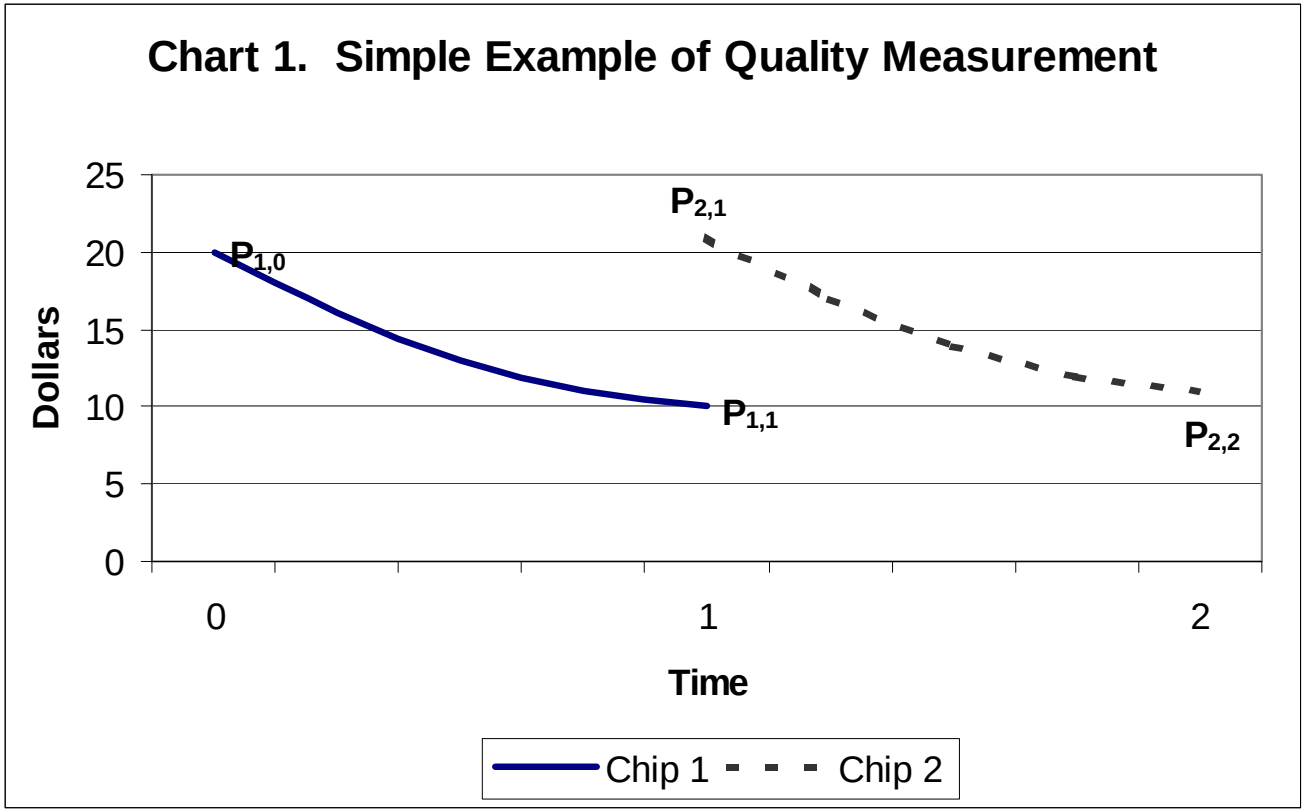
- Indirect method: Matched-Model Indexes
  - Assume that differences in prices at a point in time reflect differences in the quality of goods.

- Direct method: Hedonic Techniques
  - Explicitly model how quality affects price.

Matched-model method: DRAM chips

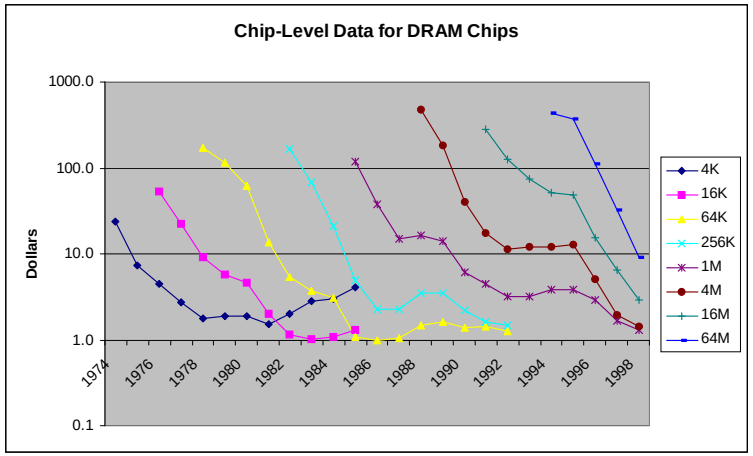


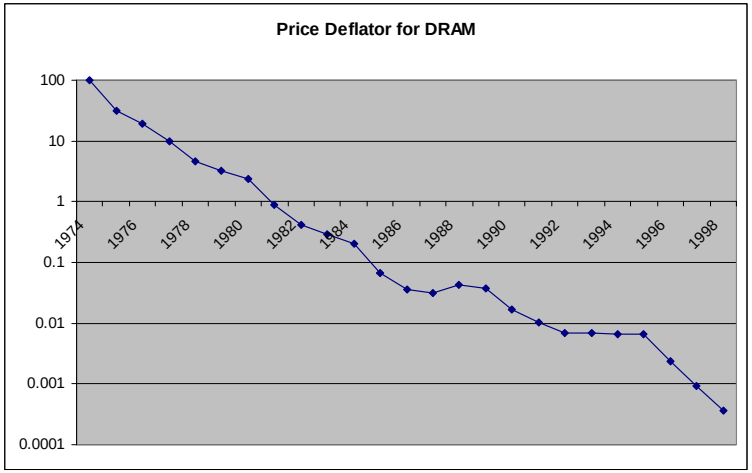
How the matched-model method imputes quality



$$P_{2,2} / P_{1,0} = (P_{2,2} / P_{2,1})(P_{2,1} / P_{1,1})(P_{1,1} / P_{1,0})$$

Accounting for quality yields declining C-Q prices.





- Once you strip out the estimate of "quality," the price index falls rapidly.
- The increase in DRAM revenues over this period is more than explained by increases in quality-adjusted quantities.
- NOTE: This technique cannot be applied in all cases (e.g., Housing)

To what extent does the matched-model method account for quality change?

- It does not capture the seismic shift that occurred with the introduction of the transistor (Nordhaus)
- Many think matched model indexes do not go far enough in accounting for quality improvements
  - Hedonic is better (conventional view)
  - Some think that MM and hedonic can give very similar numerical answers (Aizcorbe, Corrado and Doms)
- Some think matched model method is fine but BLS doesn't apply it enough (Bils)
- Some have raised the possibility that the matched model method overstates quality growth (Gordon, Hulten, and others)

Two types of Hedonic methods can also be used to account for quality.

- Dummy variable method

$$\ln P_{it} = a + b\,(\text{Density}_{it}) + \text{other attributes} + d_t + e_{it}$$

  - Time dummy price index = $\exp(d_t - d_0)$

- Problems with dummy variable method
  - Regression restricts coefficients to be constant
  - Econometric issues

Other hedonic method: Imputation

- Uses cross-sectional regressions to allow coefficients to change over time:

$$\ln P_i = a + b\,(\text{Density}_i) + \text{other attributes} + e_{it}$$

- Price index is built with the matched-model formula and regression is used to predict missing prices: $h(x)=\exp(\ln P)$.

How well do hedonic methods account for quality change?

- Conventional view is they do a good job
- Imputation method is better (less restrictive)
- Recent work
  - Pakes (2003), Pakes and Erickson (2009)

To what extent are these methods used for IT goods in the national accounts?

- **Research by Statistical Agencies**

Price indexes currently used in national accounts

- Computers
  - BEA/IBM: hedonic indexes (1980s)
  - BLS: hedonic indexes (1990s)

→BLS indexes

- Communications Equipment
  - BEA: digital switching equipment (1990s)
  - FRB: LAN equipment (2000s)

→BLS indexes adjusted for bias using FRB study

- Software
  - BEA: prepackaged software (1990s)
  - BEA: Custom software (2000s)

→BLS indexes adjusted for bias using BEA study

- Semiconductors
  - BEA: semiconductor chips (1990s)

→BLS indexes

Conclusion

- Several methods may be used to account for quality change in price indexes
- Statistical agencies have conducted considerable research into these methods for quality-adjusting indexes for IT goods
- This research has led to improvements in measures of real output, materials and capital stocks