Hedonic Adjustment for Import and Export Computer Price Indexes

The International Price Program (IPP) uses a matched model approach for its Import and Export Price Indexes, tracking prices for the same products over time to capture pure price changes and to avoid potential bias. Pricing consistent products is critical so that the indexes measure market-related price movements, not those resulting from changes to the product characteristics or features. The Hedonic quality adjustment, or value quality adjustment method, captures quality changes in rapidly evolving products that affect prices.

Rapid product innovation of cutting-edge technologies creates unique challenges for accurate pricing of high-tech goods. Desktops, laptops, and servers require frequent adjustments to product features and prices to account for changes in quality. Hedonic models are currently used to adjust quality change in prices of these high-tech goods.

IPP import and some export monthly computer prices are directly collected from respondents. Price changes resulting from product modifications are quality-adjusted using estimates typically provided by the respondent. If the respondent is unable to provide the estimated price for the quality change, the price of the replacement product is adjusted by applying the quality adjusted price from the hedonic model.

IPP export computer prices that are collected using publically available data are priced with specific item configurations. The prices for the computer items are adjusted using hedonic models when the quality of the products change. IPP has been using hedonic modeling for quality price adjustments in computers and computer parts since the 1990s.

Methodology

The generalized form of the hedonic model used is:

$$\mathrm{P}_i = \beta_o + \sum_{j=1}^{n} \beta_j \chi_{ij} + \mathcal{E}_i$$

where,

P_i = the price of computer i;

β_o = the constant, or base computer price;

χ_{ij} = price determining characteristic j for computer i;

β_j = the coefficient, or quality adjustment, attributable to characteristic j; and

$\mathcal{E}_i$ = a random error term that is assumed to have a normal distribution with a mean of 0 and a standard deviation equal to σ^2 for computer i.

Hedonic methodology controls the effects of changes in product quality by disaggregating the product by its price determining characteristics. The Bureau of Labor Statistics' hedonic models are ordinary least squares (OLS) regressions that use known data prices and features to estimate the change in price for each feature change. The regression maps a straight line whose intercept on the Y axis, β_0, is the initial price, and whose coefficients for each j feature, β_j, are the estimated price change for that feature.

For computers, the coefficients (or betas, β_j) are estimated based on a hedonic regression model that is updated yearly from publically available data, using thousands of observations for desktop and laptop computers with numerous features. This type of public pricing information is used to build the hedonic models that adjust for quality change. The coefficients provide a data-driven estimate of how much the price changes when a specific feature changes on a product.

For example, in the table below, a computer company provides the same prices on an exported computer in the previous month (*t*-1) and in the current month (*t*). The computer features/specifications are the same in both months, except that the memory has been upgraded from 6 gigabytes (GB) in the previous month to 8GB in the current month. The company reported the computer sold for the same amount of $1,199 in both months but cannot provide additional information to account for the 2GB memory upgrade.

The coefficients generated from the hedonic model to derive the implicit value for the additional 2GB memory quality change. The results show the hedonic model regression specifically for memory, where the coefficient calculates the price increase of $14.74 for each GB of memory added. Multiplying the coefficient value by 2 (GB) yields a total value of the quality upgrade in the memory of $29.48. Since IPP tracks the pure price change of products consistently over time, the 2GB upgrade value price of $29.48 is then removed from the current reported price of $1199, resulting in a 2.458 percent price decrease.

Example: Quality Adjustment calculation for an exported personal desktop computer

$$\text{Reported price for 6GB, previous period } (t-1) = \$1199$$

$$\text{Reported price for 8GB desktop, current period } (t) = \$1199$$

$$\text{Calculated coefficient } = \$14.74 \text{ per GB memory}$$

$$\text{Value Quality Adjustment(VQA) for 2GB Memory} = \$14.74(2\text{GB}) = \$29.48$$

$$\text{Quality adjusted(QA) price} = \$1199.00 - \$29.48 = \$1169.52$$

$$\text{QA price change} = \frac{\text{P(t)}-\text{VQA}}{\text{P(t}-1)} - 1 = \frac{\$1169.52}{\$1199} - 1 = 0.97541 - 1 = -0.02458 \text{ or } -2.458\%$$

Additional Information

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