

US PPI Hedonic Models for Digital Services

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Wired Telecommunication

- NAICS 517311
- Broadband, telephone, cable television, etc.
- Reason for Quality Adjustments:
 - ▶ Technology and infrastructure improving and cost of production decreasing
 - ▶ Quality improvements/speed increases while prices decrease or go unchanged

Broadband Hedonic Model

- Introduced into the index December 2016
- Updated annually
(as January data reaches final publication in June)
- Focuses on changes to download mbps
- Derived using internal BLS price data from Wired Telecommunications Carriers



Broadband Hedonic: Sample

For US PPI hedonic model:

- Used “broadband-only” items that were already active in the index
 - ▶ Both residential and business
 - ▶ For weighting, more items included from more dominant producers
- Alternative method: collect items and prices using producer websites
 - ▶ Information is often easily accessible for consumers
 - ▶ Can collect prices manually or by using a mining tool such as Python*

*company permission may be required



Broadband Hedonic: Model

- Used the R statistical language program to find and build:
 - ▶ Long-term relative (LTR)
 - ▶ Predicted price
 - ▶ Mean squared error
 - ▶ Log-log model using log-price as the dependent variable; download mbps and the varying producers used as the independent variables
- Excel or SAS can also be used

Broadband Initial Results

Broadband Model January 2016 ^{a,b,c}					
	Estimate	Std Error	t	Sig	VIF
(Intercept)	2.8844	0.3072	9.39	0	-
Log Download Mbps	0.3075	0.0977	3.147	0.005	23.684
Residential	0.032	0.3352	0.095	0.925	86.0865
Company A	0.5906	0.1025	5.762	0	4.9199
Company B	0.7529	0.1539	4.892	0	18.3561
Company C	0.7068	0.1551	4.557	0	5.1195
Log Download: Residential	0.1411	0.1096	1.287	0.213	50.5616
Log Download: Company B	-0.8863	0.1684	-5.263	0	16.9078

a. Adjusted R-Squared=0.9400; F=59.17; Root Mean Squared Error=0.0933

b. Base Configuration: Business; Several Companies

c. Dependent variable: Log Price

$$\text{Log } P_{it} = \alpha_0 + \beta_2 (\text{Log } X_{2i}) + \beta_3 (\text{Log } X_{3i}) \dots (\beta_k \text{Log } X_{ki}) + u_i$$

Where:

$\text{Log } P_{it}$ is the Log price of the i th model in period t

α_0 is the intercept

$\text{Log } X_i$ are the logged variables representing observed product characteristics

$\beta_2 \dots \beta_k$ are the regression/slope coefficients

u_i is the residual or error term

Practical Application

	Period 1	Period 2
Download Mbps	50	57.5
Price	\$100	\$100

Coefficient = 0.3075

Value of Quality Adjustment =

[Download speed change^{coefficient} – 1] * Period 1 price

$[(57.5/50)^{0.3075} - 1] * 100 = 4.3914$

Cloud Computing

- NAICS 518210 Data processing, hosting, and related services
 - ▶ Split primarily into three branches IaaS, SaaS, PaaS
 - ▶ Quality adjustment focus is on IaaS because it is the most malleable and is often the basis for the other two
- Why quality adjustment is needed:
 - ▶ The industry has become a mix of on-demand custom packages and flat-fee contracts.
 - ▶ Current base price adjustments are not able to account for all of the package changes

Cloud Computing Hedonic: Overview

- Not yet used in practice for quality adjustment
- Log-Log model
- Dependent variable: Log-price
- Independent variables [log of]:
 - ▶ RAM
 - ▶ Storage
 - ▶ vCPU
 - ▶ Operating System
 - ▶ Producer



Cloud Computing Hedonic: Sample

- 210 items from leading producers
 - ▶ # of items from each producer is based on the significance of the producer in the industry
- Manually collected by US PPI analysts from publically available data (**not** from survey respondents like the broadband model)
 - ▶ Advantage: Large product sample with no added respondent burden

Cloud Computing Hedonic: Process

- Used the R statistical language program to find and build:
 - ▶ LTR
 - ▶ Predicted price
 - ▶ Mean squared error
 - ▶ Prices obtained quarterly

- Excel or SAS can also be used

Results and Next Step

- Infrequent price change
(similar to results found in the Byrne, Corrado, and Sichel paper “*The Rise of Cloud Computing: Minding Your P’s, Q’s and K’s*”)
- Price change tends to occur with product entry and exit

Next step:

Run and compare models in quarters that include product entry and exit and see if the results are different from quarters with no product change

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