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Reestimation Result of Hedonic Regression Model in the Corporate Goods Price Index

— Smartphones —

The Bank of Japan reestimates the hedonic regression model of quality adjustment, applied to smartphones. The reestimation result as of September 2018 is shown in the Table.

The details of data for the estimation are as follows:

Scope of application[1]	・Smartphones classified in both "Cellular phones" (Producer Price Index, Import Price Index) and "Fixed & mobile radio communications equipment" (Export Price Index)
Dataset[2]	Source: ・The price data are provided with websites of Mobile Network Operators[3] and the specification data are provided with the *BCN Ranking* by the BCN Inc. Other important specifications unlisted in the database are taken from the specification sheet of each smartphone. Number of observations (release periods): ・212 (from 3rd quarter 2016 to 2nd quarter 2018) [4]
Model selection[5]	・Based on the results of likelihood ratio tests, the double Box-Cox model is selected.
Suggested period of application	・From September 2018 onward
Frequency of estimation	・Every March and September

[1] The same model is applied to domestic goods, exported goods, and imported goods.

[2] The model is estimated by mixing up price data of both domestic goods and imported goods.

[3] Cash sales prices for new subscription without speech plan are used for SIM free phones.

[4] In order to maintain the stability of the estimation, the sample release period has been extended from four quarters to eight quarters.

[5] Hedonic regression model is assumed to be the general function form expressed as follows:

$$\frac{y^{\lambda_0}-1}{\lambda_0}=\beta_0+\sum_{i=1}^{n}\beta_i\frac{x_i^{\lambda i}-1}{\lambda_i}+u$$

where λ is the Box-Cox transformation parameter.

When λ =0, function is logarithmic; When λ=1, function is linear. The functional form is determined by Box-Cox test (likelihood ratio test) under constraints of each parameter settings, such as in the Double Box-Cox Model, Semi Box-Cox Model (when λ_i=1), Log-Linear Model (when λ_0=λ_i=0), Semi Log-Linear Model (when λ_0=0, λ_i=1), and Linear Model (when λ_0=λ_i=1).

(Table)

Estimation Result for Smartphones

Suggested Period of Application	This Time Estimation September 2018-	Last Time Estimation March 2018-August 2018
Estimated Model	Double Box-Cox Model	Double Box-Cox Model
Box-Cox Parameter of Dependent Variable	0.646	0.546
Intercept	316.040 **	-1,675.998 ***
Main Memory (GB)	6.090 ***	--
Box-Cox Parameter	2.863	
CPU Frequency (GHz)	322.538 ***	83.996 ***
Box-Cox Parameter	1.741	2.313
Storage (GB)	86.920 ***	180.923 ***
Box-Cox Parameter	0.230	-0.175
Camera Resolution (Megapixels)	131.899 ***	2,249.326 ***
Box-Cox Parameter	0.316	-1.269
Dummy Variables		
Other Functions		
Waterproof	363.917 ***	121.643 ***
Face Recognition	147.017 **	100.626 ***
Iris Scanner	228.529 *	--
Manufacturer		
Manufacturer A	321.400 ***	136.358 ***
Manufacturer B	1,198.827 ***	382.751 ***
Manufacturer C	--	195.919 ***
Manufacturer D	-194.819 ***	--
Manufacturer E	131.441 *	--
Manufacturer F	-145.560 *	--
Manufacturer G	-408.459 **	--
Release Period		
4th quarter 2016	-191.392 **	--
1st quarter 2017	-204.867 ***	--
2nd quarter 2017	-128.654	-2.582
3rd quarter 2017	-216.457 ***	8.089
4th quarter 2017	-340.699 ***	-65.393 **
1st quarter 2018	-379.816 ***	--
2nd quarter 2018	-572.802 ***	--
R-squared	0.830	0.880
Adjusted R-squared	0.812	0.864
Standard Error of Regression	266.205	79.717
Mean of Dependent Variable	1,848.289	719.740
Number of Observations (release period)	212 (from 3Q 2016 to 2Q 2018)	94 (from 1Q 2017 to 4Q 2017)
Tests for Double Box-Cox Model (H_1: Double Box-Cox)		
H_0: Semi Box-Cox (λ_i=1)	9.123 *	11.225 **
H_0: Log-Linear (λ_0=λ_i=0)	50.687 ***	23.053 ***
H_0: Semi Log-Linear (λ_0=0,λ_i=1)	60.855 ***	42.266 ***
H_0: Linear (λ_0=λ_i=1)	21.206 ***	15.042 ***

Notes: 1. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

2. The specifications of Double Box-Cox Models are determined based on the result of likelihood ratio test.
The likelihood ratio statistics is distributed as chi-squared with degrees of freedom equal to the number of restraints.

3. "Waterproof" dummy is applied if a device receives either a rating of IPX 7 or IPX 8.