

## Reestimation Result of Hedonic Regression Model in the Corporate Goods Price Index and the Services Producer Price Index — Tablet Computers —

The Bank of Japan reestimates the hedonic regression model of quality adjustment, applied to tablet computers<sup>1</sup>. The reestimation result as of September 2019 is shown in the Table.

The details of data for the estimation are as follows:

Scope of application <sup>2</sup>	<ul style="list-style-type: none"> <li>• Tablet computers classified in “Notebook computers” (Producer Price Index, Export Price Index, Import Price Index)</li> <li>• Rental tablet computers classified in “Computer rental” (Services Producer Price Index)</li> </ul>
Dataset <sup>3</sup>	<p>Source:</p> <ul style="list-style-type: none"> <li>• The retail price (quarterly average price) and specification data are provided with the <i>BCN Ranking</i> by the BCN Inc. Other important specifications unlisted in the database are taken from the specification sheet of each tablet computer.</li> </ul> <p>Number of observations (release period):</p> <ul style="list-style-type: none"> <li>• 108 (from 3rd quarter 2017 to 2nd quarter 2019)</li> </ul>
Model selection <sup>4</sup>	<ul style="list-style-type: none"> <li>• Based on the results of likelihood ratio tests, the Double Box-Cox model is selected.</li> </ul>
Suggested period of application	<ul style="list-style-type: none"> <li>• From September 2019 onward</li> </ul>
Frequency of estimation	<ul style="list-style-type: none"> <li>• Every March and September</li> </ul>

<sup>1</sup> Other hedonic regression models are estimated for desktop and notebook computers separately.

<sup>2</sup> The same model is applied to domestic good, exported goods, and imported goods.

<sup>3</sup> The model is estimated by mixing up price data of both domestic goods and imported goods.

<sup>4</sup> 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  $\lambda$  is the Box-Cox transformation parameter.

When  $\lambda = 0$ , function is logarithmic; When  $\lambda = 1$ , 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  $\lambda_1 = 1$ ), Log-Linear Model (when  $\lambda_0 = \lambda_1 = 0$ ), Semi Log-Linear Model (when  $\lambda_0 = 0, \lambda_1 = 1$ ), and Linear Model (when  $\lambda_0 = \lambda_1 = 1$ ).

## Estimation Result for Tablet Computers

Suggested period of application	This Time Estimation September 2019-	Last Time Estimation March 2019-August 2019
Estimated Model	Double Box-Cox Model	Double Box-Cox Model
Box-Cox Parameter of Dependent Variable	0.250	0.432
Intercept	-6.415E+06 **	49.308 ***
CPU Frequency (MHz)	1.360E+07 **	4.957E-24 **
Box-Cox Parameter	-2.121	7.445
Main Memory (MB)	0.021 **	0.614 ***
Box-Cox Parameter	0.601	0.448
Storage (GB)	0.177 ***	4.083 ***
Box-Cox Parameter	0.570	0.405
Monitor Size (inch)	2.008E-03 ***	1.687E-03 ***
Box-Cox Parameter	3.797	4.683
Battery Runtime (hours)	6.316 ***	42.467 ***
Box-Cox Parameter	-0.044	-0.224
Number of CPU Cores	-	0.527 **
Box-Cox Parameter		1.871
Dummy Variables		
OS		
OS A	-9.027 ***	-29.790 ***
CPU		
Octa-core	2.055 ***	-
L3 Cache	-	37.218 ***
Intel Atom	-5.043 ***	-
Intel Core	4.831 ***	-
Other Functions		
Face Authentication	1.694 *	29.489 ***
High Impact Resistance	10.793 ***	96.231 ***
Manufacturer		
Manufacturer A	-	-13.837 *
Manufacturer B	-	13.462 ***
Manufacturer C	6.222 ***	38.592 ***
Manufacturer D	-	-23.219 **
Manufacturer E	-	13.662 **
Manufacturer F	-	23.630 ***
Manufacturer G	-	50.134 ***
Manufacturer H	10.818 ***	98.192 ***
Manufacturer I	-8.327 ***	-
Manufacturer J	6.683 ***	-
Manufacturer K	-5.286 ***	-
Release Period		
2nd quarter 2017	-	-9.496 *
3rd quarter 2017	-	-7.511
4th quarter 2017	-0.417	-14.529 **
1st quarter 2018	-3.000 ***	-33.220 ***
2nd quarter 2018	-0.873	-11.775 *
3rd quarter 2018	-1.234	-18.650 ***
4th quarter 2018	-0.537	-11.512 *
1st quarter 2019	-0.512	-
2nd quarter 2019	-2.472 **	-
R-squared	0.988	0.988
Adjusted R-squared	0.985	0.985
Standard Error of Regression	2.099	15.387
Mean of Dependent Variable	60.074	302.301
Number of Observations (release period)	108 (from 3Q 2017 to 2Q 2019)	124 (from 1Q 2017 to 4Q 2018)
Tests for Double Box-Cox Model ( $H_1$ : Double Box-Cox)		
$H_0$ : Semi Box-Cox ( $\lambda_i=1$ )	18.469 ***	40.935 ***
$H_0$ : Log-Linear ( $\lambda_0=\lambda_i=0$ )	26.358 ***	51.945 ***
$H_0$ : Semi Log-Linear ( $\lambda_0=0, \lambda_i=1$ )	46.609 ***	95.326 ***
$H_0$ : Linear ( $\lambda_0=\lambda_i=1$ )	181.894 ***	100.300 ***

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

2. The specifications of Double Box-Cox/Log-Linear 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. "High Impact Resistance" dummy is applied if a device is able to withstand drop and pressure testing, or is made of high durability materials.