Bank of Japan

P.O. BOX 30, NIHONBASHI
TOKYO 103-8660, JAPAN
TEL. +81-3-3279-1111

Research and Statistics Department

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Reestimation Results of Hedonic Regression Models in the Corporate Goods Price Index and the Services Producer Price Index

— Desktop and Notebook Computers —

The Bank of Japan reestimates the hedonic regression models of quality adjustment, applied to desktop and notebook computers[1]. The reestimation results as of August 2018 are shown in Tables 1 and 2.

The details of data for the estimation are as follows:

Scope of application[2]	・"Desktop computers" (Producer Price Index, Import Price Index) and "Notebook computers" (Producer Price Index, Export Price Index, Import Price Index) ・Rental desktop and notebook computers classified in "Computer rental" (Services Producer Price Index)
Dataset[3]	Source: ・The retail price (quarterly average price) and 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 computer. Number of observations (release period): ・Desktop computer: 78 (from 3rd quarter 2017 to 2nd quarter 2018) ・Notebook computer: 260 (from 3rd quarter 2017 to 2nd quarter 2018)
Model selection[4]	・Based on the results of likelihood ratio tests, double Box-Cox model is selected for desktop computers and notebook computers.
Suggested period of application	・From August 2018 onward
Frequency of estimation	・Every February and August

[1] Another hedonic regression model is estimated for tablet computers.

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

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

[4] 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 1)

Estimation Result for Desktop Computers

Suggested period of application	This Time Estimation August 2018-	Last Time Estimation February 2018-July 2018
Estimated Model	Double Box-Cox Model	Semi Box-Cox Model
Box-Cox Parameter of Dependent Variable	0.295	0.487
Intercept	74.506 ***	220.111 ***
CPU Frequency (MHz)	1.623E-28 ***	0.027 **
	8.263	
L3 Cache (MB)	1.359 ***	12.496 ***
	0.244	
Main Memory (MB)	--	6.595E-03 **
GPU Frequency (MHz)	6.316E-06 ***	0.078 ***
	2.078	
Hard Disk Drive (GB)	0.160 **	0.025 **
	0.320	
Solid State Drive (GB)	0.207 *	0.266 ***
	0.385	
Monitor Size (inch)	0.002 ***	--
	3.099	
Dummy Variables		
Main Memory		
16 (GB)	11.281 ***	--
32 (GB)	25.980 ***	--
CPU Turbo Function	8.176 ***	--
Stick PC	-16.514 ***	--
Monitor		
with a Monitor	--	84.461 ***
with a Monitor (23.8 inches or larger)	--	67.793 ***
Pre-installed Application		
Microsoft Office Home and Business Premium or Personal Premium with an Annual License of Office 365	6.043 ***	--
Microsoft Office Home and Business Premium with an Annual License of Office 365	--	28.634 *
Manufacturer		
Manufacturer A	15.050 ***	118.198 ***
Manufacturer B	10.911 ***	107.812 ***
Manufacturer C	--	107.456 ***
Manufacturer D	8.788 ***	--
Period		
2nd quarter 2017	--	5.039
3rd quarter 2017	--	-1.139
4th quarter 2017	-2.144	-7.027
1st quarter 2018	-4.557 **	--
2nd quarter 2018	0.718	--
R-squared	0.948	0.979
Adjusted R-squared	0.933	0.971
Standard Error of Regression	4.636	32.668
Mean of Dependent Variable	101.729	594.282
Number of Observations (release dates)	78 (from 3Q 2017 to 2Q 2018)	56 (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)	21.830 ***	8.257
H_0: Log-Linear (λ_0=λ_i=0)	31.244 ***	60.581 ***
H_0: Semi Log-Linear (λ_0=0,λ_i=1)	29.859 ***	45.170 ***
H_0: Linear (λ_0=λ_i=1)	51.563 ***	53.299 ***

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

2. The specifications of Double/Semi 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.

(Table 2)

Estimation Result for Notebook Computers

Suggested period of application	This Time Estimation August 2018-	Last Time Estimation February 2018-July 2018
Estimated Model	Double Box-Cox Model	Double Box-Cox Model
Box-Cox Parameter of Dependent Variable	0.463	0.553
Intercept	-2.322E+05 ***	6.905E+06 *
CPU Frequency (GHz)	2.543 **	--
Box-Cox Parameter	2.941	
Thread Count	5.714 ***	--
Box-Cox Parameter	1.070	
CPU Frequency (GHz) x Thread Count	--	5.396 ***
Box-Cox Parameter		1.214
L3 Cache (MB)	--	52.473 *
Box-Cox Parameter		7.601E-06
Main Memory (MB)	4.459E-12 ***	1.318E-11 ***
Box-Cox Parameter	3.255	3.263
Display Resolution (pixels)	1.279E+05 ***	0.353 ***
Box-Cox Parameter	-0.550	0.373
Hard Disk Drive (GB)	--	6.160 ***
Box-Cox Parameter		0.331
Solid State Drive (GB)	0.513 ***	73.269 ***
Box-Cox Parameter	0.801	0.093
Battery Life (minutes)	7.713E-10 ***	4.256E-14 ***
Box-Cox Parameter	3.582	5.185
Weight (kg)	--	-107.136 ***
Box-Cox Parameter		-0.681
Dummy Variables		
CPU		
L3 Cache	45.151 ***	-6.903E+06 *
L4 Cache	--	79.755 *
Disk Drive		
Hard Disk Drive 1 TB and more	31.573 ***	--
SSD	--	-1,129.198 ***
Graphics		
Dedicated Graphics Card	24.658 ***	--
Display Type		
Touch Screen Display	23.593 ***	85.092 ***
Optical Drive		
Blu-ray Disc Drive	25.850 ***	88.188 ***
Security		
Biometric Authentication	21.036 ***	73.953 ***
Durability		
High Impact Resistance	--	74.816 ***
OS		
Windows 10 Pro 64bit	--	70.394 ***
Pre-installed Application		
Microsoft Office Home and Business Premium with an Annual License of Office 365	44.914 ***	121.726 ***
Manufacturer		
Manufacturer A	--	66.891 ***
Manufacturer B	--	197.460 ***
Manufacturer C	38.094 ***	81.762 ***
Manufacturer D	66.535 ***	102.136 ***
Manufacturer E	71.889 ***	181.177 ***
Manufacturer F	155.996 ***	303.683 ***
Manufacturer G	--	110.477 **
Manufacturer H	18.758 *	--
Manufacturer I	-17.541 ***	--
Manufacturer J	-37.070 ***	--
Manufacturer K	-48.310 *	--
Period		
2nd quarter 2017	--	35.071 *
3rd quarter 2017	--	2.959
4th quarter 2017	-14.108 ***	-39.544 **
1st quarter 2018	-12.513 *	--
2nd quarter 2018	-29.899 ***	--
R-squared	0.946	0.967
Adjusted R-squared	0.940	0.961
Standard Error of Regression	27.801	65.090
Mean of Dependent Variable	518.631	1,245.526
Number of Observations	260	165
(release dates)	(from 3Q 2017 to 2Q 2018)	(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)	57.742 ***	50.311 ***
H_0: Log-Linear (λ_0=λ_i=0)	139.111 ***	76.235 ***
H_0: Semi Log-Linear (λ_0=0,λ_i=1)	105.167 ***	112.720 ***
H_0: Linear (λ_0=λ_i=1)	112.656 ***	62.664 ***

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. "High Impact Resistance" dummy is applied if a device is able to withstand drop and pressure testing, or is made of high durabili materials.