

**Reestimation Results of Hedonic Regression Models
in the Corporate Goods Price Index**

— Digital Cameras —

The Bank of Japan reestimates the hedonic regression models of quality adjustment, applied to compact digital cameras. The reestimation result as of May 2018 is shown in Appendix 1. Also, the results which were reestimated in November 2017 are shown in Appendices 2 and 3 for mirrorless interchangeable-lens cameras and digital single-lens reflex cameras, respectively.

The details of data for the estimation are as follows:

Scope of application ¹	<ul style="list-style-type: none"> • Digital cameras classified in “Visual equipment” (Producer Price Index, Export Price Index) and “Digital cameras & video cameras” (Import Price Index)
Dataset ²	<p>Source:</p> <ul style="list-style-type: none"> • 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 digital camera. <p>Number of observations (launch period):</p> <ul style="list-style-type: none"> • Compact digital camera: 36 (from 2nd quarter 2016 to 1st quarter 2018) • Mirrorless interchangeable-lens camera: 64 (from 4th quarter 2015 to 3rd quarter 2017) • Digital single-lens reflex camera: 48 (from 4th quarter 2015 to 3rd quarter 2017)
Model selection ³	<ul style="list-style-type: none"> • Based on the results of likelihood ratio tests, double Box-Cox models are selected for compact digital cameras, mirrorless interchangeable-lens cameras, and digital single-lens reflex cameras.
Suggested period of application	<ul style="list-style-type: none"> • Compact digital camera: From May 2018 onward • Mirrorless interchangeable-lens camera and digital single-lens reflex camera: From November 2017 onward
Frequency of estimation	<ul style="list-style-type: none"> • Compact digital camera: Every May and November • Mirrorless interchangeable-lens camera and digital single-lens reflex camera: Every November

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 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 $\lambda = 0$, 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 $\lambda_i = 1$), Log-Linear Model (when $\lambda_0 = \lambda_i = 0$), Semi Log-Linear Model (when $\lambda_0 = 0, \lambda_i = 1$), and Linear Model (when $\lambda_0 = \lambda_i = 1$).

Estimation Result for Compact Digital Cameras

Suggested Period of Application	This Time Estimation May 2018-	Last Time Estimation November 2017-April 2018
Estimated Model	Double Box-Cox Model	Double Box-Cox Model
Box-Cox Parameter of Dependent Variable	0.324	-3.166E-03
Intercept	60.178 ***	9.205 ***
Optical Zoom (times)	4.389 ***	0.016 ***
Box-Cox Parameter	0.093	0.817
Maximum ISO Sensitivity (including Expanded Sensitivity)	2.214E-16 **	0.124 ***
Box-Cox Parameter	3.704	-0.015
F-Number for Wide-angle	-0.051 ***	-1.744 ***
Box-Cox Parameter	5.536	-0.912
Maximum Number of Recording Pixels (Movie)	--	3.194E-04 ***
Box-Cox Parameter		0.444
Dummy Variables		
4K/2K Video Function	16.936 ***	--
Maximum Shutter Speed 1/2,000 second or faster	6.628 *	--
Image Sensor Size		
1 inch or larger, and smaller than APS-C	30.290 ***	0.387 ***
APS-C	53.643 ***	1.234 ***
Full Frame	--	1.785 ***
LCD Type		
Tilt or Vari-angle	10.978 ***	--
Tilt	--	0.190 ***
Vari-angle	--	0.330 **
Viewfinder		
Electronic Viewfinder (0.39 inches or larger)	--	0.255 **
Waterproof	22.512 ***	0.545 ***
Bluetooth Function	5.135 *	--
Wi-Fi Function	--	0.306 ***
Manufacturer		
Manufacturer A	--	0.477 ***
Manufacturer B	--	-0.497 ***
Manufacturer C	-14.864 ***	-0.329 ***
Manufacturer D	--	-0.428 ***
Manufacturer E	--	0.922 ***
Period		
1st quarter 2016	--	0.161 *
2nd quarter 2016	12.721 ***	0.111
3rd quarter 2016	7.442	0.103
4th quarter 2016	4.764	-0.036
1st quarter 2017	1.971	0.104
2nd quarter 2017	-4.495	0.052
3rd quarter 2017	14.071 ***	0.296 **
4th quarter 2017	1.210	--
1st quarter 2018	--	--
R-squared	0.987	0.967
Adjusted R-squared	0.974	0.953
Standard Error of Regression	4.136	0.174
Mean of Dependent Variable	96.907	10.495
Number of Observations (launch period)	36 (from 2Q 2016 to 1Q 2018)	79 (from 4Q 2015 to 3Q 2017)
Tests for Double Box-Cox Model (H_1 : Double Box-Cox)		
H_0 : Semi Box-Cox ($\lambda_1=1$)	12.544 ***	10.726 **
H_0 : Log-Linear ($\lambda_0=\lambda_1=0$)	11.144 **	13.179 **
H_0 : Semi Log-Linear ($\lambda_0=0, \lambda_1=1$)	14.971 ***	10.829 *
H_0 : Linear ($\lambda_0=\lambda_1=1$)	64.980 ***	150.412 ***

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.

Estimation Result for Mirrorless Interchangeable-lens Cameras

Suggested Period of Application	This Time Estimation November 2017-	Last Time Estimation November 2016-October 2017
Estimated Model	Double Box-Cox Model	Double Box-Cox Model
Box-Cox Parameter of Dependent Variable	0.166	-0.013
Intercept	-9.942E+06 ***	5.328 ***
Maximum ISO Sensitivity (Except for Expanded Sensitivity)	1.693E+07 ***	0.553 ***
Box-Cox Parameter	-1.703	-0.042
Longest / Shortest Focal Length of Kit Lens	0.025 *	0.121 ***
Box-Cox Parameter	1.558	0.060
Battery Life (CIPA Standard, pictures)	5.522 ***	--
Box-Cox Parameter	3.858E-03	
Image Sensor Size (mm ²)	8.013E-07 ***	--
Box-Cox Parameter	2.816	
Dummy Variables		
Including Kit Lens	1.475 ***	--
Electronic Viewfinder	2.736 ***	0.253 ***
Maximum Shutter Speed		
1/8,000 second or faster	--	0.290 ***
1/16,000 second or faster	2.768 ***	--
Waterproof and Dustproof	3.434 ***	--
Wi-Fi Function	4.064 **	--
Image Sensor Size		
APS-C	--	0.343 ***
Full Frame	--	1.138 ***
AF Sensor Point		
300 points or more	--	0.349 ***
Manufacturer		
Manufacturer A	5.048 ***	1.060 ***
Manufacturer B	-5.961 ***	-0.425 ***
Manufacturer C	-3.769 ***	--
Manufacturer D	-4.855 ***	--
Period		
1st quarter 2015	--	0.191 ***
2nd quarter 2015	--	0.190 ***
3rd quarter 2015	--	0.299 ***
4th quarter 2015	--	0.024
1st quarter 2016	1.989 ***	0.470 ***
2nd quarter 2016	3.653 ***	0.289 ***
3rd quarter 2016	1.364 *	0.335 ***
4th quarter 2016	1.858 **	--
1st quarter 2017	2.813 ***	--
2nd quarter 2017	--	--
3rd quarter 2017	0.958	--
R-squared	0.902	0.920
Adjusted R-squared	0.860	0.900
Standard Error of Regression	1.026	0.143
Mean of Dependent Variable	35.843	10.594
Number of Observations (launch period)	64 (from 4Q 2015 to 3Q 2017)	81 (from 4Q 2014 to 3Q 2016)
Tests for Double Box-Cox Model (H ₁ : Double Box-Cox)		
H ₀ : Semi Box-Cox ($\lambda_1=1$)	9.088 *	21.270 ***
H ₀ : Log-Linear ($\lambda_0=\lambda_1=0$)	14.857 **	20.332 ***
H ₀ : Semi Log-Linear ($\lambda_0=0, \lambda_1=1$)	10.157 *	21.489 ***
H ₀ : Linear ($\lambda_0=\lambda_1=1$)	23.536 ***	71.654 ***

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.

Estimation Result for Digital Single-lens Reflex Cameras

Suggested Period of Application	This Time Estimation November 2017-	Last Time Estimation November 2016-October 2017
Estimated Model	Double Box-Cox Model	Double Box-Cox Model
Box-Cox Parameter of Dependent Variable	-0.111	0.526
Intercept	5.100 ***	-924.378 ***
AF Sensor (points)	4.834E-03 ***	2.114 ***
Box-Cox Parameter	0.735	1.133
Battery Life (pictures)	0.015 **	0.817 **
Box-Cox Parameter	0.175	0.657
Maximum ISO Sensitivity (Except for Expanded Sensitivity)	0.260 ***	370.808 ***
Box-Cox Parameter	-0.207	-0.253
Longest / Shortest Focal Length of Kit Lens	--	82.174 ***
Box-Cox Parameter		-0.256
Dummy Variables		
Image Sensor Size		
Full Frame	0.133 ***	623.406 ***
Maximum Shutter Speed		
1/8,000 second or faster	0.041 **	--
Image Stabilization	0.028 **	--
4K/2K Video Function	0.106 ***	--
Quiet Shutter Function	0.085 ***	--
Longest / Shortest Focal Length of Kit Lens		
7 or more	0.073 ***	--
Double Slots	--	187.782 ***
F-Number of Kit Lens for Wide-angle		
2.8 or smaller	--	136.851 ***
Manufacturer		
Manufacturer A	-0.186 ***	--
Manufacturer B	-0.390 ***	--
Manufacturer C	--	238.491 ***
Manufacturer D	--	157.338 ***
Period		
1st quarter 2015	--	27.522
2nd quarter 2015	--	-49.104
3rd quarter 2015	--	--
4th quarter 2015	--	--
1st quarter 2016	--	55.840
2nd quarter 2016	-0.100 ***	-185.695 ***
3rd quarter 2016	-9.043E-03	4.484
4th quarter 2016	0.022	--
1st quarter 2017	-0.015	--
2nd quarter 2017	-0.013	--
3rd quarter 2017	-0.023	--
R-squared	0.985	0.991
Adjusted R-squared	0.977	0.988
Standard Error of Regression	0.029	46.838
Mean of Dependent Variable	6.606	1,057.257
Number of Observations (launch period)	48 (from 4Q 2015 to 3Q 2017)	48 (from 4Q 2014 to 3Q 2016)
Tests for Double Box-Cox Model (H_1 : Double Box-Cox)		
H_0 : Semi Box-Cox ($\lambda_i=1$)	9.584 **	23.584 ***
H_0 : Log-Linear ($\lambda_0=\lambda_i=0$)	13.001 **	41.734 ***
H_0 : Semi Log-Linear ($\lambda_0=0, \lambda_i=1$)	9.603 **	40.475 ***
H_0 : Linear ($\lambda_0=\lambda_i=1$)	85.203 ***	47.538 ***

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. "Quiet Shutter" dummy is applied if the device is capable of shooting in quiet.