Digital Cameras and Expanding Mobile Handset Functions: Competing Value Chains in the Consumer Imaging Industry

Yuri Park, Seoul National University, Techno-Economics and Policy Program, Seoul, South Korea
Milton Mueller, Syracuse University, School of Information Studies, Syracuse, New York

Abstract

This paper explores the competition between specialized, stand-alone digital cameras and digital cameras that are bundled with mobile telephones. It uses conjoint survey research to determine whether camera phones and digital cameras are complements or substitutes, and to find out how much consumer value specific features of cameras, such as LCD screen size, an internet connection, zoom, and so on.

Introduction

Handheld phones now can provide digital cameras, PDAs, storage and playback of images, video and music. The convergence of mobile handsets with digital imaging capabilities in particular has proceeded surprisingly rapidly.

Will camera phones replace stand-alone digital cameras, or will they supplement the sales of digital cameras and increase sales of related digital imaging services? Understanding this relationship is critical to the digital imaging industry. In the near future, it will be difficult to find a cell phone without a built-in camera. For many consumers the camera function will not be optional. In South Korea, for example, the ownership rate of camera phones is higher than digital cameras. If camera phones and digital cameras are substitutes rather than supplements, then the camera phone may transform the consumer market for digital imaging devices.

This study examines whether camera phones and digital cameras are substitutes or complements for household consumers and which attributes of digital cameras in both forms will attract consumers. A conjoint survey technique is used to analyze these questions and develop quantitative estimates. The survey population was based on Seoul, Korea an economy with high mobile phone penetration. It is part of a larger survey research project that explores several other issues, including printing and sharing behavior and the impact of gender and other demographic variables. The full study is available through the Convergence Center, http://www.digital-convergence.org

Methodology

Conjoint analysis

Conjoint analysis is a survey technique used to measure consumers' preferences for products or services in hypothetical situations. In a conjoint survey, various levels of attributes that capture the distinguishing features of a good or service are combined to make conjoint cards that represent hypothetical products or services. Respondents are asked to evaluate these hypothetical alternatives according to their preferences. The ways of evaluation are ranking, rating, or choosing one etc (Alvarez-Farizo and Hanley, 2002).

We selected six attributes for purchasing devices. (See Table 1) The alternatives that we considered in this study are confined to digital cameras and camera phones in order to isolate the relationship between them.

Our conjoint survey of capture devices relied on six attributes. The first attribute was resolution; i.e., the quality of the pictures taken by the device. The resolution of most camera phones is lower than the norm for digital cameras, but can be expected to increase.[1] But no one knows the extent to which consumers want higher resolution. If consumers are satisfied with moderate resolution levels, there will be no reason to concentrate on developing camera phones with significantly higher resolution. The second attribute of a capture device is the zoom function. This includes both optical and digital zoom. Zoom is currently a major point of differentiation between camera phones and digital cameras. The third attribute is LCD screen size. Currently, camera phones have much smaller screens than digital cameras. The fourth attribute is whether it is possible to connect to the internet directly with the device or not. Currently, camera phones are networked, while most digital cameras are not. The fifth attribute is whether it is possible to connect to a printer directly or not. The last attribute is the price of the device, obviously an important feature. The conjoint cards were constructed with these attributes set at various levels to represent different digital capture devices. One card represented a digital camera and the other a camera phone. Respondents were asked to choose one, both, or neither.

The survey was administered to 500 residents of Seoul, Korea, in November 2005. The sample was drawn on the basis of age and gender distribution in the population of Seoul[2]. Responses were obtained face-to-face by interviewers. We designed the survey including demographic questions such as income, education level, gender, marital status, personal income etc. We used these data for analyzing influence of demographic characteristics on consumer behaviour.

---

[1] E.g., in November 2005, Samsung Electronics developed the world's first 8.0 megapixel camera phone.

[2] 94% of respondents owned cell phone and 83% of cell phone owners has camera phone. 35% of camera phone owners also owned a digital camera. The ownership rate of digital camera was 35% and 78.6% of digital camera users also had a camera phone.

Table1. Attributes and levels for digital capture devices

Attribute (Variable)	Levels	Description
Resolution ($PIXEL$)	1.0 3.0 5.0 10.0	Resolution is the number of pixels per inch in a digital image. The more megapixels, the higher resolution.
Zoom ($ZOOM$)	None/ 6X/ 12X/ 24X	Total zoom: optical $\times$ digital
LCD screen size (LCD)	1.5 in 2.5 in	The display size of digital capture devices. One can preview images right after taking them, or view menus and settings through the LCD display.
Connecting method for transferring and storing images (C_INT)	Connect to the internet directly	You could connect to the internet websites and store or share your images with WiFi embedded devices
	Connect to a computer	You have to connect device to a computer for transferring and storing through blooth or USB cable.
Connecting method for printing images (C_PRI)	Connect to a printer directly	With PictBridge enabled device, you could print in images from the memory card in a device directly to a printer
	Impossible to connect to a printer	You have to connect to a computer or internet in order to print
Price ($PRICE$)	US$ 200/ 400/ 600/ 800	The price you have to pay for buy the device

Model Specification

Bivariate probit model[3] is used to estimate purchasing digital capture device. In the survey for purchasing a digital capture device, there are two alternatives so there are also two dependent variables, y_1 and y_2. There are two equations with correlated disturbances as follows:

$$
\begin{aligned}
y_1^* &= x_1'\beta_1 + \varepsilon_1 \\
&= \beta_{1PIXEL} PIXEL_1 + \beta_{1ZOOM} ZOOM_1 + \beta_{1LCD} LCD_1 \\
&\quad + \beta_{1C\_\text{int}} C\_INT_1 + \beta_{1C\_PRI} C\_PRI_1 + \beta_{1PRICE} PRICE_1 + \varepsilon_1 \\
y_2^* &= x_2'\beta_2 + \varepsilon_2 \\
&= \beta_{2PIXEL} PIXEL_2 + \beta_{2ZOOM} ZOOM_2 + \beta_{2LCD} LCD_2 \\
&\quad + \beta_{2C\_\text{int}} C\_INT_2 + \beta_{2C\_PRI} C\_PRI_2 + \beta_{2PRICE} PRICE_2 + \varepsilon_2
\end{aligned}
\qquad (1)
$$

$$
E\left[\varepsilon_1 \mid x_1, x_2\right] = E\left[\varepsilon_2 \mid x_1, x_2\right] = 0,\ Var\left[\varepsilon_1 \mid x_1, x_2\right] = Var\left[\varepsilon_2 \mid x_1, x_2\right] = 1
$$
$$
Cov\left[\varepsilon_1, \varepsilon_2 \mid x_1, x_2\right] = \rho
$$

[3] See Green (2003)

where y_1^* and y_2^* are latent variables that we cannot observe with $y_1 = 1$ if $y_1^* > 0$, 0 otherwise and $y_2 = 1$ if $y_2^* > 0$, 0 otherwise. x_1 and x_2 are the vector of attributes and ε_1 and ε_2 are random disturbances. We estimate the parameters β_1 and β_2 using the maximum-likelihood estimation method. The equations for the effects of demographic variables[4] are

$$
\begin{aligned}
y_1^* &= \beta_{1GEN} GEN_1 + \beta_{1AGE} AGE_1 + \beta_{1MAR} MAR_1 \\
&\quad + \beta_{1EDU} EDU_1 + \beta_{1INCOME} INCOME_1 + \varepsilon_1 \\
y_2^* &= \beta_{2GEN} GEN_2 + \beta_{2AGE} AGE_2 + \beta_{2MAR} MAR_2 \\
&\quad + \beta_{2EDU} EDU_2 + \beta_{2INCOME} INCOME_2 + \varepsilon_2
\end{aligned}
\qquad (2)
$$

where GEN is dummy variable takes 1 if respondent is man, AGE is age, MAR is dummy variable takes 1 if person get married, EDU is education level, and $INCOME$ is personal expense[5].

Result

The estimation results for purchasing digital imaging devices are shown in Table 2.

Table 2. Estimation results of purchasing devices

Variable	Digital camera		Camera phone	
	Coeff.	Std. Err.	Coeff.	Std. Err.
$PIXEL$	0.436**	0.124	0.589**	0.129
$ZOOM$	0.002	0.042	0.029**	0.005
LCD	-0.021	0.058	0.293**	0.065
$PRICE$	-0.014**	0.002	-0.017**	0.002
Rho	-0.486			

**: $H_0 : \beta = 0$ is rejected at the significance level of 1%.

$PIXEL$ has a positive coefficient, which means that higher resolution makes consumers more likely to purchase digital capture devices. The coefficients of $ZOOM$ also have a positive value, but it is not statistically significant for digital cameras. Zoom is more important to camera phone users because many camera phones don't have the zoom function while all digital cameras have it. LCD has negative estimates in digital camera but it's not significant. On the other hand, camera phone has significant positive coefficient for LCD. Digital cameras users don't pay attention to LCD screen size because digital cameras already have LCD screens of sufficient size. However LCD display size is still an important factor for camera phones. For many years manufacturers have concentrated on miniaturizing mobile phone handsets. The newest mobile phones, however, are equipped with multiple functions such as camera, MP3 play, VOD play, DMB etc. so the tendency is toward larger screen sizes. Finding an appropriate display size will thus be critical for cell phones.

[4] AGE and $INCOME$ were taken logarithm and EDU is categorized into three levels such as 1= high school graduation or less than high school degree, 2= undergraduate but no degree or undergraduate degree, 3= higher than graduate school.

[5] We used personal expense instead of income because some respondents have no income.

The correlation coefficient between digital cameras and camera phones has a negative value. This indicates that digital cameras and camera phones are more like substitutes than complements. As the debate whether digital cameras and camera phones are friends or enemies continues to swirl around them, our results show that they may be enemies. Most ordinary consumers will opt for one or the other, not both.

Conclusion

This study, based on a Korean population, suggests that camera phones and digital cameras are substitutes, not complements. Therefore the degree to which the features of camera phones catch up with those of digital cameras will be a key factor shaping the evolution of the device market. We found that resolution, zoom, and LCD screen size were important factors in camera phone adoption, implying that the quality of camera phones needs to be improved in these areas. In digital cameras, variation in zoom and LCD screen size were not significant.

The decision to purchase an imaging device is also related to the sharing and printing method. We found that easy access to the internet was not a significant factor affecting the decision to purchase both types of devices, while easy access to a printer was an important factor in digital cameras. We know that camera phone users are not very concerned about printing the images taken by their camera phones, but this may change when camera phones can take better images. There were few remarkable effects of individual characteristics on purchasing behavior.

References

[1] Alvarez-Farizo, B. and N. Hanley, "Using Conjoint Analysis to Quantify Public Preferences over the Environmental Impacts of Wind Farms: An Example from Spain", Energy Policy, 30, pg. 107-116. (2002).

[2] Green W. H., M., Econometric Analysis, 5th edition, Prentice Hall, New Jersey. (2003).

Author Biography

Yuri Park received her BS in Engineering from the Ewha Womans University (2002) and she is now Ph D. candidate in Economics at Seoul National University. She has worked as visiting scholar in the Convergence Center at Syracuse University since Oct, 2005.

Milton L. Mueller is Professor and Director of the Graduate Program in Telecommunications and Network Management at the Syracuse University School of Information Studies. He directs the Convergence Center.