2014

Grasping a Global View of Smartphone Diffusion: An Analysis from a Global Smartphone Study

Masao Kakihara
London School of Economics and Political Science, m.kakihara@lse.ac.uk

GRASPING A GLOBAL VIEW OF SMARTPHONE DIFFUSION: AN ANALYSIS FROM A GLOBAL SMARTPHONE USER STUDY

Masao Kakihara

Google Asia Pacific

8 Marina View, Asia Square Tower 1 #30-01, Singapore 018960

kakihara@google.com

Abstract

The patterns of smartphone diffusion and usage are not consistent across the world at all. The diffusion of smartphones is influenced by many socio-economic factors in complex and dynamic ways. This paper addresses the current status of smartphone users in the world by analysing quantitative data from a large-scale smartphone user study to highlight particular clusters of country in terms of smartphone diffusion. It then addresses some characteristics of those clusters and sheds a light on some distinctive countries by exploring some cultural dispositions for smartphone adoption in those societies.

Keywords: Diffusion of technology, Technology adoption, Smartphone, Survey

1 Introduction: Smartphone Diffusion

It was in 2007 that two monumental phenomena for the smartphone world happened. That is, Apple launched the first generation of iPhone in 2007, and Google announced Android open platform initiative also in 2007. At that time, the mobile phone handsets industry was still widely dominated by GSM standard devices. Today in 2014, smartphones have been embedded into people's social lives in most of the developed countries so deeply that it is even impossible to imagine the world without it.

However, the situation around smartphone diffusion and usage is not consistent across the world at all. The social penetration of smartphones is influenced by many socio-economic factors in complex and dynamic ways. We have witnessed various technology diffusions in the past century, such as televisions, refrigerators, fax machines, and fixed-line telephones. Smartphones are of course a subset of mobile phones that have been rapidly diffused since mid 1990s, and yet they can be also seen as a distinct technology category apart from mobile phones in many ways. Smartphones are not just mobile telecommunication handsets but also powerful Internet-enabled entertainment devices with which people enjoy 'anytime anywhere' online experiences. Moreover, smartphones are also an online service platform on which many online service and application providers are competing with each other and created a totally brand new business field. The diffusion of smartphone also widely varies by country and region in the world, depending on social, economic, and technological environments. Precedent wide diffusion of ICT infrastructure does not necessarily grantees smartphone diffusion as seen in the case in Japan where smartphone penetration still significantly lags despite its well developed broadband Internet infrastructure.

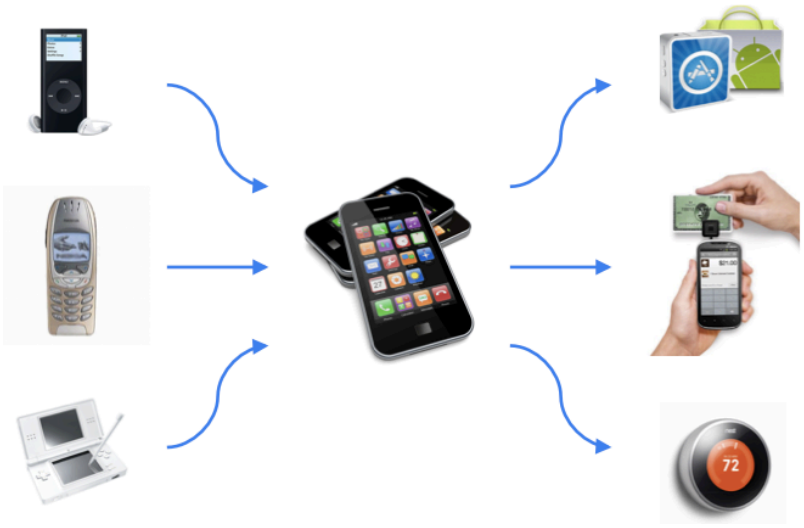

Figure 1. Smartphone in a non-linear evolution

Given these emerging dynamic realities around smartphone diffusion, it is of paramount importance to grasp an overview of the global smartphone diffusion with support of robust quantitative data. This paper introduces the result from a large-scale quantitative survey for smartphone penetration and usage across 48 countries in the world and identifies particular smartphone diffusion patterns by utilizing multivariable cluster analysis. The paper then addresses some characteristics of those clusters and sheds a light on some distinctive countries by exploring some cultural dispositions for smartphone adoption in those societies.

2 A Brief Overview of Technology Diffusion Theory

The diffusion and social penetration of technology has been one of key topics in many technology related academic disciplines in social science since the middle of the past century. Heidegger (1977), one of the key philosophers in the 20th century, posed key questions on the essence of technology beyond just technological artefacts, stating "the essence of technology is by no means anything technological. Thus we shall never experience our relationship to the essence of technology so long as we merely conceive and push forward the technological, put up with it, or evade it" (ibid. p. 3). Technology is by nature deeply weaved into social fabric. Likewise, the diffusion of a certain technology is a dynamic process of the interaction amongst society, technology and users (MacKenzie & Wajcman, 1999).

There are a few different but mutually interacted academic streams around the topic of technology diffusion. One of the key references for technology diffusion is Roger's "Diffusion of Innovations" theory (Rogers 2003). Rogers offers a comprehensive view and a framework to understand various patterns and processes of technology diffusion, especially identifying key elements for technology diffusion: i.e. innovation, communication channels, time, and social systems. Rogers also proposes famous five categories of technology adopters: 1) innovators, 2) early adopters, 3) early majority, 4) late majority, and 5) laggards. Rogers's theory and framework is still widely used and applied to various real-world cases of technology diffusion, but now more and more challenged by the rapidly expanding online communication channels that make the diffusion patterns more difficult to predict.

Technology Acceptance Model (Davis 1989) is another key theoretical vein of technology diffusion theory, established in the Information Systems field. TAM's main proposition is that the actual technology adoption is influenced by perceived benefits from technology usage. TAM sheds a clear light on individual's perception of the use of the technology: perceived ease of use and perceived usefulness. Perceived usefulness is a critical factor for individual's technology adoption and defined as outcome expectancy yielded by the consequences of adoption behavior. Perceived ease of use is defined as "the degree to which a person believes that using a particular technology would be free from efforts" (Ibid. p.320). TAM has evolved by being added various value-based attributes in the late 1990s and Venkatesh and Davis (2000) proposes TAM2 by incorporating social and cognitive influence factors into the model.

Technology diffusion has been a hot topic also in marketing field. Bass (1969) proposes a classic model of new product diffusion. The Bass model's basic assumption is that potential adopters of a technology are influenced by two means of communication, i.e. mass media and word of mouth. With its simplicity and wide applicability, the Bass model and its revised forms have been widely used for forecasting innovation diffusion in retail service, industrial technology, agricultural, educational, pharmaceutical, and consumer durable goods markets (Mahajan et al. 1990).

Economists have been also keen to discuss technology diffusion and its socio-economic impact. For economists, diffusion can be seen as the cumulative result of a series of individual calculations that weigh the incremental benefits of adopting a new technology against the costs of change, often in an environment characterized by uncertainty and by limited information (Rosenberg 1972). Some scholars pointed out 'path dependency' in some technology diffusion processes, indicating historical inertia of consumer's choice of technology adoption (David 1975).

Smartphone diffusion is one of the latest widespread technology diffusions we are now witnessing in many parts of the world simultaneously. Although the history of smartphone is still relatively short, it is possible to conduct quantitative and qualitative research on individual's adoption of smartphone in a certain context or environment by applying established technology diffusion theories discussed above. However, the serious issue that we are now facing for a study on smartphone diffusion is the lack of macro-level, worldwide smartphone adoption data. Smartphone diffusion is happening not just in the developed markets like the U.S. and UK, but also in many developing markets, both economically and technologically, as a form of 'leapfrogging'. In order to grasp the whole picture of such an emerging

reality of smartphone diffusion, we clearly need an accurate data set of smartphone adoption and usage in multiple countries in the world.

3 Data Collection: Conducting a Global Survey

To acquire accurate and robust data sets for smartphone diffusion, we have conducted annual worldwide quantitative survey research since 2011. This research project is called "the Connected Consumer Study (CCS)", fully funded by a firm to which the author belongs. This research aims to annually offer an accurate picture of general Internet usage and device adoption. In the third round conducted in 2013, it covered 58 countries including many developing countries in Asia, East Europe, Middle East, and Africa. Sample size per country is n=1,000. Fieldwork timing is the first quarter of each year (January – March).

Unlike most of the global surveys of this kind offered by large research firms, CCS does not use online survey method for data collection. Rather it employed 'offline' survey method, either CATI (Computer Assisted Telephone Interview) or face-to-face interviews. The reason for this is to minimize the potential sampling bias of online survey. To capture accurate realities for Internet usage and device adoption, using 'offline' interview method is critical to cover non-Internet users too for sample recruiting.

To explore the diffusion patterns of smartphones, we selected 28 countries where data sets both in 2011 and 2013 are available for analysis. Below is the overview of national smartphone penetration for selected countries.

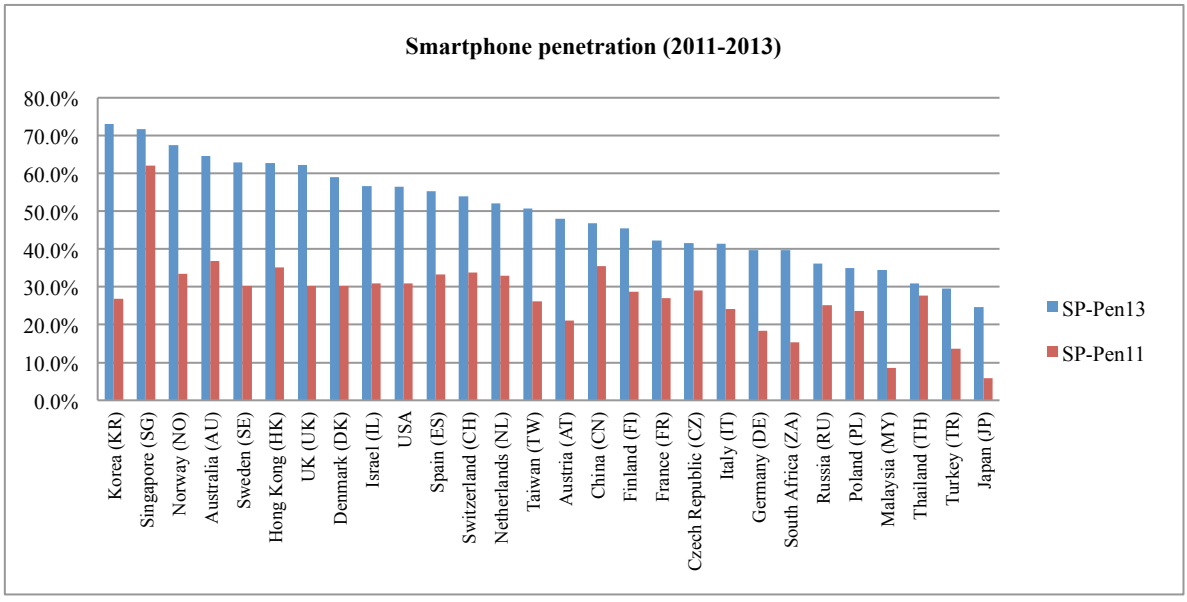

Figure 2. Smartphone penetration (2011-2013), Source: Connected Consumer Study 2011-2013.

4 Cluster Analysis for Smartphone Diffusion Patterns

It is obvious that smartphone diffusion patterns are not globally consistent and cannot be predicted in a linear manner. The adoption of smartphone is influenced by multiple environmental factors as well as perceived benefits of smartphone itself. Here we conducted cluster analysis by using CCS data for 28 countries to identify distinctive groups of smartphone diffusion patterns in the world.

It is possible to utilize various public socio-economic data sets, but for the sake of model simplicity, we limit our analytical scope into the following six variables:

- Smartphone penetration in 2013
- Smartphone penetration in 2011
- Smartphone penetration growth rate (2011-2013)
- Smartphone penetration growth point (2011-2013)
- PC penetration in 2013 (PC includes desktop/laptop PC and web-book)
- Broadband Internet penetration in 2013 (DSL, Cable TV, other broadband)

In addition to four variables relating to smartphone penetration, we included PC penetration and broadband Internet penetration for cluster analysis. PC penetration can be treated as a precedent technology that can affect users' smartphone adoption choice. Broadband Internet penetration was included to take the basic readiness of Internet infrastructure into account. Cluster analysis was conducted with the standard hierarchical clustering method and the statistical tool used is JMP. With interpretive exploration of the result, we split 28 countries into 6 clusters.

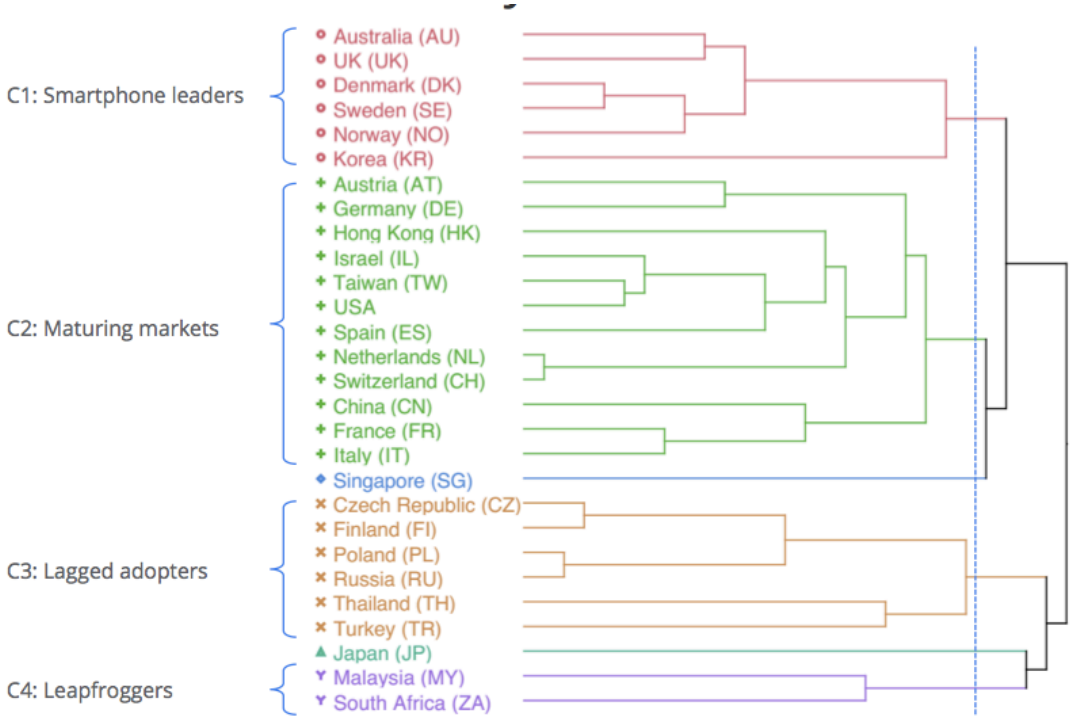

Figure 3. *A result of cluster analysis for smartphone diffusion patterns, Source: Connected Consumer Study 2011-2013.*

Cluster 1: Smartphone leaders (KR, NO, AU, SW, UK, DK)

This cluster is clearly the world's leading group of smartphone diffusion. These countries show the highest level of smartphone penetration in 2013 (60-70%) and significant increase of smartphone penetration rate from 2011 to 2013. Especially, Korea's smartphone penetration is 73%, the highest amongst 28 countries addressed in this paper. There are three Scandinavian countries (NO, SW, DK) in this cluster, still leading the smartphone world.

Cluster 2: Maturing markets (HK, IL, USA, ES, CH, NL, TW, AT, CN, FR, IT, DE)

This is the largest cluster including the countries showing relatively high smartphone penetration in 2013 (40-60%) but moderate growth from 2011 to 2013. Although geographical distribution of this cluster is widespread, ranging from North America to Europe, Asia and Middle East, the diffusion patterns are consistent in terms of the pace of diffusion and environmental factors.

Cluster 3: Lagged adopters (FI, CZ, RU, PL, TH, TR)

This cluster is a group of countries where people are adopting smartphones much more slowly than the rest of the countries. In addition, still low broadband Internet penetration is also another characteristic of this cluster. It is supposed that there are some blocking barriers against smartphone diffusion, mostly on a supply side such as mobile network infrastructure and data price. Further investigation needs to be done to address such barriers.

Cluster 4: Leapfroggers (ZA, MY)

The final cluster, including South Africa and Maylasia, is the leapfroggers that have shown rapid adoption of smartphone in the extremely poor situation of PC and broadband Internet penetration. South Africa's PC penetration in 2013 is still as low as 20.7%, and its broadband penetration is only 9.2%. Despite such poor infrastructural readiness, people in South Africa have adopted smartphone very rapidly since 2011, increasing from 15% to nearly 40%.

Besides these four clusters of country, there are two countries that do not belong to any of those clusters but stand alone, i.e. Singapore and Japan.

SG: Matured market

Singapore is distinct from all other countries in terms of smartphone diffusion pattern. Singapore's smartphone penetration rate was already very high in 2011, i.e. 62.0%, when the rest of the world was still in very early stage of smartphone diffusion. The first iPhone was launched in Singapore in 2008, almost one year later from the US launch. But Singaporean users showed exceptionally high enthusiasm towards iPhone, accelerating their smartphone adoption significantly. The rapid diffusion of 3G mobile networks also drove smartphone penetration in 2011.

JP: Isolated innovators

Clearly, Japan is a distinct market in terms of smartphone diffusion. Despite its high PC penetration and broadband Internet penetration and the early lunch of iPhone (i.e. July 2008), Japan's smartphone penetration rate was the lowest amongst 28 countries, both in 2011 and 2013. This is mainly because of the existence of the highly advanced 'feature phones' in the market. Japanese feature phones are fully web enabled and equipped with many technical features such as TV program viewing and RFID based payment function. Japan's case is so exceptional that we need separate investigation and discussion on it, which is out of this paper's scope.

5 Discussions

The simple cluster analysis presented in the previous section can be extended by adding other variables such social and economic development indictors, people's income level, mobile industry maturity, etc. However, this clustering appears reasonable from a practical perspective, splitting 28 countries into meaningful 6 clusters. The cluster analysis is by no means a method for prediction. It is a tool for acquiring practical implications on diverse entities through a clustering process and the results.

Here, the particular focus of interest comes into two 'anomalies' in the cluster analysis, i.e. Singapore and Japan. These two countries are apparently distinct from other counties in smartphone diffusion patterns. Whereas there are a number of literatures that explored social and cultural characteristics of Japanese mobile phone users and businesses (e.g. Ito et al. 2005; Kakihara 2008), Singapore's mobile users and business have been rarely addressed in the academic discussion on technology diffusion.

Singapore's case shows a particularly unique pattern of smartphone diffusion. Smartphone penetration skyrocketed just after the iPhone local launch in 2008. Even in the 'early skepticism' phase for smartphone category as a whole, Singaporean people enthusiastically purchased smartphones and energetically utilized them in their everyday lives. It appears that Singapore's smartphone diffusion pattern cannot be properly explained by any of existing technology diffusion theories discussed in Section 2 and that more socio-cultural ingredients need to be placed to grasp full meanings of it (Straub 1994; Leidner & Kayworth 2006).

6 Concluding Remarks

This paper explored the patterns of smartphone diffusion in various countries based on the result from a large-scale global smartphone user study. Cluster analysis was conducted to identify similarities amongst the smartphone diffusion patterns across 28 countries and addressed key characteristics of each cluster. Then two distinct cases were highlighted, i.e. Singapore and Japan. These two countries showed highly distinct patterns of smartphone diffusion compared to other countries, which cannot be fully explained by existing technology diffusion theories.

Limitation of this paper is clearly its overly simple method of analysis, just employing simple hierarchical clustering analysis. It is possible to build a more advanced model by adding some variables on both demand and supply sides such as app market size, tablet penetration, etc. Econometric time series analysis can also be applied to this study.

Smartphone is still 7 years old since its advent in 2007. And yet it is already weaved into our everyday lives so deeply that we tend to fall into 'myopia', without macroscopic understanding of its emerging reality. The main contribution of this paper is to offer basic smartphone penetration and usage data at a worldwide level through a robust quantitative survey, which aims to help many scholars to analyse smartphone diffusions in multiple countries and also help practitioners grasp an overview of rapidly changing smartphone business environments.

References

Bass, F.M. (1969). A new product growth model for consumer durables. Management Science, 15 (1), 215-27.

David, P. (1975). Technical Choice, Innovation, and Economic Growth. Johns Hopkins University Press, BL.

Davis, F.D. (1989). Perceived usefulness, perceived ease of use, and adopter acceptance of information technology. MIS Quarterly, 13(3), 319–340.
Heidegger, M. (1977). The Question Concerning Technology. Harper and Row, New York.
Ito, M., M. Matsuda, and D. Okabe eds. (2005). Personal, Portable, Pedestrian: Mobile Phones in Japanese Life. MIT Press, MA.
Kakihara, M. (2007). Japan: The leading mobile market at the crossroad (In Trends in Mobile Technology and Business in the Asia-Pacific Region. Edited by Y. Youngjin Yoo et al), City University, UK.
Leidner, D.E. and T. Kayworth (2006). A review of culture in information systems research: Toward a theory of information technology culture conflict. MIS Quarterly, 30(2), pp.357-399.
MacKenzie, D and J. Wajcman eds. (1999). The Social Shaping of Technology. 2nd ed. Open University Press, UK.
Mahajan, V., Eitan Muller and F.M. Bass (1990). New product diffusion models in marketing: A review and directions for research. Journal of Marketing, 54(1), 1-26
Rogers, E.M. (2003). Diffusion of innovations, 5th ed. The Free Press, New York.
Venkatesh, V. and F.D. Davis (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. Management Science, 46(2), 186-204.
Rosenberg, N. (1972). Factors affecting the diffusion of technology. Explorations in Economic-History, 10(1), 3-33.
Straub, D. (1994). The effect of culture on IT diffusion: Email and fax in Japan and the US". Information Systems Research. 5(1), pp.23-47.