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Exploring the patterns and determinants of the global mobile divide

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ABSTRACT

This study explores the patterns of the global mobile divide and the factors that influenced it. It proposes a comprehensive framework to explain mobile phone adoption by integrating technology acceptance model (TAM) and economic consumption analysis. The empirical analysis is conducted using the data from more than 150 countries. The results show that the gaps of mobile phone penetration among different groups of income level countries have decreased during the past 23 years. Average income had a negative correlation with mobile phone adoption rate, represented by the slope of mobile phone diffusion curve. However, average income had a positive correlation with mobile phone penetration, suggesting that there are still gaps of mobile phone penetration between rich and poor countries. Besides average income, other factors, such as legacy phone system, population density, and education level, were also demonstrated to have influence on mobile phone penetration. The framework and findings of this study suggest the potentials for the integration among consumption analysis, diffusion of innovation theory (DIT), and TAM. Strategies for further bridging the global mobile divide are suggested based on the empirical findings.

1. Introduction

In the information society, information and communication technologies (ICTs) become significant in people's lives. The Organization for Economic Cooperation and Development (OECD) argued that ICTs have become an essential part of human activities (OECD, 2005). The United Nations Development Program (UNDP) alleged that ICTs are the requisites for economic and human development (UNDP, 2001). The United Nations advocated the access to ICT services is one of the basic human rights in the contemporary society (United Nations, 2009), and ICTs make significant contributions to achieve Millennium Development Goals, such as promoting higher education, improving healthcare services, facilitating occupational advancement. However, ICTs exhibit various development patterns in different countries. The concept of the digital divide was developed to describe the gaps between those who get access to ICTs and those who do not (National Telecommunications and Information Administration (NTIA), 1999). These gaps reflect the different rates of ICT diffusion processes in different groups of people.

Mobile phone is one of the major ICTs that have diffused rapidly in recent decades. There were 4.08 billion mobile phone users globally in 2012. This number grew to 4.33 billion in 2013, and to 4.55 billion in 2014. The total mobile phone users are likely to reach 5.13 billion users globally by 2017. The smart phone users worldwide were about 1.75 billion in 2014

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(Emarketer, 2014). In the United States, more than 64% of adults own a smartphone (Nielson, 2012). However, like the diffusions of other ICTs, the diffusion of mobile phone exhibits different patterns across the world. The gap between the users of mobile phones and non-users is mobile divide, which is one of the significant aspects of digital divide (Jung et al., 2013; Mir and Dangerfield, 2013; Loo and Ngan, 2012). Since the adoption rate of mobile phone has accelerated in recent years, many scholars argued that mobile technology has the potential to bridge digital divide in the globe (e.g. Srinuan et al. (2012), Mir and Dangerfield (2013), Loo and Ngan (2012)). And many other scholars demonstrated that mobile technology has the potential to achieve multiple development goals, such as economic growth, political participation, and education (e.g. Bomhold (2013), Martin (2014), Loo and Ngan (2012), Prieger (2013)).

Although more evidence is needed to support these arguments of the significance of mobile phones in bridging digital divide and prompting social development, it is undeniable that mobile phones play increasingly important roles in people's lives as they have diffused rapidly in many countries. At the same time, they have diffused relatively slowly in many other countries. Therefore, it is necessary to explore how mobile phones have diffused across the world, and the different patterns of their diffusion among different countries. The current study proposes a new comprehensive framework to explain mobile phone adoption, and conducts empirical analysis using cross-country data.

2. Surveying the literature

2.1. The slope of the diffusion curve and the global mobile divide

The s-shaped curve has been widely used to describe the diffusion process of an innovation, with time on the X-axis and the number/percentage of adopters on the Y-axis. At the beginning, the curve is flat because only a few people adopt the innovation. As more people adopt it and the curve becomes steeper. When there are few people left who have not adopted the innovation, and the curve becomes flat again. When this curve reaches its asymptote, the diffusion process is finished. This s-shaped curve was first proposed by Rogers (1962), and applied in many following studies in the diffusion of innovations tradition. The slope of the diffusion curve is one crucial factor that determines the pattern of an s-shaped curve. At the early stage of the diffusion process, the slope of an s-shaped curve is low. Then, it becomes larger as the s-shaped curve gets steeper. At the later stages of this process, the slope decreases again and becomes zero when the curve reaches its asymptote. The slope of an s-shaped curve, in fact, measures the number of new adopters within a given time period, which is the rate of adoption defined by Rogers (2003). Thus, it should be investigated when we study how fast an innovation is diffused in a social system.

Although there are many empirical studies demonstrating that an s-shaped curve describes the actual diffusion process of various ICTs, such as radio, television, and the Internet (e.g. Bohlin et al. (2010), Gruber (2001), Norris (2001), Liu and San (2006), Wu and Chu (2010)), these s-shaped curves are not uniform in their slopes. Rogers (2003) held that "there is a variation in the slope of the 'S' from innovation to innovation" (p. 23). Some slopes of the s-shaped curves are steep while others are flat. He also argued that the s-shaped curves of the same innovation also exhibit different patterns in different social systems. That is, different innovations have different adoption rates, and even the same innovation has different adoption rates in different social systems.

Scholars developed mathematical models to describe various innovation diffusion curves. Coleman (1964) proposed two models: The internal-influence model and the external-influence model. The internal-influence model is based on the assumption that the adoption of an innovation depends on the interactions between adopters and non-adopters (Barnett, 2011). And this model generates an s-shaped curve, which reflects the normal pattern of innovation diffusion process (Jackson, 2008). The external-influence model is based on the assumption that the adoption of an innovation depends on the factors of the social system (Barnett, 2011). This model generates a curve that resembles an "r" in that its slope is much steeper than the normal s-shape curve. Henrich (1999) named this as "r-shaped" curve.

The gap between mobile users and nonusers is called the mobile divide, which is regarded as one aspect of digital divide (Jung et al., 2013; Mir and Dangerfield, 2013; Loo and Ngan, 2012). The global mobile divide can be measured by the gaps of the penetration levels of mobile phones between different countries. In other words, it can be measured by the vertical distances of the diffusion curves of different countries. The change pattern of the vertical distance between the two diffusion curves is determined by the slopes of them. As Rogers (2003) argued, the same innovation may have different diffusion patterns in different social systems. This is true for the mobile phone diffusion across countries. The slope of the diffusion curve is one crucial variable in the study of different diffusion patterns. And the slope of mobile phone diffusion curve is a crucial variable in the investigation of the global mobile divide.

2.2. Major theories explaining the mobile phone adoption

The diffusion of innovations theory (DIT) is a traditional theory that has been long used to study the diffusion of innovations, and has recently been applied to study the diffusion of mobile phones. This theory provides a classical framework that consists of five major characteristics of innovations: relative advantage, compatibility, complexity, trialability, and observability. Barnett (2011) incorporated these characteristics into the coefficient of diffusion of the internal-influence model, which yields an s-shaped curve. DIT also borrowed a concept *critical mass* from nuclear physics, and defined it as the point "at which enough individuals in a system have adopted an innovation so that the innovation's further rate of adoption