Technological Forecasting & Social Change 100 (2015) 176–185

Contents lists available at ScienceDirect

Technological Forecasting & Social Change

Determinants of Internet diffusion: A focus on China

Guangchao Charles Feng [*,1]

School of Journalism and Communication, Jinan University, Guangzhou, Guangdong, China

ARTICLE INFO

Article history:
Received 28 April 2014
Received in revised form 20 April 2015
Accepted 16 June 2015
Available online 18 August 2015

Keywords:
Determinant
Internet diffusion
China
Time series

ABSTRACT

Global Internet penetration could be attributable to many factors. Based on a new proposed framework called EPIC (Economy–Policy–Infrastructure–Content) and cross-sectional data, the world's Internet penetration was found to be determined by the literacy rate, telecom infrastructure and the availability of Internet content. To find out other possible lurking factors, another study particularly focused on China's booming while strictly controlled Internet industry. A multivariate time series analysis was performed to examine the relationships between China's Internet diffusion and these factors. The growth of Internet penetration was found to be mainly driven by the cost of Internet access, and Internet content, yet GDP per capita and telecom infrastructure failed to play roles. The implications were discussed at last.

There have been over 3 billion people using the Internet around the world as yet, corresponding to a global penetration rate of around 45% according to the International Telecommunication Union, or the ITU (2014). This compares to 2.7 billion people and 38% penetration a year earlier, and 2 billion people and 30% penetration 4 years earlier. However, as can be seen from Fig. 1, the global distribution of Internet penetration and use is far from uniform. According to the World Bank, Internet penetration rate in tier 1 and tier 2 countries is 7.24% and 24.53%, respectively, whereas Internet penetration rate in tier 3 and tier 4 countries is 45.14% and 77.60%, respectively. The ITU (2014) has also observed that there are still 4.3 billion people worldwide who are not yet using the Internet, 90% of whom live in the developing world. Digital divide is a well-documented fact, and factors causing digital divide or affecting global Internet diffusion have been extensively examined in the literature. Nonetheless, most studies used variables at the individual or organizational level (for a review, see Dewan and Riggins, 2005; Fichman, 1992; Kumar et al., 2007), relying on theory of the diffusion of innovations of Rogers (1983), uses and gratifications theory of Rubin (1994) (e.g., Ebersole, 2000), the model of the adoption of technology in households (MATH) (see Venkatesh and Brown, 2001; Brown and Venkatesh, 2005), fvr (Taylor and Todd, 1995a, 1995b), the chain process model of Dutton et al. (1987) (e.g., Zhu and He, 2002), and technology acceptance model of Davis (1989), to investigate factors affecting people's intentions or behavior in adopting certain technologies either at the workplace or in households. Despite the importance of individual level factors, they missed the variance taken by the effects due to the country-level factors and passage of time. Consequently, theories that address the concern of diffusion as well as applied studies that have examined the determinants of Internet diffusion on the country level were reviewed in the following section (see Table 1).

1. Literature review

1.1. Rogers' diffusion model

In the diffusion literature (for a review, see Meade and Islam, 2006), the diffusion of innovation has been defined as the process, by which that innovation "is communicated through certain channels over time among the members of a social system" (Rogers, 1983, p. 5). Understandably, each

* Tel.: +852 5403 9666.
E-mail address: fffchao@gmail.com.

[1] Dr. Guangchao Charles Feng is a professor at the School of Journalism and Communication, Jinan University.

http://dx.doi.org/10.1016/j.techfore.2015.06.010

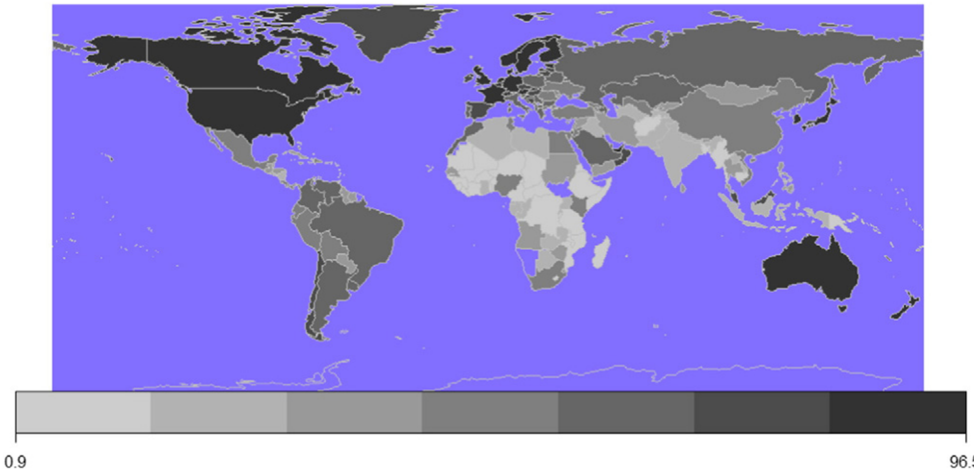

Fig. 1. Heat map of global Internet penetration in 2013 (made using the rworldmap package of R).

innovation has unique characteristics, while mass media and interpersonal communication may facilitate the process. Rogers (1983) further classifies innovation adopters according to the timing of their adoption, i.e., innovators, early adopters, early majority, late majority, and laggards. Furthermore, adopters are influenced in the timing of adoption by the pressures of the social system; the pressure increases for later adopters with the rise of the number of previous adopters. Rogers (1983) underscores the importance of a system's structure over individual characteristics. As many later scholars (e.g., Glanz et al., 2002; Siegel, 1999) have noted, however, the characteristics and behaviors of adopters are also critical to the adoption. In spite of the elegance of Roger's theory, few empirical studies have examined the diffusion process. Bass (1969) hence argued that Rogers' theory[2] is largely literary, so that it is not always easy to separate the premises of the theory from the conclusions.

1.2. The Bass model

Sultan et al. (1990) summarized a general model of diffusion of innovation, which can be mathematically defined as follows:

$$\frac{\partial N(t)}{\partial t} = g(t)\left[N^{*} - N(t)\right],$$

where $\frac{\partial N(t)}{\partial t}$ is the rate of diffusion at time t, N(t) is the cumulative number of adopters at time t, N^* is the total number of potential adopters in a population, and g(t) is the adoption rate. Various functional forms of g(t) result in models implying different diffusion processes (Sultan et al., 1990). For example, $g(t) = P$ implies an "external influence" model, with diffusion driven by mass media. The coefficient P is commonly called the "coefficient of innovation" and this model leads to a modified exponential diffusion curve. If g(t) equals $Q \times F(t)$, the model is called an "internal influence" model, where later adopters learn from earlier adopters through word of mouth (Mahajan et al., 1990). Q is often called the "coefficient of imitation" and market growth follows a logistic curve related to the Gompertz function (Mahajan and Peterson, 1985). When $g(t) = P + Q[F(t)]$, it is a "mixed influence", or the so-called Bass model (Bass, 1969), in which both innovation (P) and imitation effects (Q) drive the innovation, and market growth follows a generalized logistic curve (Sultan et al., 1990). The Bass paradigm is empirically based, and this line of research has been prolific, whereas problems associated with the Bass paradigm (the Bass model and its extensions), e.g., abstract parameters, deterministic model specification, restrictive model assumptions, and lack of validity and reliability, have been well noted (see Mahajan and Muller, 1979; Mahajan et al., 1990). Moreover, this paradigm has also failed to consider the contemporaneous as well as long run dynamic relationships among factors concerned, which can yet be tackled with time series modeling.

1.3. Country level factors

Aside from the literature based on the Bass paradigm, previous studies focusing on the diffusion of new technologies have examined factors at the aggregate level from socio-economic (e.g., GDP per capita, Internet access cost and the literacy rate), technological (e.g., network infrastructure), cultural (.e.g., uncertainty avoidance) and political (e.g., government regulations and openness) perspectives. Among them, Wunnava and Leiter (2009) analyzed the main determinants of inter-country Internet diffusion rates using cross-sectional data from 100 countries. They found that economic strength, infrastructure, knowledge of the English language, the openness of a country, tertiary enrollment, and income equality positively affected Internet connectivity. Similarly, Roycroft and Anantho (2003) hypothesized that factors influencing Internet access include economic development, international Internet bandwidth, domestic Internet hosts, ISP market structure, the cost of a local telephone call, and whether English is the official language. Nevertheless, most of these factors seem to be relevant only during the period when broadband access was not popular. The factor regarding whether English is the

[2] The first edition was published in 1962.