Relationships between Mobile-Phone/Internet Usage and Socioeconomic Development Level

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Abstract

With the rapid development of the smart phone market and smart phone technology, the smart phone has become a necessity for many people nowadays. More and more people develop a dependency on their smart phone. Potentially it could have a negative impact on many people's lives. Having noticed this apparent trend of people's addiction to the smart phone, we decided to explore the reasons why people use their phones so much, and it turned out that the overall socioeconomic development level(locally and nationally) has a huge impact on how people use their smart phones. In particular, in China's provinces, there is a positive (linear) dependence of the Internet usage on disposable income. For developed countries, a power law is found in the Zipf plot of smart phone usage while there is also a negative dependence of smart phone usage on the country's development level. These results are presented after a brief survey of previous studies. Finally, the positive effects of smart phone use in developing countries are noted.

Keywords: Mobile device, Economic development, Smart phone, Development level, Comparative research

1. Introduction

In recent years, in addition to traditional communication services like sending text messages and making phone calls, smart phones allow users to participate in popular online social networks like Facebook, We Chat, Line, and so on. With a smart phone, people are able to play a wide variety of games both online and offline, to stream movies and live sports, to take and share personal photos and videos, and to browse the Internet. The rapid growth of the Internet and mobile communication devices has caused significant effects, both positive and negative, on individual consumers and on the entire society. As more fancy functions are developed, it has become a global phenomenon that many people are finding it more and more difficult to stay away from their smart phone.

Researches including surveys (some have been posted on the web) have produced statistics and results concerning differences in smart phone usage patterns among various demographic groups (age, gender, and socioeconomic level)[Forgays et al, 2014; Sarraute et al, 2014; van Deursen et al, 2015; Pourrazavi et al, 2014; Hsiao & Chen, 2015; Li, 2014].

Additionally, numerous studies also focus on the pattern of good and bad effects of smart phone usage on individuals [Lepp et al, 2015; Lepp et al, 2014; Mathews, 2004; Carroll et al, 2002], and look into the phenomenon of smart phone addiction [Walsh et al, 2008; van Deursen et al, 2015; Lu et al, 2011]. (More details are given in Sections 2 and 3.) However, it appears that no previous research has discussed the relationship between the general (economic, social, medical, etc.) development level of a nation/region and the smart phone usage patterns of the local people. Neither have they analyzed the social and psychological reasons leading to the differences.

In China, since the mobile-device company Xiaomi released its new product "Xiaomi 2S" in 2013, the smart phone market has entered a new era that attracted worldwide attention. The product had an advanced hardware, a good operating system and a reasonable price, and smart phones like Xiaomi'sbegan to expand in market share in both China and around the world. The popularization of the smart phone has brought about the second wave of mobile-phone consumption, and it has started a trend that people are constantly hoping to buy the newest smart phones on the market.

Yet, there are people who actively choose not to use their smart phones, and more people are intentionally staying away from their phones, aware of the risk of addiction. It could happen that people from certain social level are more likely to stay away from their smart phones than others, while people from certain economic levels are addicted to their smart phones to a greater extent than others. However, to the best of our knowledge, there has not been any research covering the relationship between people's usage of smart phones and their economic level.

The aim of this paper is to study the connection between the development level and small-phone usage patterns. We have collected data through two avenues: online data bases and our own original survey. The rest of the paper is organized as follows: Our choices of two development level indicators are explained in Section 2. Previous literature related to the study of economic development and smart phone usage is presented in Sections 2 and 3. Section 4 presents our results on China's provinces while those on developed countries are given in Section 5. Section 6contains results from our own questionnaire and discussion. Section 7 concludes the paper with suggestions for further study.

2. Development Level Indicators

We choose the Human Development Index (HDI) as the indicator of development levels of different nations, and the Disposable Personal Income (DPI) as the indicator of development levels among different regions in China. The reasons are as follows.

From our perspective, the best indicator of the development level of a nation or region should take into consideration not only the basic overall economic level, but also other different factors more microcosmic and personal, i.e., the living standards, the life expectancy, the average literacy rate, the infant-mortality rate, etc. In other words, instead of merely focusing on the economic development as a whole, we try to dig deeper into the overall development level of the selected nations or regions. In fact, previous commentary has proven the failure of using Gross Domestic Product (GDP) as the reasonable index of a region's general development level [Meadway, 2011]. Others also argue that Gross National Product (GNP) per capita does not capture every aspect of the overall development [McGillivray, 1991; Lind & Nathwani, 1991]. Based on some other research, though there are still imperfections, the HDI covers useful information about the current development level of one nation such as the education level, the standard of living, and average life expectancy [Ivanova et al, 1998; Lind, 2004]. Thus, we do not use GNP or GDP per capita as the indicator of the development level for the selected nations and regions; instead, we choose the HDI as the variable indicating the development level among nations. However, due to the limitation of available statistics, we have chosen the DPI index as the variable depicting the regional development level of different regions of China.

3. Previous Studies on Patterns of Mobile-Phone Usage

Here the patterns of smart phone usage studied previously are summarized.

3.1. Mobile-Phone Usage

Previous results concerning mobile-phone (which includes smart phone unless otherwise stated) usage can be divided into two categories: the distinctions of smart phone usage patterns among different demographic groups, and the relationship between the users and the devices.

3.1.1. Demographic features

Results concerning the smart phone usage patterns of people of different age groups, gender groups, or socioeconomic backgrounds have been directly or indirectly found before. For example, Forgays et al [2014] concluded in their research that there are significant differences in mobile-phone etiquette between genders and among different age groups. Other researchers have also discovered a variation in mobile usage patterns in people with distinctive demographic features [Sarraute et al, 2014; van Deursen et al, 2015; Pourrazavi et al, 2014; Hsiao & Chen, 2015; Li, 2014]. Note that the research methods used in these studies almost all contain survey and statistical analysis of correlations between demographic variables and mobile usage pattern data.

3.1.2. Relationship between users and mobile devices

In the relationship between users and their mobile devices, much of the previous literature has focused on teenagers and young adults in universities [Lepp et al, 2015; Lepp et al, 2014; Hong et al, 2012]. Moreover, most of the existing results are dealing with the benefits of mobile devices to users, the phenomena of misuses and addiction of mobile devices among college students, and the effect of misusing or being addicted to mobile devices on psychological conditions, social relations, and academic performance, in various countries.

The use of mobile phones is particularly popular among teenagers and young adults, and there are proven benefits that can arise from the proper usage of mobile devices, such as an increased sense of social identification and connectedness [Mathews, 2004], and increased feelings of safety for young females when they are alone at night [Carroll et al, 2002]. Furthermore, by using smart phones, users are attempting to achieve several values, such as sense of confidence, amusement, sense of comfort, and restorative [Jung, 2014]. Mobile phones have actually been an integral part in the life of youth in Australia, but symptoms of addiction have also appeared, which can then lead to a level of distress and a feeling of disconnection from others, when they are withdrawn from their mobile phones for a certain amount of time [Walsh et al, 2008]. Habitual smart phone use contributes significantly to the development of an underlying addiction, and those who use their smart phones extensively *for social purposes* will develop smart phone habits in a shorter time which might then result in addiction [van Deursen et al, 2015]. In another study on Japanese adults, researchers find that the level of depression among subjects is in proportion to the extent of their “text-message dependency”, whereas anxiety was associated negatively with text-message dependency [Lu et al, 2011]. Other studies center on the possible predictors and the negative effects of mobile addiction. One piece of research has found that the use of Social Network Site (SNS) mobile applications is an important indicator of mobile addictive condition [Salehan & Negahban, 2013]. Besides, it has been found that compulsive usage of one’s smart phone and “techno-stress” are proportionate positively to psychological traits such as “locus of control”, “social interaction anxiety”, materialism, and “the need for touch” [Lee et al, 2014].

3.2. Summary of Previous Studies

Existing results and data provide the current study with a guiding direction in choosing the most proper variables for both the development level of different countries and regions and for mobile usage patterns. Moreover, as for research methods, the previous studies offer several useful methods and instructions on designing surveys and making a statistical analysis. On the other hand, although there are a few studies looking into the connection between social economic factors or income and smart phone usage [Choudhary, 2014], there is nearly no result depicting the relationship between the overall development level of a certain place and the general usage pattern of mobile phones for the local people. Moreover, the influence of mobile usage on the economic condition is only researched limitedly, while no research has ever analyzed the mutual influence between overall regional development level and mobile usage habit of the general local public. Moreover, despite the fact that there is some research discussing the cross-national situation of the development of mobile devices as well as the differences in the common usage patterns for different nations [Sey & Ortoleva, 2014; James, 2014], the scope is still limited merely to one particular region or category, but not extended to a more global and general level, thus leaving room for the present study.

In the following, in our own study, the possible relationship between the socioeconomic level and the patterns of smart phone usage are analyzed. Research methods used previously are adopted in our online-survey questionnaire; data are gathered from online databases; the relationships between usage time and the socioeconomic level of a certain region are shown graphically.

Firstly, statistics about the usage patterns of smart phones as well as the socioeconomic levels of different provinces in China are gathered respectively; results are given in Section 5. Secondly, a similar study done in international scope, with data concerning developed countries, is presented in Section 6.

4. China's Provinces: Positive Dependence in Internet Usage

Dependence of the Average Internet Access (AIA) on Provincial Disposable Income (PDI) within China is shown in Fig. 1, which depicts clearly a positive linear relationship between the two. Here, the AIA is the percentage of every Chinese province's Internet flow (i.e., the ratio of the data from the province to that of the countrywide total) in the year of 2014; separate data on mobile-phone usage alone are unavailable. Provinces here include the municipalities directly under the central government: Beijing, Shanghai, Chongqing and Tianjin. The PDI is calculated by multiplying the DPI data of a province in 2014 by the population of that province in the same year. All three original sets of data were obtained from online database.[1] Overall, the results show a positive dependence of mobile-phone usage on provincial development level in China's provinces: the *higher* the disposable income, the *higher* the Internet usage.

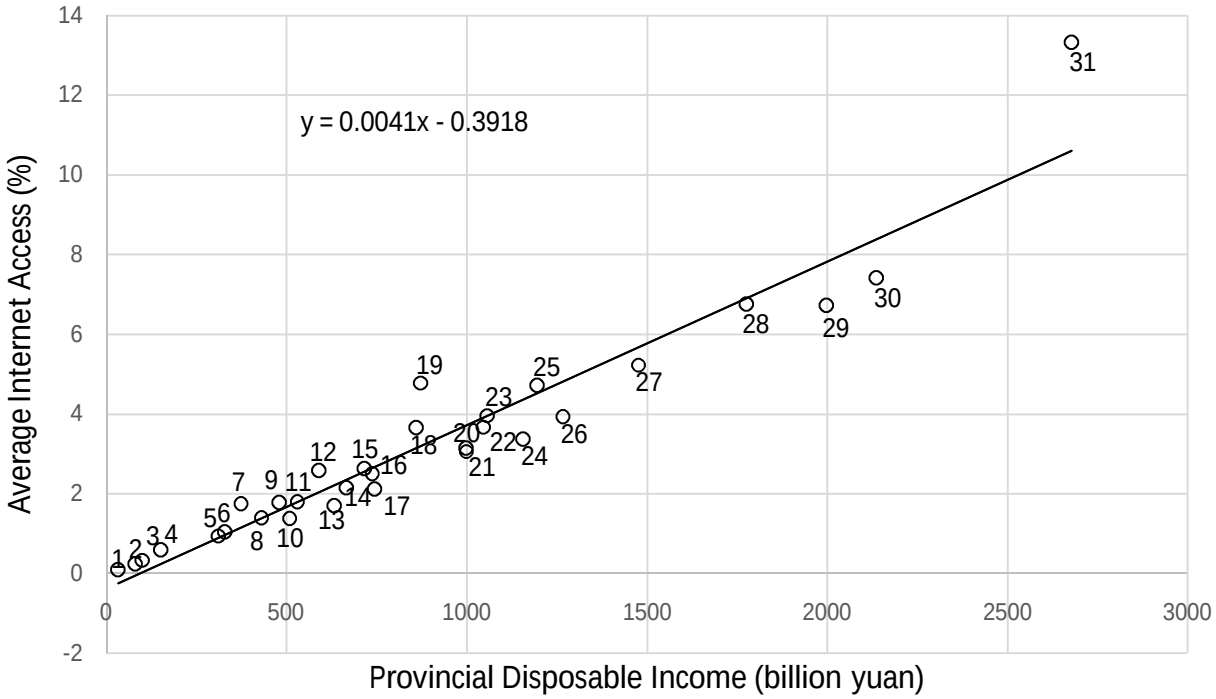

Fig. 1.Dependence of average Internet access on provincial disposable income within China (see text). From left to right, the dots correspond to:1. Tibet;2. Qinghai;3.Ningxia;4. Hainan;5. Gansu;6. Xinjiang;7;Tianjin;8. Guizhou;9.Jilin;10. Inner Mongolia;11. Chongqing;12. Shaanxi;13. Yunnan;14. Heilongjiang;15. Guangxi;16. Shanxi;17. Jiangxi;18. Fujian;19. Beijing;20. Liaoning;21. Anhui;22. Hubei;23. Shanghai;24. Hunan;25. Hebei;26. Sichuan;27. Henan;28.Zhejiang;29. Shandong;30. Jiangsu;31. Guangdong.

This positive-dependence phenomenon may due to the still-far-from saturated mobile market of China, since China has the largest population globally. Besides, although China's overall economic level ranks high in the list, its HDI is only around 0.719 in 2013, much lower than the developed countries/regions we have chosen in this research (see Fig. 4 below). In other words, China is not yet fullydeveloped, and the potential of the Internet/smart phone usage is still large.

[1]Statistics about the DPI and population of each province in China in 2014are obtained from the NBS Survey Office in Shaanxi website:
http://www.nbssosn.cn/index.aspx?menuid=3&type=articleinfo&lanmuid=13&infoid=1625&language=cn(July 25. 2015).
Statistics about the percentage of every Chinese province's Internet flow from the overall national Internet flow in 2014 are obtained from Baidu Statistics:http://tongji.baidu.com/data/ (July 25, 2015).

We have also conducted an online survey on the relationship between average smart phone usage time and DPI of different provinces, but due to the imperfections of the data, the result of the survey only shows similar positive trend as was depicted in Fig. 1, but does not demonstrate any clear dependence. (The resultswill be presented and discussed in Section 6.)

5. Developed Countries: Power Law and Negative Dependence in Smart phone Usage

In international scope, the dependence of the "average weekly smart phone Internet access"[2]on the HDI of selected countries/regions is shown in Fig. 2. The average weekly smart phone Internet access is defined as the average time (in days) spent weekly using smart phones to connect to the Internet by people taking part in the program from different countries/regions. In fact, the Internet access data is about the *frequency* of smart phone usage; the original data says "how frequently you use your first phone/second phone/third phone/fourth phone for general device usage including web browsing, app usage, email/messaging, camera, gaming, etc.". Even though it does say it is about smart phone users, it does not explicitly mention "using smart phone to access Internet". The HDI data of different countries/regions are from the United Nations Development Program (UNDP).[3] Both sets of data refer to the year 2013.

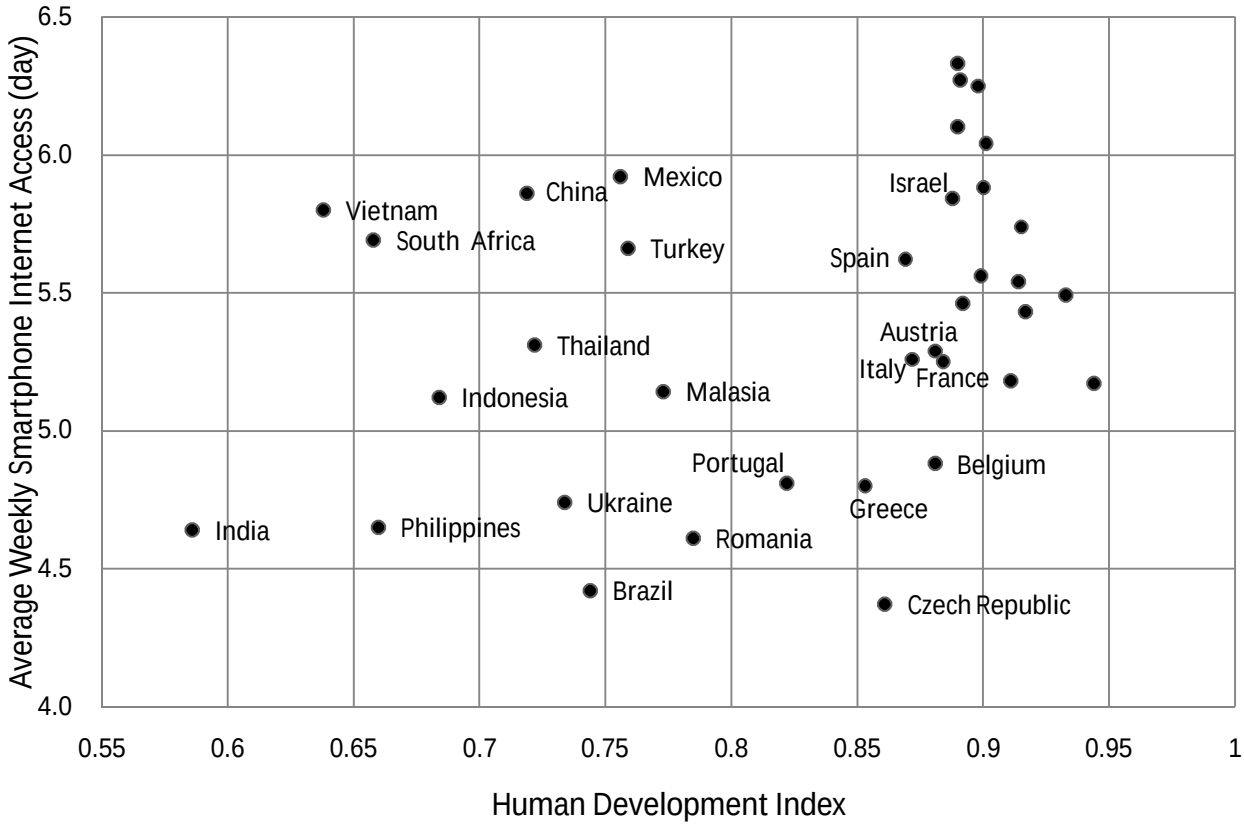

Fig. 2. Dependence of the average weekly smart phone Internet access on HDI from 36 countries. The unnamed dots at the right correspond to countries/regions with HDI ≥ 0.89, and are reproduced in Fig. 4 for further discussion.

[2] Statistics about the pattern of mobile-phone usage (including the average weekly smart phone Internet access) of different countries/regions in the year 2013 are collected from the website of OUR MOBILE PLANET program provided by Google (https://think.withgoogle.com/mobileplanet/zh-cn/downloads/, July 25, 2015).In Fig. 2, the access data is about the *frequency* of smart phone usage, and the original data says "how frequently you use your first phone/second phone/third phone/fourth phone for general device usage including web browsing, app usage, email/messaging, camera, gaming, etc.", and it says it is about smart phone users. It does not explicitly mentioned "using smart phone to access Internet".

[3]Statistics about HDI are collected in the website of United Nations Development Program (UNDP): http://hdr.undp.org/en (July 25, 2015).

There is no obvious trend in Fig. 2.Therefore, we calculate the "ratio", i.e., the ratio of the average weekly smart phone Internet access (in days) to the HDI of different countries/regions in 2013, and "rank" this ratio; i.e., the highest ratio is ranked 1, the second highest ranked 2, etc. The log-log plot of Ratio vs Rank (called the Zipf plot [Lam, 2008]) is displayed in Fig. 3, which shows a (negative) linear relationship, indicating a power law with exponent -0.15; i.e., Ratio ~ $Rank^{-0.15}$. A power law in a Zipf plot is very common among complex systems such as earthquakes, city population distributions, and word counts in writings [Zipf, 1949].

It means that there is no characteristic magnitude in the ratio among different countries/regions. An explanation for this *new* phenomenon in smart phone usage is an interesting and open problem. Note that we do not include Czech Republic (the black dot in Fig. 3) in the trend line, since this data point deviates significantly from the rest of the data, meaning that relative to the country's overall development, its people use significantly less smart phones than that in other countries/regions. The deviation may first of all be caused by certain events or abnormal situations happening in Czech Republic in the year 2013, but such events or situations are not found. On the other hand, the deviation may be caused by the uniqueness in Czech Republic's culture and society, which remains to be studied.

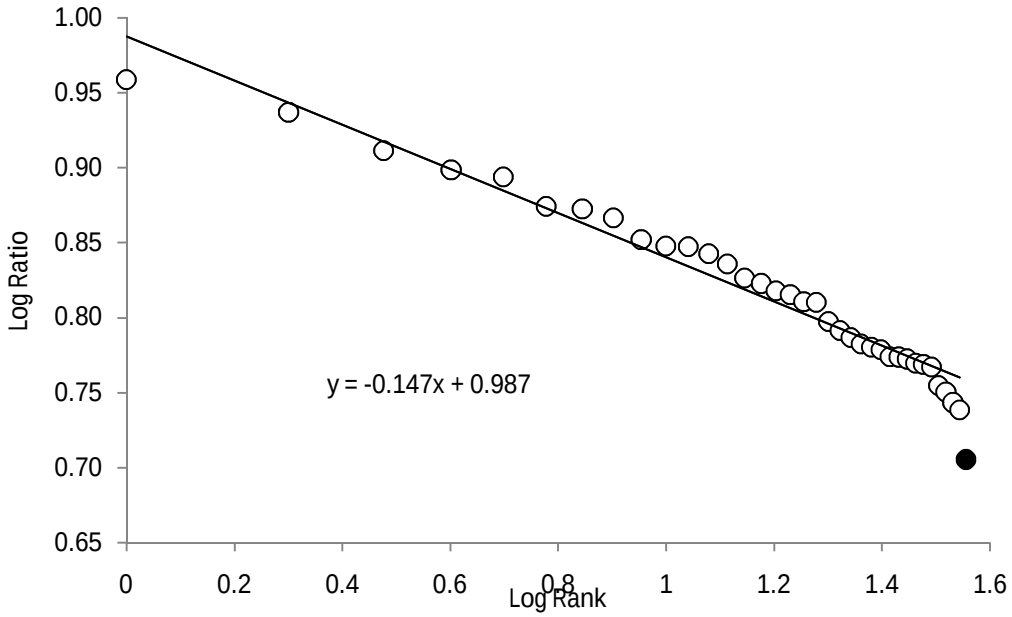

Fig. 3. Dependence of the Ratio on Rank in 36 developed countries, same countries as those in Fig. 2. From left to right, the dots correspond to: Vietnam, South Africa, China, India, Mexico, Indonesia, Turkey, Thailand, South Korea, Philippines, Hong Kong, Sweden, Japan, Singapore, Malaysia, Israel, Denmark, Spain, Ukraine, the Netherlands, Ireland, UK, USA, Italy, Austria, Brazil, France, Switzerland, Australia, Romania, Portugal, Germany, Greece, Belgium, Norway, the Czech Republic. The last point in black (Czech Republic) is excluded from the linear fit (see text).

The rich countries/regions with high HDI (≥ 0.89, the unnamed dots in Fig. 2)are considered the most developed countries/regions in the world. They present an interesting trend that is opposite to that shown in Fig. 1. As shown in Fig. 4, that is an overall negative dependence: higher the human development level, *less* mobile-phone usage. This negative trend does not seem to exist in the less rich countries/regions, the named dots shown in Fig. 2.What the negative dependence says is that when a country/region is developed well enough, people would maintain a comparatively lower frequency of smart phone usage. This phenomenon could result from the high socioeconomic development level in these countries. For example, people in these countries lead lives with better health conditions, and possess more time for leisure and amusement, while people in less developed countries/regions tend to have free times which are shorter in length and more scattered. Thus, for the former, they can choose from a greater variety of activities for social gathering and recreation, but for the latter, using smart phones may be the only efficient and direct way to contact their friends or to relax.

Moreover, Fig. 4 also illustrates another phenomenon, that people in European countries maintain a comparatively lower frequency of smart phone usage than those in Asia (Japan, Korea, Hong Kong and Singapore, in upper-left corner of Fig. 4) which share a similarly high level of HDI.

This is due perhaps to the fact that European people have more other cultural interests, such as reading books and going to museums which is quite time consuming.

Apart from the usage frequency presented in Fig. 2 (and Figs. 3 and 4), some other data provided by Google[4]demonstrate a clear distinction of people's smart phone usage pattern between the highly-developed European countries and Asian countries like China.

It shows that, on public transports and in restaurants, the British people use smart phone less frequently than Chinese people.[5]Also, a lot more Chinese people report they use their smart phones to "stay informed" (88%), compared with 54% for British people and 67% for Danish. For online shopping with smart phones, there are 69% of Chinese reporting having purchased a product or a service over the Internet on smart phones, while the number is 39% for the UK and 31% for Denmark. However, for the statement "I have no other Internet access at home—so I use my smart phone", more Chinese people tend to agree to this statement (22%), while only 5% of the British people and 7% of the Danish agree to the same statement. These findings illustrate that there may be cultural differences between Chinese and people from Western developed countries, which influence the smart phone usage pattern of different people. Furthermore, the result also shows that people from more developed places using their smart phones less could be due to their broader adoption and availability of other alternative devices such as computers, laptops, or tablets in their homes and working places.

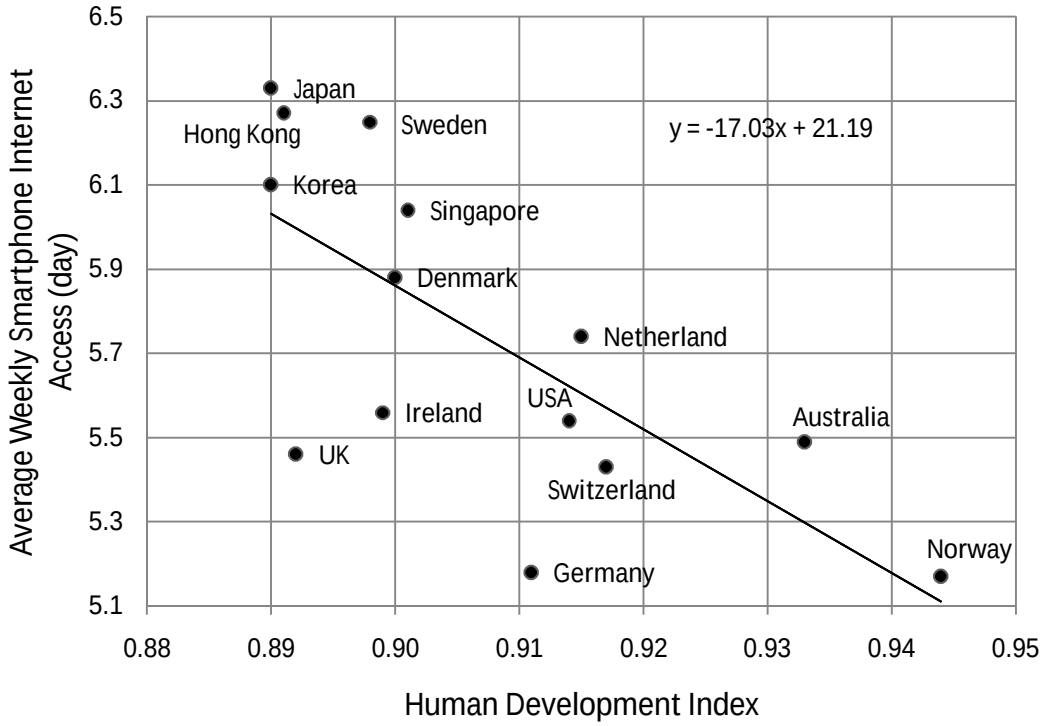

Fig. 4. Dependence (with negative slope) of the average weekly smart phone Internet access on HDI from different countries. The line is the best linear fit, shown here to indicate the trend and to guide the eye.

6. Discussion

The returned data collected from our own questionnaires[6] are analyzed in Fig. 5, which shows the dependence of the average smart phone usage time on DPI for provinces/cities within China. Note that those who fill in the questionnaires are entirely of Chinese nationality, and all grew up inside China, but some have spent a certain amount of time (from 2-6 years) abroad studying and living.

[4]https://think.withgoogle.com/mobileplanet/zh-cn/downloads/ (July 25, 2015).

[5]For the question "Where do you tend to use your smart phone?" 68% from UK report that they have used their cell phones on public transport and in restaurants. Meanwhile, for Chinese people, the number is 89% for public transport and 86% for restaurant usage.

[6]The questionnaire contains four questions: the growing-up province, the duration of mobile-phone usage time per day, top three frequently used mobile applications (e.g. WeChat, QQ and Weibo),and rating of their own mobile-phone experience.We used SoJump.com and WeChat to post the questionnaire.Within two days, 389 valid returns were obtained.

For those who have been living or studying abroad, the duration of abroad is small compared to that spent in growing-up in their province; we thus classify them according to their provinces. We divide the data into groups according to the province answered in the survey. The average smart phone usage time is defined as the group average time spent per day on smart phone apps.

The data of DPI of different groups (province) are gathered from an online database.[7]Figure 5 shows an approximate positive dependence of average smart phone using time on DPI for each province in China, similar to the trend demonstrated in Fig. 1. However, the dots are too scattered to reach a convincing result. The cause of this imperfection might be due to the limited amount of data obtained from our survey. Currently, our subjects are mainly composed of college students from big cities like Beijing and Guangzhou. People from other regions and in other ages are not able to be reached due us not having sufficient time.

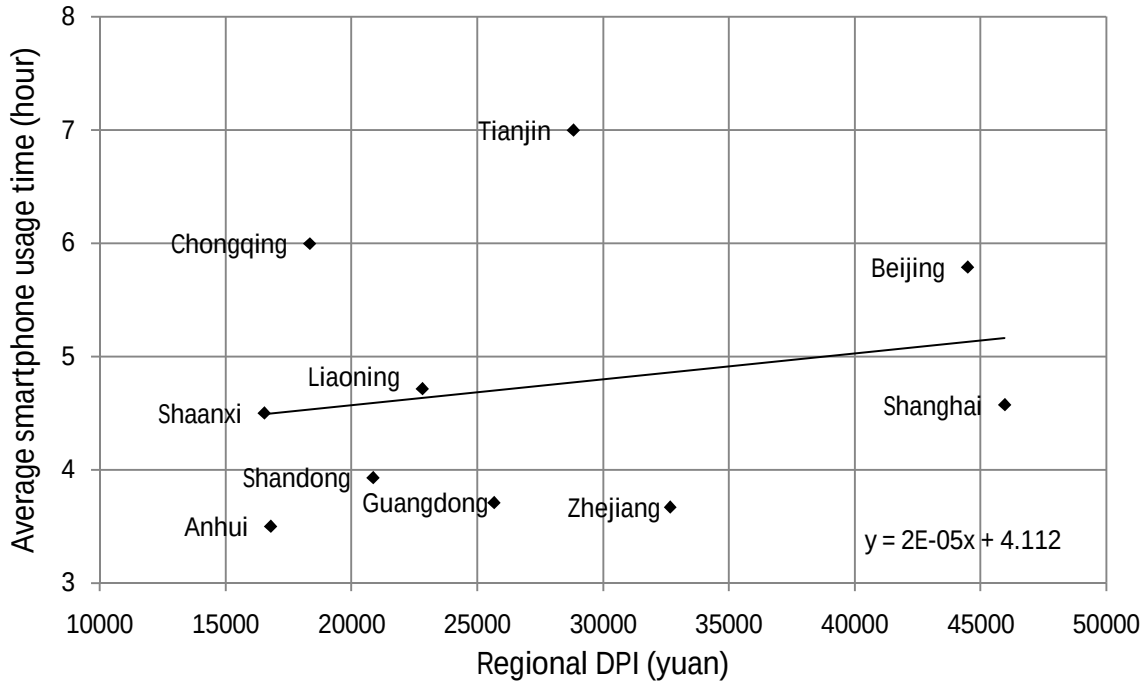

Fig. 5. Dependence of average smart phone usage time on DPI for each province/city based on returned questionnaire (see text). The line is the best linear fit, shown here to show the trend and to guide the eye.

Apart from how smart phone usage reflects development level, we have also found some successful attempts that make good use of the advanced smart phone technology. Social media has a great platform for farmers to promote selling of agricultural products. There is an ascending industry that brings financial tools into the use of the smart phone [Kendall & Voorhies, 2014]. Such inventions lower the cost of delivering bank services to areas that are difficult to be reached by banks. With this kind of technological inventions, the very factor that makes smart phone an addiction can be turned to be beneficial and helpful to salvage the less developed regions, as is happening now in China and India. Meanwhile, with the wide-spread popularity and application of smart phones and other mobile devices, security problems concerning personal and organizational cyber information would be another key factor to consider [Jones et al., 2014; Thompson, 2013].

7. Conclusion

The economic level of a certain region/group can be reflected by their smart phone usage pattern. There is a trend in the relationship between development level and smart phone usage. People in a country or region with a lower development level tend to use smart phone more often and show a stronger tendency to addiction. Interestingly, after certain wealth level, there is a clear decrease in the frequency of smart phone usage.

[7]Statistics about the DPI and population of each province in China in 2014are obtained from the NBS Survey Office in Shaanxi website: http://www.nbs-sosn.cn/index.aspx?menuid=3&type=articleinfo&lanmuid=13&infoid=1625&language=cn (July 25. 2015).

This indicates that people in higher development level places tend to use smart phone not as often, and they may intentionally choose to avoid the addiction to smart phone. Also, there is a power law in the Zipf plot of smart phone usage in developed countries (see Fig. 3) which remains to be explained.

For future studies, we suggest expanding the survey to a larger scale, in terms of both geographical and age distribution. With a larger set of data as basis, one will get a much clearer and convincing result of the relationship between development level and smart phone usage pattern. Furthermore, based on the results we found, a socio-psychological study can be conducted, to study the reason why people from certain wealth levels tend to use their smart phone in the corresponding pattern, i.e., less frequently than people from medium development level. Moreover, experts in the field of technology should also put more attention on how to use smart phones are used to improve the economic status of less developed regions.

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