DIGITAL DIVIDE BETWEEN URBAN AND RURAL REGIONS IN CHINA

Michelle W. L. Fong
School of Applied Economics
Faculty of Business and Law
Victoria University, Melbourne, Australia
michelle.fong@vu.edu.au

ABSTRACT
This research paper evaluates the development relationship between the adoption rate of Information and Communications Technologies (the Internet, mobile phone, pager, personal computer, and telephone) and per capita income gap between the urban and rural areas in China, mainly between 1985 and 2006. The Pearson’s correlation coefficients suggest there has been a strong correlation in the development relationship between this income gap and the adoption of the Internet, mobile phone, personal computer, and telephone during this period. This paper also examines the adoption of these ICTs between the urban and rural regions, and probes into two pressing issues that affect the digital divide - affordability of these technologies to the rural population, and the educational level of rural users that impact upon usage capability.

Keywords: Income disparity, Internet, mobile phone, personal computer, telephone, affordability, and ICTs literacy.

1. INTRODUCTION
There is a consensus that ICTs (Information and Communication Technologies) have a propensity to contribute to economic growth and to improve quality of life. For example, these technologies can be deployed to facilitate integration of value chains within and among firms, industries and economic sectors. In addition, they can enhance productivity and improve competitiveness for businesses through appropriate strategic applications (OECD, 2003; Fong, 2009). These technologies have also been viewed by governments and international aid agencies as important tools for national integration because they are capable of enabling greater access to health and education services, and creating economic opportunities for underprivileged population groups (Mercer, 2001; Reisman et al, 2001; The World Bank, 2001; UNDP, 2001; Oberski, 2004; Jensen, 2007) There have been empirical studies investigating the impact of ICTs on economic development. For example, Canning (1999) and Breitenbach et al. (2005) found a positive causal relationship between GDP (Gross Domestic Product) and telephone penetration rate. Maiorano and Stern (2007) highlighted the contribution of mobile telecommunication infrastructure to higher levels of per capita GDP in 30 low and middle-income countries between 1990 and 2004. At the microlevel, Jensen’s (2007) study on fishermen in Kerala shows that the adoption of mobile phones can promote economic and social welfare not only for these fishermen but also for consumers.

The EIU’s (2004) analysis offers further insights into the link between ICTs and GDP per capita growth. It examines this relationship in 26 developed countries and 34 less-developed countries between 1995 and 2002, and reported strong evidence of positive association between ICTs and economic growth for developed countries but not for developing countries. Weak association in the latter case was attributed to the absence of a critical mass in ICT adoption within these developing countries, suggesting that significant economic growth will only be attained if a minimum threshold of ICT penetration and usage is achieved. Together, these studies indicated that a digital divide between developed and
developing countries is likely to result in significant differences in economic development. Developing countries such as China, South Korea, Malaysia, India and Brazil have made substantial investments to install national ICT infrastructure in an effort to bridge this divide in order not to lag behind developed countries. However, these countries tend to focus such investments on developed urban regions due to limited resources and thus, courting the risk of creating a digital divide between urban and rural areas and generating income disparity between these areas.

This research paper provides greater details on the link between digital divide and income disparity between the urban and rural areas in China. Firstly, it evaluates the development relationship between the adoption rate of ICTs and per capita income gap between the urban and rural areas in China between 1985 and 2006, using Pearson’s correlation method. Secondly, it examines the adoption of specific ICT between the urban and rural regions, and looks at two pressing issues that affect the digital divide - affordability of these technologies to the rural population, and the educational level of rural users that impact upon usage capability.

2. BACKGROUND
In China, the rise of rural-urban inequality in income constitutes a grave challenge to its economic and social development. In 2006, statistics show that the average annual disposable income of urban residents was 3.3 times that of rural residents (National Bureau of Statistics of China, 2007). In addition, 56 percent of China’s population lives in the rural regions and about 6 percent of rural households live below the poverty line of 1,067 yuan (US$152) per annum. Figure 1 shows the widening income gap between the urban and rural population in China. The rural population has been isolated from the urban economy, and mostly engaged in semi-subsistence farming, with relatively little cash income available. The narrowing of the economic gap between these two socioeconomic groups requires improved communications for the commercialization of rural food markets for the rural farmers and increased interchange between rural and urban populations. It is important to narrow this digital divide as it could easily hinder the country’s development efforts.

In 2003, the Chinese government pledged to invest 200 million yuan (US$24.2 million) to narrow the digital gap between the eastern and western regions (12 provinces and autonomous regions) in the country (Xinhua News, 2003). A majority of the poorer and rural population is located in the western region, and this fund has been used to purchase computer and install broadband in this area. However, this is still insufficient to close the gap for the rural region.
Figure 1: Per Capita Annual Disposable Income in China’s Rural and Urban Regions


2.1 The Importance of Bridging Digital Divide

ICT is not a panacea for all the problems of developing countries. However, digital divide has important implications for these countries, such as China, as the uneven distribution of ICTs access may mean that segments or groups who have no or limited accessibility to these technologies may be denied of socioeconomic opportunities such as:

- Social equality. ICTs have the potential to dispel disadvantages that may be associated with cultural barriers. For example, ICTs may be used to improve gender equality in education. Through ICTs, girls may undertake their education through e-learning at home in a society where cultural barriers isolate girls. In addition, they may be empowered to utilize high-end technology in their economic participation in later years. (Daly, 2003 and Chen, 2004a).

- Social mobility which refers to the upward movement in status of individuals or groups based on wealth, occupation, education, or some other social variable in a society where one status is not dictated or decreed by birth of origin. Advancements in ICTs are capable of bestowing advantages in education, job-training, health-care as well as social networking and quality of life that they could make a difference between upward social mobility and a declining standard of living. In other words, ICTs could improve life for those who are within reach of these technologies.

- Economic equality. Bridging the digital divide has implications in terms of fostering economic equality, educational potential, and earning potential.

- e-democracy. ICTs can be a powerful tool for increasing transparency and facilitating information and communication processes among stakeholders. ICTs may lead to increased democratization by enabling citizens or constituents to participate in the decision-making process of policymakers and government through the electronic
channel. However, e-democracy has yet to reach its ideal level of actualization in the political participation process, especially in the case of China.

- Economic Growth and Innovations. Long-term economic growth has often been associated with technological progress. There were past studies that confirmed the positive relationship between ICT and economic growth (Bongo, 2005). It has also been showed in studies that ICTs play a central role in driving productivity (OECD, 2003). This means that ICTs have the potential in alleviating poverty in poor countries. In the ‘2006 Information and Communications for Development’ report published by The World Bank (2006), ICTs have been considered crucial to poverty reduction. ICTs have also opened up new business horizons such as innovative trading or transaction platforms for e-commerce or m-commerce. Individuals or countries who have no or limited accessibility to these technologies would likely be excluded from participating in this fast-developing electronic trading regime. Therefore, equality in ICT access is a pertinent issue in many countries including China.

3. VARIABLES AND METHODOLOGY
The ICTs of focus in this paper are the Internet, mobile phone, pager, personal computer, and telephone. This paper used the Pearson’s correlation method to investigate the development relationship between each technology’s adoption rate and the Chinese per capita income gap between the urban and rural areas. The variables are as follows:

- Income gap = Difference in per capita income between urban and rural areas.
- Internet = Number of Internet users per 100 people;
- Mobile phone = Number of mobile phone subscribers per 100 people;
- Pager = Number of wireless paging service subscribers per 100 people;
- Personal computer = Number of personal computer per 100 people; and
- Telephone = Number of telephone mainlines per 100 people.

4. RESULTS AND DISCUSSION
The results in Table 1 show that the adoption rates of telephone, personal computer, Internet, and mobile phone appear to have significant direct correlations with the per capita income gap (between the urban and rural areas in China) between 1985 and 2006. The Pearson’s correlation coefficients show that as the adoption of these ICTs increased between 1985 and 2006, the per capita income gap between urban and rural areas in China has also widened at the same time. The adoption rate of paging service in 2006 was not compiled by the National Bureau of Statistics of China due to the fact that this service is fast reaching its demise, being superseded by mobile phone technology. Available data on the adoption of paging service between 1985 and 2005 did not suggest a significant relationship with this income gap. This service is expected to reflect a decreasing adoption rate and contribute to a weaker correlation coefficient with income gap in 2006. The following section provides further insights into the adoption of ICT between urban and rural regions.
Table 1 – Pearson’s correlation coefficients

<table>
<thead>
<tr>
<th>Variables</th>
<th>Income gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet</td>
<td>0.977***</td>
</tr>
<tr>
<td>Mobile phone</td>
<td>0.930***</td>
</tr>
<tr>
<td>Pager</td>
<td>0.361 (data from 1985 to 2005)</td>
</tr>
<tr>
<td>Personal computer</td>
<td>0.944***</td>
</tr>
<tr>
<td>Telephone</td>
<td>0.981***</td>
</tr>
</tbody>
</table>

Note: *** indicates significance at 1%; ** indicates significance at 5%; * indicates significance at 10%.

5. ICT ADOPTION BETWEEN URBAN AND RURAL AREAS

5.1 Pager
Paging technology has reached its maturity in the Chinese market and been experiencing decline in its number of subscribers since 2001. The pager has lost its relevance in the urban areas where consumers have been switching to the more versatile mobile phone. The decline of paging service was also driven by the fact that more than 100 channels of wireless paging services (out of 389 registered channels) were shut down by the Ministry of Information Industry because their frequencies disrupt aviation and navigation communications (People’s Daily, 2000b). As a result of decreasing urban demand and shut downs, telecommunication operators channeled their resources towards building, expanding, and upgrading mobile phone networks that have potential in generating better returns. Although there have been attempts by paging service providers to rejuvenate this product, they were without success (People’s Daily, 2000a). Paging services were once largely adopted in the mid-western provinces and in rural areas where telephone penetration rates and income levels have been very low. However, demand and supply support for such services is also waning in these rural regions.

5.2 Fixed-line Telephone
As per Table 1, telephone’s adoption rate appears to have the strongest correlation with the development in Chinese per capita income gap between 1985 and 2006. The increase in telephone penetration rate has been accompanied by a widening income gap between the urban and rural areas during this period. The installation of telephone lines has been centered mainly in major Chinese cities and provinces, instead of the rural inland areas where there has been the additional problem of underdeveloped supporting infrastructure such as inadequate supply of electricity, substandard power networks, and inadequate road access. Teledensity coverage in the rural areas is significantly lower than the urban areas, as shown in Table 2; the fixed-line telephone penetration rate in rural areas was about 3 times below urban areas in 2006.

Table 2: Number of Fixed-Line Telephone Subscribers Per 100 Persons in 2006

<table>
<thead>
<tr>
<th>Areas</th>
<th>Fixed-line telephone subscribers per 100 persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>44</td>
</tr>
<tr>
<td>Rural</td>
<td>16</td>
</tr>
</tbody>
</table>

5.3 Computer and Internet

In 2006, there were 47.2 computers for every 100 urban households and 2.7 computers for every 100 rural households (CNNIC, 2007a). Computer ownership was 23 times lower in the rural areas. The digital gap was also exacerbated by the higher rate of growth in computer installation in the urban households.

In terms of Internet connection, data from the National Bureau of Statistics of China (2007) and the China Network Information Center (CNNIC, 2007b) reported that 10.5% of the Chinese population has access to the Internet, and the penetration rate in urban areas was 21.6%, compared with 5.1% in rural areas. In a separate survey conducted by the CNNIC on Internet usage in the Chinese rural areas, it was found that 53.9% of Internet rural users surf online at Internet cafés, which was above the national average Internet café surfing rate of 37.2% (CNNIC, 2007a). This indicates that there are rural dwellers who are inclined towards the use of the Internet despite infrastructural limitations, and the government and Internet service providers should consider further public places for ICT accessibility in rural areas.

The same report also found that the Internet application level of rural users is less developed than urban users based on their online activities. Users in rural areas rarely used the Internet for online shopping, banking and stock trading activities. They use the Internet mainly for online entertainment. Although there were 6,389 websites with downloadable information related to agriculture (Farmer Daily, 2007), a survey conducted in January 2007 found that only 0.4% of total online population in China were peasants or farmers (CNNIC, 2007c).

5.4 Mobile Phone

China now has the world’s largest mobile phone user population, many of whom do not have a fixed-line telephone. Although the mobile phone was only introduced into this country in 1987, it has been experiencing a relatively rapid rate of adoption. By October 2003, the number of mobile phone subscribers exceeded the number of fixed-line telephone subscribers. By 2006, there were 35 mobile phones per 100 inhabitants as compared to 28 telephone mainlines per 100 inhabitants (National Bureau of Statistics of China, 2007). If the trend in mobile phone adoption continues to increase into the future and exceed the adoption rates of all other ICTs, this technology may become the common base for e-commerce. However, the ratio of mobile phone penetration rate between urban and rural areas has been about 7:1 (www.catr.cn, 2006; Ouyang, 2007). If this rate continues into the future, participation in e-commerce may be confined mainly in the urban region and exclude rural residents. A survey conducted in 2006 provides insights into the width of the digital gap for mobile phone in three years time. This survey investigated the type of white goods that rural population were likely to purchase in one to three years time. The desire to own a mobile phone was ranked highest among refrigerator, air conditioning system, microwave, washing machine, computer desktop, and DVD player. This survey found that 4.4% of the respondents intend to own a mobile phone in one year time, 10.7% in two years time, and 8.6% in three years time (Cui and Chen, 2007). If these adoption intentions were realised in 3 years time for mobile phone, the penetration ratio for this technology between urban and rural will be narrowed to 1.62: 1.

This Chinese digital gap has been influenced by a range of issues and this paper looks at two of the main issues that account for low adoption of ICTs in rural areas - the affordability of these technologies to the rural population, and the educational level of rural users that impact upon usage capability.
6. TWO ISSUES OF CONCERN

6.1 Affordability

The widening income gap between urban and rural residents in China is a constraining factor in the rural adoption of ICTs. For example, a personal computer and mobile phone have been considered a luxury item by many rural dwellers (China Daily, 2003). Table 3 shows the expenditure (represented by price basket) in using different ICTs as a proportion of income (represented by percentage of GDP per capita) between an urban and rural subscriber exhibiting the same usage pattern in China. On the basis of the same usage behaviour, the cost of telecommunications constitutes a significant portion of the rural per disposable capita income, particularly for mobile phone usage (28.90%). Even though the expenditure for mobile phone and Internet usage has fallen in 2005 as compared to 2004 (Fong, 2007), due to drop in fees, the costs of using these ICTs are 3.2 times higher for rural residents.

Table 3: Comparison of Price Basket for Different ICTs as a Percentage of GDP Per Capita between Urban and Rural areas

<table>
<thead>
<tr>
<th>China</th>
<th>Price basket for mobile as % of per disposable capita income in 2005</th>
<th>Price basket for Internet % of per capita disposable income in 2005</th>
<th>Price basket for residential fixed line % of per capita disposable income in 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>8.97%</td>
<td>2.65%</td>
<td>4.30%</td>
</tr>
<tr>
<td>Rural</td>
<td>28.90%</td>
<td>8.55%</td>
<td>13.86%</td>
</tr>
</tbody>
</table>


Because rural users tend to access the Internet at Internet café or through their mobile phones, this has resulted in higher cost of usage (as compared to home connection) and shorter usage time. In term of usage time, rural users spent 13.7 hours per week which is lower than urban users’ 20 hours per week (CNNIC, 2007d). Although the digital gap on Internet usage has narrowed between the urban and rural areas as compared to previous years, this gap remains wide (CNNIC, 2007d).

To hasten the ICTs’ adoption rate, the rural population needs assistance in overcoming the affordability issue. The MII encourages and supports scientific research institutions and equipment manufacturers to develop telecommunications systems and products suited to the rural conditions (“Chinese Ministry”, 2006). Software and hardware manufacturers are providing support and contributing resources to cultivate IT talents and usage in the rural regions. For example, Microsoft has been sponsoring school and community training programs for rural population (China CSR, 2008). Intel has also pledged to donate personal computers and sponsor training programs to promote ICT access for the rural regions (Ding, 2008).

In 2007, Chinese personal computer manufacturers such as Lenovo (which acquired IBM’s PC division), Sichuan Sinomamic Technology, and Dell separately announced that their plans to design and market a low-cost personal computer for use by the rural population in this country (“China PC”, 2007; BBC News, 2007). The pricing of this computer has been between 1499 yuan and 2999 yuan (tech.163.com, 2007; “Dell’s new”, 2008). At the price of 1499 yuan, the product does not include a monitor in order to keep at affordable level for the rural consumers. The low-cost PC is designed to plug into televisions sets which are found in most rural homes. Rural population does not suffer a wide digital gap in their access to colour television sets. In 2006, the average number of colour televisions per 100 households was 89.4 units in the rural region and 137.4 units in the urban region (National Bureau of
Statistics of China, 2007). Designing a PC that could use a television as its display ancillary appears to be a sensible and good strategic approach adopted by these manufacturers. These low-cost projects are similar to the non-commercial initiatives of OLPC (One Laptop Per Child) project launched by faculty members at the MIT Media Lab. The OLPC project aims to develop a US$100 laptop for children in poor countries who will be otherwise not offered technological learning opportunities. In the Chinese context, this low-cost personal computer will not support sophisticated operating functions. However, the current IT skills and capability of these rural users do not warrant the need for a PC with sophisticated functions. In fact, the low-cost computers serve as an ideal platform for these rural users who are not familiar in using this technology.

Although a mobile phone provides a quicker and less costly solution for overcoming the slow development or inadequacy of the current fixed-line infrastructure, the cost burden of mobile phone telecommunications is shifted to the users by way of high fees. To encourage mobile phone adoption in the rural areas, the high telecommunications cost requires some form of subsidization, as operators will take a considerable period of time to build a critical mass in those regions to achieve breakeven point or economies of scale on their investment. The expansion of telecommunication coverage, whether fixed-line or wireless, into the rural areas is not so much for the sake of increasing business revenue but more on the grounds of social responsibility in closing the economic gap between the ‘haves’ and ‘have-nots’. The Chinese government has undertaken the following projects through its state-owned enterprises in narrowing the digital gap for mobile phone.

For example, China Mobile has invested 9 billion yuan (US$1.13 billion) in establishing a mobile infrastructure for about 26,000 rural villages in recent years (Gu, 2006). The objective of this project is to enable farmers to keep track of weather conditions or forecasts, as well as commodity prices for their agricultural produce. However, mobile communications are very costly to the rural inhabitants, particularly in the poorest areas. Chen (2004b) found that expenditure on mobile communications as a percentage of excess income (disposable income after subtracting for food expenditure) of inhabitants living in the poorest rural areas, such as Inner Mongolia, Ningxia, Xinjiang, Gansu and Guizhou, varied in the range from 67.76% to 147.38% (indicating that mobile telecommunications cost far exceeded the income of some subscribers), in 2002.

In July 2006, China Unicom announced the official launch of an agricultural wireless information project for farmers in 26 provincial district cities (“China Unicom”, 2006). Agricultural information from government and third-party service providers is transmitted via SMS and WAP (Wireless Application Protocol) at special mobile communication rates to farmers under this program. For example, receiving agricultural-related messages via wireless paging services would involve a monthly subscription fee of 5 yuan (US$0.625). In the case of mobile phone usage, a monthly subscription fee of 3 yuan (US$0.375) allows users to send up to 5 SMS text messages each day without further charges. In addition, it includes mobile voice communication at 0.18 yuan (US$0.023) per minute with no charges imposed on incoming calls. This program is a positive initiative in helping farmers to access useful information for efficient planning and production. However, the program would need to make further inroads into the inner rural regions where the economic gap is more pronounced.

6.2. ICT Literacy
Besides affordability issue, ICTs illiteracy is another major problem that contributes to the digital divide between the urban and rural areas. Although Internet access is the cheapest means of communication in China (refer to Table 3), the rural Internet users has lower education background as compared to urban Internet users (refer to Figure 2). Internet usage
has been associated with the educational level of Internet users, the higher the educational level the greater the use of Internet (CNNIC, 2008).

![Figure 2: Education level of Internet users](image)

Data source: China Internet Network Information Center (2007d).

Overall, schooling attrition rate is very high in the rural area. A survey conducted by a group of university students on rural education found that 56.3% of schooling attrition was due to financial reason, 37.5% due to lack of interest in studies, and 6.2% due to the belief held by the parents that their children had received sufficient education for their livelihood (“Current rural”, 2006). An anecdote that has been frequently used to describe the attrition rate in rural education was the “1, 2, 3 tragedy”, which refers to the situation where three classes of students at secondary one level dwindled to two classes when these students progress to secondary two in the next year, and ultimately, the school is left with only one class of students pursuing their secondary three level. The shortage of teachers and talents is a pertinent issue in the rural education system. In the remote rural area, students’ topics and areas of learning is based on what the teachers are capable of teaching rather than skills that the economy requires. The acute shortage of IT teaching staff in the rural area has a major impact on cultivating a pool of capable ICT users. A constant shortage of IT talents can potentially perpetuate a digital divide and a vicious cycle in income disparity.

7. CONCLUSION

China has been experiencing rapid economic growth since the 1980s. However, this growth enriches the urban population at a faster pace than the rural population, resulting in a widening of income gap between these regions. The Pearson’s correlation coefficients suggest that there has been a strong correlation in the development relationship between this income gap and adoption of ICTs such as telephone, personal computer, Internet, and mobile phone between 1985 and 2006. However, it appears that there was no significant relationship between the adoption of paging service and this income gap between 1985 and 2005 due to the maturity of this technology life cycle in the urban region, and its risk in disrupting with important aviation communications in the country.

This paper shows that the Chinese urban-rural digital gap remains wide as the disparity in income between these two regions grew. It will be difficult to close the digital
and income gaps if issues such as ICTs’ affordability and literacy issues remain unresolved. In addition, skewed investment policies favoring urban regions can reinforce social divisions and impact upon development of associated infrastructure and amenities for rural regions. Equal access to basic public services for rural population is an important condition for expanding domestic demand and maintaining steady and rapid economic growth. Therefore, it is important that there are concerted efforts from government and industry in channeling more resources to poor groups and regions. In particular, the high cost of ICTs to the rural users as a result of low earning power and the acute shortage of training resources in the rural area require government support and intervention. Otherwise, it will be difficult for the rural communities to integrate into the main stream of economic activities and catch up in economic development with their urban counterparts.

8. REFERENCES
Chinese Ministry Encourages Firms to Develop Rural IT Market. (2006) http://www.c114.net.cn

The Electronic Journal on Information Systems in Developing Countries
http://www.ejisdc.org
Current Rural Education in China through the Eyes of University Students. (2006)
http://www.zb.in.com/show.aspx?id=906&cid=128
Daly, J.A. (2003) ICT, Gender Equality and Empowering Women,
http://old.developmentgateway.org/node/133831/sdm/blob?pid=5233
Ding, Q. (2008) Intel Eyes China’s Rural Market, China Daily,
http://www.cncct.cn/info.asp?xxid=2007929160842
http://www.cttl.cn/scgc/sczs/t20060517_199149.htm
http://www.catr.cn/tecm/txaygl/200711/t20071107_648556.htm
People’s Daily (2000b) China Shuts Down 100 Channels of Wireless Paging
http://english.peopledaily.com.cn/english/200009/05/eng20000905_49730.html


