Telecommunications Policy 40 (2016) 102–115

Contents lists available at ScienceDirect

Telecommunications Policy

URL: www.elsevier.com/locate/telpol

The effects of ICT* on output per worker: A study of the Chinese economy

Ronald Ravinesh Kumar [a,b,*], Peter Josef Stauvermann [c], Aristeidis Samitas [d]

[a] FBE Green House, School of Accounting & Finance, Faculty of Business & Economics, Laucala Campus, The University of the South Pacific, Suva, Fiji
[b] School of Business, University of Bolton, Deane Road, Bolton BL3 5AB, UK
[c] School of Global Business & Economics, Changwon National University, Gyeongnam, 9, Sarim Dong, 641-773 Changwon, Republic of Korea
[d] Department of Business Administration, Business School, University of the Aegean, 8 Michalon street, Chios Island, Greece

ARTICLE INFO

Available online 7 July 2015

Keywords:
ICT* development
Fixed broadband
Mobile cellular
Internet
Telecommunication
Hi-tech exports
Economic growth
ARDL cointegration
Causality
China

ABSTRACT

In this paper, we explore the short-run and long-run contribution of five indicators of information and communication technology (ICT*) on economic growth of China over the sample period 1980–2013. We use the augmented Solow (1956) framework, the ARDL bounds (Pesaran, Shin, & Smith, 2001) approach to cointegration and the Toda and Yamamoto (1995) granger non-causality tests to examine the possible linkages. The results show evidence of long-run association among level variables for all the indicators of ICT*. From the results, we also note that all the indicators of ICT* have a positive and statistically significant elasticity coefficient ranging from 0.010 to 0.080. From the Granger causality results, we note bidirectional causality between mobile cellular, telecommunication and economic growth; and between mobile cellular, telecommunication and capital per worker, respectively. Other results indicate that fixed broadband cause capital accumulation; capital accumulation causes internet technology. We also note bidirectional causality between mobile cellular and telecommunication, and between fixed broadband and internet, respectively; and a unidirectional causality from internet and fixed broadband to hi-tech exports; and from mobile cellular and telecommunication to fixed broadband, respectively. From the overall results, within caveats, we highlight that while all the indicators of ICT* are imperative for long-run growth, besides capital per worker, the dominant technology drivers are mobile cellular and telecommunications technology.

1. Introduction

Since 1976, China has experienced an enormous increase of its gross domestic product (GDP) and an unprecedented growth in information and communications technology (ICT)*.[1] The average per capita income (constant 2005 prices)

* Corresponding author. Tel.: +679 3232638.
E-mail addresses: kumar_RN@usp.ac.fj, rrk1mpo@bolton.ac.uk, ronaldkmr15@gmail.com (R.R. Kumar), pstauvermann@t-online.de, pjsta@changwon.ac.kr (P.J. Stauvermann), a.samitas@ba.aegean.gr (A. Samitas).

[1] We associate an * to the information and communication technology (ICT) to indicate that ICT* is not only a broad term and comprises of a number of measures (Zhang & Liang, 2012), but a complex term to measure and can be "unpacked" by a number of proxies. In our case, ICT* is measured by the Internet users, mobile subscriptions, fixed broadband subscriptions, telecommunication lines and hi-tech exports.

http://dx.doi.org/10.1016/j.telpol.2015.06.004
0308-5961/

increased from US$175.36 (1970–1980) to US$3583.38 in 2013. In the same period, there was a marked increase in the ICT technologies. The first mobile phone was available in 1987 and in 1994 the internet age started in China (Loo, 2004). Until the middle of the 1990s the development of the telecommunication industry was led by the initiatives of the Ministry of Posts and Telecommunications. From this period onwards, China began to liberalize its telecommunication market slowly in line with reforms done to other sectors to effectively shift to market-oriented economy. The pace of the telecommunication market liberation increased as China sought to enter the World Trade Organization (WTO) and allowed domestic private companies to enter the telephone and internet services sector. However, it has remained from the past that only Chinese companies are allowed to participate in the market for telecommunication infrastructure internet service providers, and the market is protected by the state (Xia, 2010).

As part of the reform after accession to WTO, in 1998, the former Ministry of Posts and Telecommunications separated the postal operation from telecom operations, and telecom enterprises from government services resulting in the birth of real entities like China Telecom, China Netcom, China Mobile, China Unicom, China Railcom and China Satellite Communications with more than 4400 companies offering telecom value-added services and non-basic telecom services (Chen, Gao, & Tan, 2005). Furthermore, the drastic 2008 industry consolidation and government reform resulted in the reduction of the number of major industry players from six to three – that is, China Mobile, China Unicom, and China Telecom, and the merger of the former industry regulator, the Ministry of Information Industry, into Ministry of Industry and Information Technology (Xia, 2011).

Moreover, the inception of China's economic reforms over the last 30 years has shown promising results and the dynamism in the ICT* sector is notable (Meng & Li, 2002). Notably, China has become a computer production base for the rest of the world. The Chinese brand Lenovo which bought IBM's PC business in 2005 is the world biggest producer and supplier of personal computers (PC's). One of the biggest advantages of Chinese companies is the huge domestic market in which they can test the ICT products before offering them to the rest of the world. Moreover, the reforms initiated competition, attracted investment and technical innovation, reduced operational costs and improved the service quality in the telecom sector with a notable influence on the mobile communications (Chen et al., 2005). Further, the Open Policy since 1978 has resulted in a more than tenfold increase in fixed-line teledensity and the growth and popularity in mobile telecommunications and also superseded the fixed-line telephones. Similarly, the launch of the “Village Access Project” (VAP) in 2004 targeted the provision of basic telephone services and in the state's effort to “informatize” the rural areas (Loo & Ngan, 2012; Xia, 2007, 2010; Xia & Lu, 2008).

Similar developments are also noted in the entire consumer electronics world market because of the relatively low wages in China. Aggregating only the production quantity of consumer electronics and other electronic devices needed for telecommunication, China is the main production base of the world, because also the non-Chinese companies like Samsung, LG, Dell, Apple, Hewlett Packard among others manufacture all or a large proportion of their products in China. Besides the effects caused by the exports of ICT equipment, we also should expect in China that an increasing income leads to a rising domestic demand for ICT equipment like PCs, mobile phones, telecommunication services and so on, which in turn leads to more investments in the ICT equipment producing industry and therefore to a higher income.

In this paper we investigate the role of ICT* on the economic growth of China. We interpret investments in ICT as investments in a ‘general purpose technology’ or ‘generic technology’ in the sense of Breshnan and Trajtenberg (1995). Investments in this kind of technologies have mostly a much stronger impact on the economic performance of a country than traditional investments in capital, because very often general purpose technologies induce complementary innovations. Therefore, it can be expected that investments in generic technologies create positive externalities to some extent. At the microeconomic level, investments in ICT enable firms to increase its productivity and henceforth its production efficiency. If all firms in an industry adopt ICT technologies, the prices of the goods and services produced in this industry decline and the quantities produced increase (Oz, 2005). However, the effect of ICT on productivity of a firm can differ depending on how information intensive the firm is. Communication technologies imply in addition network externalities; the more firms and consumers are connected to a network, the higher will be the rate of return of investments in these communication technologies. However, if the generic technologies are sufficiently widespread the network externalities will probably vanish.

As a result, investments in ICT lead at the macroeconomic level to a rise of the total factor productivity, where the scale of the increase depends on the availability of skilled labor and experience. With respect to the question how to operationalize the effects of ICT investments, it seems to be reasonable to use indicators instead of taking the value of ICT investments into account. The reason is given by Yorukoglu (1998) who argued that ICT's pace of technological improvement is much higher than other capital goods and as a consequence, ICT capital and non-ICT capital are of poor compatibility. Additionally, by using other indicators for ICT investments than the value of ICT capital, the Solow-paradox[2] can be circumvented.

Subsequently, the main contributions of this paper are in terms of (a) methodology, where we show the application of augmented Solow (1956) framework to examine the ICT* impact; (b) examination of the short-run and long-run elasticity coefficients (magnitudes) of various indicators of ICT* and causality nexus using widely accepted tools in econometrics (ARDL bounds approach to cointegration) (Pesaran et al., 2001; Pesaran & Pesaran, 2009) and Toda and Yamamoto (1995) Granger non-causality tests. From the literature, there are no prior studies done on the Chinese economy that have looked at these aspects in particular. We intend to modestly contribute to the literature in this regard and highlight the momentous

[2] Solow (1987) remarked, “You can see the computer age everywhere, but in the productivity statistics.”