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A study on the correlation between technology innovation and the new-type urbanization in Shaanxi province

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ABSTRACT

In the past three decades, China has experienced vigorous urbanization. However, the economy-centered urbanization caused social issues and is being replaced by the new-type people-centered urbanization. Technology innovation plays a key role in urbanization. Previous studies examine the relationship between technology innovation and the traditional economy-centered urbanization. But the relationship between technology innovation and the new-type people-centered urbanization remains unknown. As such, this paper develops a comprehensive evaluation index system for technology innovation and the new-type urbanization based on the data from Shaanxi province between 2000 and 2014. A variation coefficient method is applied to determine the weight of each index. Then a model is proposed and tested. At the end, conclusions are reached based on the results of the tests on the model. Recommendations for dealing with technology innovation and the new-type urbanization are provided.

1. Introduction

Urbanization is an integral element of rapid income growth and industrialization throughout the world (Fan, 2017; Feng and Xu, 1992, Feng, 1993, Feng and Xu, 2000; Henderson et al., 2009). According to United Nations (2010), 70% of the world's population will live in cities in 2030. Technology innovation plays an important role in the process of urbanization. For example, urbanization in the U.K. began at the time when the first technological revolution occurred. During the second and the third technological revolutions, urbanization processed quickly in the U.S. The continuous introduction of foreign technologies and continuous innovation from 1950s to 1970s changed Japan into a science, technology and economic power. The urbanization rate in Japan rose quickly from 33% to 70% in this period. In recent years, industry development has been driven by advanced ICT including IoT (Internet of Things) (Gürdür and Asplund, 2018; Kim, 2017; Li et al., 2015, Li et al., 2018; Oliverio, 2018; Wang et al., 2016; Viriyasitavat and Martin, 2017). Because manufacturing and service production are more efficient when undertaken in urbanized areas, urbanization is critical to the success of modernization (Henderson et al., 2009). Urbanization changes population distribution, production mode, life style, and ecological environment.

China's urbanization has been a notable global event (Li, 2013, 2017; Li and Zhou, 2013). In the past three decades, market reform and globalization drove dramatic growth and structural changes in the Chinese economy, society, and spatial organization (Lin and Yi, 2011). As economy grows, China is experiencing a massive rural-urban migration and expansion of cities and towns (Fan, 2008; Henderson et al., 2009; Hsing, 2010; Lin, 2009; McGee et al., 2007). In 2013, China's urbanization rate rose to 53.7%, with an urban resident population of 770 million (Wang et al., 2015). However, compared with developed countries which have an average urbanization rate of 80%, the urbanization rate in China is still low.

Rapid urbanization has put significant stress on city infrastructure because it may lead to a reduced per-capita access to subsistence resources in urban areas (Homer-Dixon, 1999; Homer-Dixon and Blitt, 1998). According to Buhaug and Urdal (2013), rapid urbanization can seriously constrain local governments' ability to provide basic public services, including employment, education, housing, electricity, water, sanitation, healthcare, enforcement of law and order. In order to reduce costs, improve efficiencies, and deliver the quality of life, cities rely more on information and communications technology and new working practices (Naphade et al., 2011). As Nam and Pardo (2011a) point out, the smart city approach is emerging as a way to solve tangled and wicked problems inherited in the rapid urbanization (Nam & Pardo, 2011). However, the transformation to smart cities require innovation

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in technologies, planning, management, and operation (Naphade et al., 2011). According to Porter (2011), innovation driven development stage is an important stage of economic modernization.

In China, the traditional economy-centered urbanization has created notable economic and social benefits as well as adverse impacts, such as the loss of arable land, the phenomenon of ghost cities, and the urban heat island effect (Chan, 2014; Chen et al., 2016). Thus, the National New Urbanization Plan (2014–2020) unveiled by the Chinese Central Government revealed a new path for urbanization (Chen et al., 2016). Different from the traditional economy-centered urbanization, the new-type urbanization is people oriented and places more emphasis on the universal coverage of social and public services, the service economy, the integration of local culture and urban development, ecological and environmental protection, and innovation in urban and rural management (Fang et al., 2015).

So far research on urbanization through the lens of integrating technology innovation and urbanization are missing. Accordingly, this paper develops a comprehensive evaluation index system for technology innovation and the new-type urbanization. After data from Shaanxi province between 2000 and 2014 are loaded into this index system, a variation coefficient method is applied to calculate the comprehensive level of technology innovation and the new-type urbanization. Then a model is proposed to describe the relationship between technology innovation and the new-type urbanization. Tests are performed to examine the proposed model. Finally, conclusions are reached based on the results of the tests on the model. Recommendations for dealing with technology innovation and the new-type urbanization are provided.

2. Literature review

Urbanization is the increase in the urban share of the total population (Henderson et al., 2009). It is the result of natural agglomeration of population (Zhou, 2015). According to Buhaug and Urdal (2013), urbanization is driven by reproduction rate, rural-urban migration, and reclassification of rural land. Rural-to-urban migration is the consequence of high and increasing population pressure on scarcity of renewable resources (Homer-Dixon, 2010) as well as labor moving from under-employment in low-productivity rural activities to full employment in higher-productivity urban manufacturing activities (Henderson et al., 2009). In recent years, advanced ICT including IoT (Internet of Things) facilitate industrialization across the world (Bi et al., 2014; Chen, 2017; Cheng et al., 2018; Duan and Binbasioglu, 2017; Lu, 2017; Xu, 2011, 2016a; Wu et al., 2009; Xu and Duan, 2018; Xu et al., 2014; Xu et al., 2018; Xu and Viriyasitavat, 2014; Xu et al., 2017; Xu et al., 2018; Yang et al., 2017). Urbanization becomes critical to the success of modernization because manufacturing and service are more efficient when they are undertaken in urbanized areas (Henderson et al., 2009).

With increasing urban populations and expanding industrial activities, China has experienced vigorous land urbanization and an uneven population distribution pattern since 1978 (Chen et al., 2016). The rapid and unprecedented process of urbanization was created by the history's largest flow of rural-urban migration in the world (Lin and Yi, 2011). During the period of 1978–2013, China's urban population has risen from 170 million to 730 million, and the level of urbanization has reached 53.7% in 2013(Wang et al., 2015). Rural-urban migration has made dominant contributions to Chinese urban population growth (Zhang and Song, 2003), and reshapes the economic, demographic, and social landscapes of the Chinese city and countryside (Fan, 2008).

However, rapid population growth in urban areas causes cities to face a variety of risks, concerns, and problems, including deteriorating conditions in air and transportation and unemployment (Nam and Pardo, 2011b). In China, rapid urbanization causes issues such as big city malaise, unbalanced regional development, and urban-rural contradictions (Chan and Hu, 2003; Fan, 2008; Zhou and Ma, 2003; Pannell, 2002). Urbanization, economic growth, technological progress, and environmental sustainability drive cities to become smarter in managing their infrastructure and resources to cater to the existing and future needs (Naphade et al., 2011). The rapid urban population growth requires sustainable development and better livability (Nam and Pardo, 2011a). Making a city smart has recently emerged as a model to mitigate and remedy current urban problems and make cities better as places to live (Nam and Pardo, 2011b). To achieve sustainable development, Chinese government has adopted an innovation driven development strategy, which applies technological innovation to support social productivity and comprehensive national strength (He, 2014).

According to Toppeta (2010), a smart city combines information and communication technology (ICT) and Web 2.0 technology (He et al., 2009) with other organizational, design and planning efforts to speed up bureaucratic processes and to identify new, innovative solutions for improving sustainability and livability. Smartness in the urban context indicates utilizing cutting-edge of ICT as well as importantly management and policy concerns (Nam and Pardo, 2011b). A smart city supports long-standing practices for running the city in a more efficient way, making the city perceptual, interconnected and intelligent, and improving the quality of life based on advances in ICTs and infrastructures (Harrison et al., 2010).

Infrastructures are central to a smart city. A smart city relies on combination, connection and integration of systems and infrastructures (Al-Hader and Rodzi, 2009). The competitiveness of a city relies on its ability to continuously develop, accumulate, and exploit specialized knowledge assets (Herstad et al., 2011). A city gains competitive advantages by developing information processing and knowledge diffusion infrastructures (Simmie, 2003), and linking a set of technologically related and globally networked actors and industries (Frenken et al., 2007; Giuliani and Bell, 2005; Graf, 2010; Lazaric et al., 2008). In specific, innovation is a primary source of economic growth, industrial change, competitive advantage, and public service (Beckett and Vachhrajani, 2017; Boyne et al., 2006; Christensen et al., 2004; Hisrich et al., 2016; Tidd et al., 2001; Xu et al., 2016).

Technology is key to being a smart city because ICT can transform life and work within a city significantly and fundamentally (Hollands, 2008). Smartness in the technology context implies the automatic computing principle like self-configuration, self-healing, self-protection, and self-optimization (Spangler et al., 2010). By integrating complex organizational and physical systems, technology innovation can help model and simulate the implications of decisions in cities (Dodgson and Gann, 2011). Technology innovation is “a mechanism to change and upgrade technological tools to improve services and create conditions where the tools can be better used” (Nam and Pardo, 2011b, p187). The drivers of technology innovation are primarily reduction in delivery time, increase in operational flexibility, and lowering of production costs (Boer and During, 2001). According to Damanpour et al. (2009), technological innovations are directly related to the primary work activity of the organization and mainly produce changes in its operating systems. A smart city can be considered as a contextualized interplay among technological innovation, managerial and organizational innovation, and policy innovation (Ianuale et al., 2015; Nam and Pardo, 2011b).

Rapid urbanization stimulates innovations (Dodgson and Gann, 2011). Urban areas are the major contributors to the supply of and demand for innovation (Simmie, 2001). Cities are generally portrayed as centers of innovation (Isaksen and Aslesen, 2001; Simmie, 2004). Creativity is the heart of innovation and successful innovation activities positively contribute to an urban region's economic competitiveness (Krätke, 2012). Cities have fostered creative systems that multiply the capacity for networking and encourage the generation of knowledge and innovation (Camagni and Capello, 1999). In cities, it is easier for firms to learn from other firms about new technologies, to hire the workers with the exact skills they need, and to purchase and transport intermediate inputs (Duranton and Puga, 2004; Rosenthal and Strange, 2004). Cities provide the environment for incubating innovations and