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Research Article

Winners in the urban champions league – A performance assessment of Japanese cities by means of dynamic and super-efficient DEA☆

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ABSTRACT

This paper aims to provide an advanced dynamic efficiency assessment methodology for city performance strategies in Japan, based on an extended and super-efficient Data Envelopment Analysis (DEA). The use of this novel efficiency-improving approach originates from earlier research based on the so-called Distance Friction Minimisation (DFM) method. In the present study we develop a new multi-period model from a blend of a Target-Oriented (TO) DFM model including a dynamic approach. This new model is able to present a more realistic efficiency improvement projection comprising a dynamic system of target-settings to achieve a target improvement level so as to programme more realistic policy actions. The above-mentioned Dynamic TO-DFM model will be applied to and tested for a multi-dimensional efficiency assessment of several large Japanese cities. In this study, we consider due to comparative data limitations, two inputs (population and city budget) and two outputs (GDP and tax revenues). Based on these items, this study assesses the relative economic performance of 16 Japanese big cities by means of the above described, extended super-efficient DEA model. Finally, we present an efficiency improvement programme based on the Dynamic TO-DFM model for enhancing the position of inefficient cites.

1. Introduction

Japan -like many other Asian countries- shows a high degree of spatial and demographic dynamics. Compared to other nations in Asia, the Japanese economy is characterized by quite some turbulence in the past decades. We will briefly illustrate the dynamics in the Asian countries based on population changes as presented in Fig. 1. We have chosen this demographic information, as this is a relatively easy variable to predict over a relatively long time period.

From Fig. 1, it can easily be seen that Japan is already in a transition process towards a depopulating society as a result of the structural ageing process. Korea, Thailand and China will also become depopulating nations in the period 2020 to 2040, while other countries will sooner or later also show a downward trend in the rate of population growth (for more detail, see Suzuki and Nijkamp (2017b)). It should be added that the spatial distribution of people – despite declining growth rates of the population- is not showing a stable pattern over the past decades. On the contrary, we observe that an increasing share of people lives in urban areas (the so-

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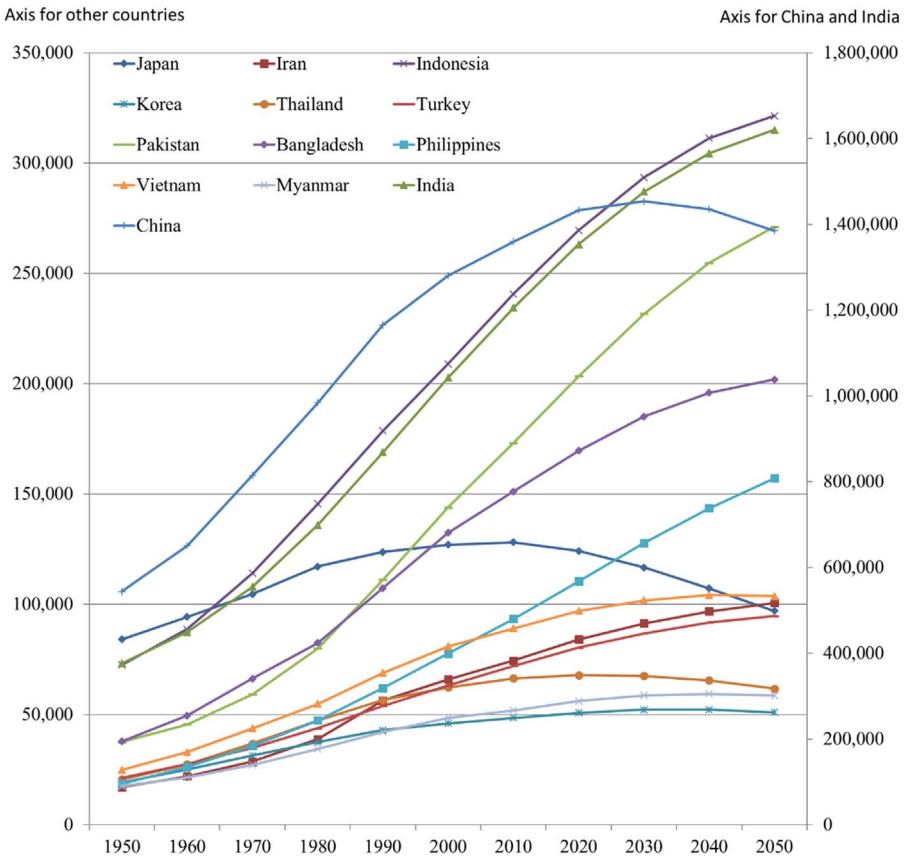

Fig. 1. Population change in Asia (1000 persons).
Source: UN, World Population Prospects: 2012 Revision

called '*new urban world*'; see Kourtit (2015)). Thus, population decline and urbanization rise appear to become two parallel phenomena. Consequently, the position of cities is becoming more strategic in this new and dynamic societal development.

We live nowadays in the '*urban century*', in which the role of urban systems is becoming more and more dominant. The megatrend of structural population concentration in urban areas does clearly not come to a standstill, even not in a depopulating nation like Japan. The unprecedented increases in urban population in Japan - and all over the world - have close links with the magnet position and the economic performance of cities. And therefore, it is important to assess the real socio-economic performance of urban agglomerations. An urban agglomeration comprises not only the central city, but also its suburban areas that form a functional unity with the city concerned.

There is an avalanche of literature on the driving forces of urban agglomerations (see for an overview Barufi and Kourtit (2015)). Most explanations for the emergent dominance of cities and urban agglomerations stem from economic arguments related to spatial-economic externalities. But it should be added that also sociological explanations (ranging from Weber (1947) to Sassen (1991)) and institutional explanations (see Scott (2003)) have been provided to understand the backgrounds and force fields of modern urbanization phenomena.

The growth of cities is historically explained from the presence of agglomeration economies, in particular Marshall-Arrow-Romer (MAR) externalities, Jacobs externalities and Porter externalities. It is also often assumed that such positive returns to scale may be affected by negative externalities, such as environmental pollution, high energy consumption, traffic congestion, etc. Clearly, such negative factors are abundantly present in an urban economy, but if one corrects these phenomena for population size, joint use of alternative energy generation or supply (e.g., CHP, solar installations, etc.), or degree of technological innovation, one often finds that urban agglomerations are rather efficient ecological entities, compared to a completely dispersed pattern of the population.

In recent years, many efforts have been made to create a classification or ranking of cities based on their actual performance or their perceived success (see e.g. Taylor et al., 2009, Grosveld, 2002, Arribas-Bel, Nijkamp & Scholten, 2011; Kourtit, Nijkamp & Arribas-Bel, 2012). A main challenge in current empirical research is the creation of a consistent, quantitative database that is suitable for a comparative, strategic urban benchmark analysis. In the extant literature on comparisons of cities one finds a great diversity of such approaches. Urban efficiency performance has been assessed from a broad standpoint based on various quantitative models (Qiu, Xu & Zhang, 2015, Hao, Zhu & Zhong (2015), Saaty & Sagir, 2015, Guan & Peter G. Rowe, 2016 and Lalehpour (2016)).

The measurement of urban performance calls for an appropriate methodological approach, in which the output-input ratio of cities will be interpreted as a performance measure (in economics usually called efficiency or productivity). The assessment of urban