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Aging, Urbanization, and Energy Intensity based on Cross-national Panel Data

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Abstract

On the basis of an unbalanced cross-national panel, this study employs the two-way fix-effects model to investigate the impact and effects of aging and urbanization on energy intensity. Estimation results show that aging has a negative effect on energy intensity, whereas urbanization has a positive effect on energy intensity. Empirical results also show that GDP per capita, overall productivity, and energy price have significant negative impacts on energy intensity. In addition, we find no empirical evidence of the general influence of foreign direct investment (FDI) on energy intensity. In the comparison of the classification of developed and developing countries, we further validate the previous results. Thus, this study provides a reference for governments in reducing energy intensity and improving governance.

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Keyworks: Aging; Urbanization; Energy intensity

1. Introduction

Energy is a driving force of national economic development. Reducing energy consumption and conserving limited resources are important factors in ensuring sustainable national development. Thus, the impact of population aging and urbanization on national energy consumption and the energy policy is worthy of attention. Population aging has an impact on economic growth, per capita consumption level, and productivity level of a country [1-2]. Urbanization affects the development of a country's industrial process and service industry [3]. The aging and urbanization of the objective development trend is bound to affect the country's energy consumption and energy policy. We choose energy intensity as the starting point of this study to identify the effect of aging and urbanization.

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The rest of this paper is organized as follows. Section 2 briefly reviews the literature on energy intensity. Section 3 presents the hypotheses and methodology. Section 4 shows the results of empirical estimation. Section 5 concludes the paper and discusses future research.

2. Literature review

Several researchers have examined the link between age structure and energy consumption. People in different age groups or at different stages in life have different levels of economic activities. These consumption patterns induce variations in their indirect energy requirements because of the energy embodied in different consumer goods [4-5]. Using micro-level data, researchers have shown that activities, such as transport and residential energy consumption, vary according to age structure [6-7]. Liddle determined that for transport energy consumption, young adults (20–34) have a positive coefficient, whereas the other age groups all have negative coefficients. Age structure has a U-shaped impact on residential electricity consumption, given that the youngest and oldest (20–34 and 70 and older) have positive coefficients, whereas the middle cohorts (35–49 and 50–69) have negative coefficients [8]. Liddle and Lung similarly found that people who travel have a U-shaped lifecycle with respect to energy intensity. That is, they have a relatively energy-intensive lifestyle in early adulthood and as they enter the "retirement age" or grow older than 65, but have a relatively non-energy-intensive lifestyle during "middle age" (35–64) [9].

Several studies have considered the relationship between urbanization and energy intensity. Jones and Madlener and Sunak documented the channels through which urbanization can affect energy intensity [10-11]. Using heterogeneous panel settings, Sadorsky discovered mixed results with respect to the impact of urbanization on energy intensity in 76 developing countries from 1980 to 2010 [12]. A weak relationship exists between energy intensity and urbanization, which is consistent with the findings of Krey et al. and O'Neil et al. [13-14]. Liu and Xie examined the relationship between urbanization and energy intensity using the time series data of 1978–2010 in China and revealed non-linear causal relationships between these two variables [15]. Several studies have also highlighted that the positive effect of urbanization on energy intensity. Ma studied the effects of urbanization on energy intensity, coal intensity and electricity intensity in China and revealed through empirical findings that urbanization has no effect on coal intensity but has positive effects on energy intensity and electricity intensity [16]. Rafiq et al. found that urbanization significantly increases energy intensity in emerging economies [17]. On the contrary, on the basis of the panel data analyses of 10 Asian countries for the period 1990–2014, Bilgili et al. found that urbanization has a negative impact on energy intensity [18]. They reported that urbanization path increases energy productivity by diminishing the energy intensity in Asian panel models.

3. Methodology

3.1. Hypotheses

To explore the influence and effects of aging and urbanization on energy intensity, we provide the following hypotheses:

H1: Aging decreases energy intensity. Compared to young people, old people have less transport energy consumption and engage less in social and economic activities, which in turn decreases energy intensity.

H2: Urbanization increases energy intensity. First, urbanization moves a huge part of the labor force from the agricultural sector in rural areas to the industry sector in urban areas. The industry sector is highly energy-intensive [12]. Second, urbanization attracts more energy-intensive activities, such as those that use electrical appliances, enhance passenger mobility, and raise inner city transportation [19]. Lastly, urbanization increases construction activities and infrastructure expenditures, which exerts an upward pressure on energy intensity [18].