China Economic Review 23 (2012) 1011–1019

Contents lists available at SciVerse ScienceDirect

China Economic Review

Impact of demographic dynamics on food consumption — A case study of energy intake in China

Funing ZHONG, Jing XIANG, Jing ZHU *

College of Economics and Management, Nanjing Agricultural University, No. 1 Weigang Road, Nanjing, 210095, China

ARTICLE INFO

Article history:
Received 29 March 2011
Received in revised form 7 May 2012
Accepted 13 May 2012
Available online 24 May 2012

JEL Classifications:
Q18
Q13
Q11

Keywords:
Demographic change
Energy intake
Adult Male Equivalent
Food demand
China

ABSTRACT

Most existing studies of food demand focus on economic factors, such as income and price. Physical factors which determine human energy intake requirement, given economic conditions, such as gender and age structures of the population as well as occupation, are usually not incorporated. While this is appropriate in the situation of a continuous, stable development of demographic structure, it might lead to biased result if drastic and irregular demographic changes have taken place. This paper provides a case study of China of the impact of demographic dynamics on the change of physical requirement and energy intake demand. The unique population pyramid in China, resulted from the big famine in the early 1960s and then the "One Child" policy" starting from the 1980s, has led to the irregular evolution of age groups and the consequent changes in the proportion of the "big-eaters". As a result, given food price and income, the very age structure of the population at the time affects the overall weighted energy intake level of the population significantly. Using household survey data ranging from year 1991 to 2009, the index of Adult Male Equivalent Scale (AMES) is constructed to reflect the varying per capita physical requirement resulted from the demographic dynamic over the years in China. The AMES index, together with food price and income, has been applied to the per capita energy intake model. The empirical results show that the AMES index has statically strong impact on per capita energy intake, and the inclusion of the AMES index into the model has improved the model fitness. This finding sheds light on a possible way for improvement in projecting China's food demand in the future by incorporating the country's changing demographic factors.

1. Introduction

Food security has long been a hot topic in both academic study and policy debate, though the attention may be largely influenced by world market situations. After only two years from the 2008 world food crisis, grain price in the world market has reached the historical level again since late 2010. How to understand the evolution of past supply and demand and how to project their future trends once again become a focal point in both academic and policy making communities. This paper is trying to provide a new framework to measure per capita food demand by incorporating demographic factors, in order to improve the understanding and projection of per capita food demand in a changing world.

Based on economic theory, most existing studies of food demand focus on economic factors, such as income and price. Changing dietary pattern is taken as an important factor, as a shift of food consumption from cereals to meat will require much more grain to be consumed indirectly as feed. However, the changing diet, no matter associated with urbanization or not, is also basically determined by economic factors (See for examples, Rosegrant, Agcaoili-Sombilla & Perez, 1995; Mellor, 1983; Mellor & Johnston, 1984; Alexandratos, 1997; Fan, Wailes & Cramer, 1995; Yen, Fang & Su, 2004). As such, physical factors which

* Corresponding author. Tel.: +86 25 84395739; fax: +86 25 84395649.
E-mail addresses: fnzhong@njau.edu.cn (F. Zhong), xiangjing19850726@126.com (J. Xiang), crystalzhu@njau.edu.cn (J. Zhu).

1043-951X/$ – see front matter © 2012 Elsevier Inc. All rights reserved.
doi:10.1016/j.chieco.2012.05.005

determine human energy intake requirement given economic conditions, such as gender and age structures of the population as well as occupation, are usually neglected. The understanding and explanation of food demand dynamics will be incomplete without considering these demographic factors in a fast changing world, and the projection of food demand into the future might be biased.

India and China are two countries exhibiting fast economic growth and declining per capita calorie intake (Deaton & Dreze, 2009; Du et al., 2002; Meng et al., 2009).[1] These interesting observations seem to be contradictory to the conventional theory of food demand and worth further exploration. According to Deaton and Dreze, one explanation to the puzzle is the reduction in physical activity which led to lower level for energy intake requirement. Similarly, Carter, Zhong and Zhu (2009) have explained the stagnated per capita food consumption in China with some demographic factors, such as occupation and age structures. It is believed that although consumers in each social/demographic group increase their food consumption following income growth, the weighted average consumption level may still decline if a large portion of consumers has shifted away from demographic groups requiring higher calorie intake to that require less energy intake.

This paper will further explore to what extent the demographic change, i.e., the changing age structure, could explain the seemingly contradiction between per capita income and calorie intake with Chinese situation as a case study. There are two reasons to conduct such a country study. First, the aging is rather significant in China, as the percentage of aging population (65+, who requires relatively less daily energy intake) reached 8.5% in 2009 from 6.2% in 1995 (NBS, 2011), while that of 15–29 year group (big eaters) declined from 26% to 21% during the same time period. Second, the Chinese population pyramid is rather irregular due to the big famine in the early 1960s and the "one child" policy implemented since the 1980s. It is believed that a relatively larger variation in Chinese population structure may provide clearer picture in understanding the relationship between population structure and energy intake.

While aging is a worldwide phenomenon negatively impact per capita energy intake and hence food consumption, the irregular population pyramid is unique in China that may lead to long term swing in per capita food consumption. The big famine in the early 1960s led to a gap of some 30 millions in corresponding age groups; accompanied with "one child" policy, an even larger gap appeared in age groups born in 1980s. This pattern of swing in population pyramid is likely to continue, at least for some years, and result in up-and-downs in per capita food consumption. When the big gap in population pyramid appears in age group with less energy intake requirement, the average food consumption for the total population may be pushed up; on the contrary, when the gap moves to age groups requiring higher energy intake, the average food consumption will be dragged down.

It is expected that including age structure, along with income and price, in modeling Chinese food consumption will not only improve explanations of past behavior, but, more importantly, also improve future projections. It is also expected that the unique Chinese experience may provide better understanding of the impact of age structure on food consumption with significant variations in long term evolution in the population, and that might be useful to apply in other countries/regions.

2. Analytical framework

It is reasonable to assume that daily energy intake requirements are partly determined by age and gender, given price and per capita income, due to physical conditions. Therefore, any significant change in household composition or population structure may alter total energy intake and hence the quantity of food consumed even the size of household or population maintaining constant. Furthermore, for a nation as a whole, if the shape of a population pyramid is significantly changed in one period, the irregular shape might appear again later through the population reproduction process, and food demand might exhibit long term up and down swings as a result. It is the case in China since the early 1960s, and Fig. 1 is constructed with data from Chinese population statistics.

It is evident that the big famine in the early 1960s has resulted in a big gap among the age group born in the three years of 1961–63. The gap reappears in a larger scale among age groups centered at those born in 1980, and then even bigger gap centering around those born in 2000. When the gap is at bottom as in the 1980s, the weighted average energy intake per capita is likely to be greater than that under a normal-shaped population pyramid, as the part of population requires low daily energy intake is less than proportional. However, when the gap (or one of the gaps) moves up to the ages require high daily energy intake, the weighted average might be less than that under normal population structure. The irregular population pyramid suggests that persons at different ages and of different genders should be converted into a kind of standardized index in order to estimate the effect of population structure on food demand, and to project de future demand, with more accuracy.

This concept of converting all persons into a standardized index is not new. According to Lewbel (1985), "Equivalent scales originated with Engel (1893)", and "Commodity specific demographic effects may be traced back to Sydenstricker and King (1921)". Following these pioneer study, effects have been made to incorporate a new variable, namely, Adult Equivalent Scales, into commodity demand models at family levels, in order to better understand and describe household behavior. (See for examples, Prais & Houthakker, 1955; Barten, 1964; Buse & Salathe, 1978; Pollak & Wales, 1981; Gould & Villarreal, 2002.) Most of these and similar studies focus on explaining demographic effects, such as age, gender, and family size on household consumption behaviors, especially expenditures on specific commodities. These studies usually construct their own adult equivalent scales based on empirical estimations first, and then apply the estimated scales in demand functions to estimate the effects of age, gender, and family size on demand for specific commodities.

[1] The reduction of energy intake over time in China is also documented in Appendix of this paper.