

POPULATION FLOW, SPATIAL DEPENDENCE AND DAIRY CONSUMPTION-ANALYSYS BASED ON CHINA'S PROVINCIAL

Jia Shushuai

National Institute of Development Administration

ABSTRACT

Based on the perspective of population mobility, this study analyzes changes in the pattern of dairy product consumption in China and the impact of population movement on dairy consumption since 2000. The study explores market factors such as per capita disposable income and market prices, and explains the relationship between population movements and dairy consumption needs and regional consumption changes. The results of the study show that variations in market size have been brought about by population movement leading to a positive impact on the regional patterns of consumption and the elasticity of regional consumption demand for dairy products. From the perspective of regional distribution, the elasticity of consumption demand for dairy products is calculated by size. On this assumption, this study suggests policy recommendations in favor of promoting the development of the dairy industry and revitalization of the national industry.

Keywords: Dairy consumption, Population mobility, Regional consumption pattern

Introduction

Before the beginning of the “reform and opening-up” in 1978, China implemented a strict household registration control system, and population movements were relatively static. After the reform and opening-up, the strict household registration system was not adapted to the development of the market economic system; however, in 1984 the State Council issued regulations allowing peasants to leave the land and work, engage in business, and provide commercial services in urban areas. At the same time, other barriers to population movements began to relax, creating the conditions for the large-scale movement of the population. Since then, China has entered a period of active population movement, especially during the 1990s. The national census and the 1% national population sample survey data show that the size of the country's floating

population has increased from 6.57 million in 1982 to approximately 246 million in 2015, predominantly moving from countryside villages to the cities. According to the results of the sixth national census in 2010, 150 million members of the floating population came from rural areas, 54% of the population in the province, and 82% of the rural population in the inter-provincial population. In the 1980s and early 1990s, the Pearl River Delta and other developed coastal cities were the main areas of population inflows. Since the beginning of the 21st century, the population inflow in the Yangtze River Delta has grown faster than the Pearl River Delta region. With the in-depth implementation of non-equilibrium regional policies and the development of regional central cities, the Beijing-Tianjin-Hebei region continues to attract population inflows (Chen, 2005; Liu & Zhong, 2009).

The difference in consumption of dairy products between urban and rural areas in China is greatly influenced by local economic development, eating habits, and population structure. Dairy statistics show that regional differences in dairy product consumption are not directly related to economic geographical distribution. From the perspective of the distribution of urban residents' consumption, the characteristics of "two highs and one low" with high levels of consumption in western minority towns with in modern cities and towns with the inertia of dairy products, lower in high-yield urban areas of undeveloped areas and southeastern regions of China, where the consumption of agricultural products is low.

At the same time, the consumption of dairy products of urban residents in Shanghai, Tibet and Beijing is above the national average and belongs to the main market for urban dairy product sales. Due to the distribution of rural residents' consumption, high-consumption areas are mostly in the northwest and other economically developed areas, such as Beijing and Tibet. In 2014, rural residents in Tibet had the highest consumption, with a per capita consumption of 38.3 kg. The consumption of dairy products by rural residents was the lowest in Hainan, with a per capita consumption was 0.5 kg. Therefore, the relationship between dairy consumption and regional food habits and preferences of rural residents has a strong relationship, but a weak correlation with absolute income. In comparison, the consumption level of dairy products in rural areas is high, but lower in cities and towns (Cheng & Ren, 2018).

Research Objectives and Expected Benefits

This study focuses on the factors of domestic dairy consumption of Chinese, particularly

the characteristics of population movement and spatial dependence.

To achieve its goal and in consideration of the availability of data, the research was conducted from a provincial level perspective. This report consists of five parts, beginning with the introduction outlining the research and the necessity to study the problem. Also, related research is summarized and the approach to the research explained. Secondly, regional differences and population flow characteristics of dairy product consumption are introduced divided into two parts: regional differences and population flow characteristics, providing an overview of the situation of dairy product consumption in China. After that is the research methodology which employs a spatial fixed effect model to investigate the characteristics of the evolution of dairy product consumption. The fourth part consists of a statistical description of dairy consumption levels describing spatial correlations. An index of global spatial autocorrelation is used to measure characteristics of the adjacent spatial unit. The last part is the conclusions and policy recommendations.

Literature Review

In 2016, the central government of China actively promoted the structural optimization of domestic industries, or the adjustment of economic structure. Therefore, over the coming several years, the domestic consumption structure will change. Under the current structural reform of agricultural supply and the great opportunity presented by the revitalization of China's national dairy industry, it is important to analyze the factors affecting the demand for dairy products, the response to these factors, and the evolution of demand to further explore the quality and efficiency of the

dairy industry and stabilize the market function mechanism. Taking food consumption as an example, academic research on food consumption structure of residents can be divided into three categories: the description of the food consumption structure of residents; the changes of residents' food consumption structure; and the study of foreign food consumption structure effects on domestic food consumption and how it influences the structure of Chinese food consumption.

Lin (1991) carried out a descriptive analysis of changes in China's food consumption structure since the 1980s, analyzing reasons for the changes. The researcher believed that the development of industrialization, urbanization and the growth of residents' income were the main reasons for changes in the structure of food consumption. Huang (1997) investigated the adjustment of food consumption structure of residents, particularly in Guangdong Province, analyzing the problems of food consumption structure from the perspective of nutrition. Wang (2000) also studied that the changes in food consumption structure of urban and rural residents in 1987 and 1997 according to the input-output table. Feng and Shi (2006) researched that the changes in food consumption and consumption structure of urban and rural residents in China since 1978 and analyzed the coefficient of elasticity, and found that the protein intake of urban residents in China was relatively low, and the fat intake exceeds Chinese standards; however, both protein and fat consumed by rural residents were lower.

Huang and Yi (1999) established a food consumption structure model with the Linear Expenditure System (LES) and the Extended Linear Expenditure System (ELES), and conducted an empirical analysis of the main food consumption of urban residents in China,

arguing that urban residents following income and expenditure increase, will increase purchases of fruit and animals. Wang (2001) used an input-output analysis model to scrutinize the quantity of food expenditure per consumer on the food system, and the extent to which changes in food consumption structure effected the income of different sectors.

Maji (2002) used the ELES and found that urban residents have greater consumption potential for milk, melons, fruits, wines and other beverages; urban residents' food consumption is eating from a lower level of eating. The researcher stated that there is a higher level of transition among those with newly increased income, and that in the eastern region the consumption of beans, aquatic products and food is predominate; while in the central and western regions, the consumption of meat, poultry, vegetables, fruit, milk, wine and beverages are predominate; an in the western region, the consumption of eggs is predominate. Furthermore, urban residents in the eastern region are sensitive to food prices; residents of the central region are sensitive to meat and poultry prices; and residents of the western region are sensitive to melon and fruit prices.

Cai (2009) used the ELES to study changes in characteristics of urban residents' consumption structure in Chongqing, showing that the differences in consumption structure levels of different income groups are becoming more and more obvious; and the consumption structure has changed from quantity expansion to quality improvement. Zhang (2010) applied the AIDS model with family attributes to analyze the consumption behaviors of low-income, middle-low income, middle-income, and high-income groups of urban residents. It was found that

the consumption structure and consumption behavior of different income groups were clearly different. Wang (2012) used the ratio semi-log inverse function (RSLI) model to study the upgrading of food consumption structure of residents of different income groups in China's cities and towns. It is believed that the changes in residents' food consumption structure basically reflect the improvement from consumption of the energy-supplying staple foods to emphasis on nutritional value. The consumption of non-staple foods, the quality consumption of animal and plant foods, and the trend toward socialized service upgrading food consumption.

Some studies have also analyzed the changes in China's food consumption structure from the perspective of changes in other regional food consumption structures. Zhang (2003) studied the changes in food consumption in mainland China with reference to food consumption of residents of Taiwan. In 2007, Luo (Luo, 2007) analyzed the evolution of Japanese food consumption structure by studying the general characteristics of food consumption structure, age characteristics and income levels of different populations.

Li (2007) analyzed the food consumption structure and nutrient intake level in Thailand over 40 years and found that the changing characteristics of Thailand's food consumption pattern upgrade, and measured and analyzed the food security level in Thailand before and after the upgrade. In 2007, Lu analyzed and summarized the characteristics of US food consumption upgrading model from the perspective of consumer spending, and provided a model for improving the food consumption level and consumption structure of Chinese residents. In 2007, Cheng compared the process of food

consumption improvement of China and South Korea in three aspects: Engel's coefficient, characteristics of main food consumption, and food consumption structure at different stages, pointing out the similarities and differences between China and South Korea's food consumption upgrade.

Therefore, this study considers the impact of population mobility on Chinese regional agricultural product market demand and selected dairy products and analyzes factors affecting the consumption of dairy products and the impact of regional population mobility on dairy product consumption.

Methodology

Data source and processing

The sample of this study consists of 31 provinces, municipalities and autonomous regions excluding Hong Kong, Macao, Taiwan from 2002 to 2016. The three regions are excluded due to lack of data. The relevant data is from 2001-2015 China Dairy Yearbook and 2017 China Dairy Statistics Compilation. The data is processed as follows: using the 1978 GDP and basing GDP deflator to calculate the actual per capita GDP during the period 2002-2016. In addition, the per capita income, the Gini coefficient, and the dairy product price which is based on the price of raw milk, the price of substitutes (e.g., eggs, pork, chicken, beef, mutton), the total net import of dairy products and so forth are considered. In order to deal with fluctuations, the study adopts the logarithm. In the estimation of model parameters, this paper also considers the error of processing of population flow, the internalization of variables and omissions. For this reason, the net population flow of the region is measured as the observed variable to measure the flow of the population; the endogenous problem is dealt with as the

variables which are processed with lag-phased for parameter estimation.

Regarding the potential missing variables, the population mobility, household income, and commodity price are the main factors affecting consumption. It is also difficult to quantify the factors such as the uncertainty of population migration and the consumption preferences of major migrants. The potential missing variables are unified into the residual term for analysis, and the influence of the missing variables can be analyzed through the control variables. At the same time, the mutual offset between the missing items and the systematic errors in the estimation can be eliminated. Dairy consumption is equivalently converted by the original milk.

Variable selection and empirical model estimation

The global spatial autocorrelation is used to describe the correlation between the study area and the adjacent spatial unit. It is intended to describe the agglomeration relationship of the variable with the adjacent area at the regional level. The formula is as follows:

$$I = \frac{\sum_{i=1}^n \sum_{j=1}^n W_{ij} (x_i - \bar{X})(x_j - \bar{X})}{S^2 \sum_{i=1}^n \sum_{j=1}^n W_{ij}}$$

Among them, x_i express as dairy consumption in area i , n is the number of subjects, \bar{X} indicates the average value of dairy consumption in the study area, S^2 indicates the variance of dairy consumption in the study area, and W_{ij} for the spatial weight matrix.

1. Dairy consumption

This paper studies the impact of population movement on dairy consumption based on the provincial level. The explanatory variable is dairy consumption. The total demand for dairy products will continue to grow concomitant to the net inflow of

population. At the same time, dairy products are perishable and are a favored food choice of migrants. The per capita consumption of dairy products in the selected regions is used to indicate the consumption of dairy products. The sum of the consumption of per capita dairy products and the increase in net inflow population/ dairy consumption is the observed value of per capita dairy consumption in the region.

2. Population movement

Considering the correlation between population movement and dairy consumption, population growth is the basic factor for expanding the consumer market. Therefore, the net inflow of population is the observed variable of population flow in this study. According to the definition of net population inflow, the difference between the resident population and the registered population in a certain area represents the net inflow. In order to accurately estimate the relationship between population mobility and dairy consumption, this paper uses binary variables to analyze the impact of net outflows or net inflows and dairy consumption. The impact of net population inflows on dairy consumption is also considered. I is the binary variables, the net inflow of the population is assigned a value of one, and the net outflow is zero.

3. Control variables

From the demand model

$$Q = f(X_1 + X_2 + X_3 + \dots + X_n)$$

where $Q = f(x)$ is the demand function and x is the demand influencing factor, including per capita income, population, price, etc. In the design of control variables, per capita income, Gini coefficient, dairy product price (calculated as raw milk price), substitute prices (e.g., pork, chicken, beef, lamb), and

total net import of dairy products were selected as control variables.

To study the impact between population movements and dairy consumption, the model is set as follows:

$$\text{Consumpt} = \alpha + \beta X_{it} + \gamma \text{migrat}_{it} + \mu_{it}$$

The i is the region, t is the year, and Migrat_{it} is the binary variable of the population flow. If there is a net inflow of the population, the value is 1; otherwise, it is 0. X_{it} is a control variable, including per capita income, Gini coefficient, price, etc. μ_{it} represents the disturbance items.

Results and Discussion

From the global autocorrelation coefficient of China's dairy consumption level from 2003 to 2016, it can be seen that the Moran's I values of China's dairy consumption levels have been positive since 2003, and both have passed the 5% significance test. Therefore, according to Moran's I , it is worthwhile to conclude that there is a positive spatial autocorrelation in the consumption level of dairy products in China, which indicates that there are high levels of consumption of dairy products and low consumption clusters in neighboring provinces in China. Also, the degree of agglomeration occurs in 2008 and presents two different agglomeration features. From 2003 to 2008, the Moran's I value of China's dairy consumption level rises from 0.1896 to 0.4987, showing an increasing trend; then it shows a fluctuating trend, which decreases to 0.2343 in 2012 and rebounds to 0.3952 in 2016 as shown in Table 1.

China's dairy product market is divided into four major types of zones. The i -type zone is the areas of traditional high-consumption, which mainly includes traditional agricultural and pastoral areas such as China's four northwestern provinces, Inner Mongolia, and Northeast China. This area is an important functional area and milk source for animal husbandry, and the dairy product consumption habits are deeply rooted. The increasing degree of marketization of the local animal husbandry industry has led to the combination of farming and cultivation as local milk source. In addition to self-use, which is useful to promote the combination with other industries, thereby consolidating the status of the main functional zone and the position of the whole consumer market.

Class ii could be called emerging high-consumption zone, mainly including developed areas such as Beijing, Zhejiang, and Shanghai. Compared with other areas, these areas have a higher quality environment and higher per capita income level. Also, the industrial structure is relatively reasonable, and at the same time they are important trade hubs, with diverse markets. In recent years, these areas have gradually become new centers for dairy consumption. With the frequent population movement, economic activities, effective circulation system and high degree of import facilitation, the emerging areas have impacted the dairy product market, improving the consumption level of dairy products in these regions, and enriching the pattern of China's dairy product consumption market.

Table 1 Moran's I Value and Space Gini Coefficient Of China's Dairy Consumption Level from 2003 to 2016

years	Moran's I	z value	years	Moran's I	z value
2003	0.189 6	5.024 8	2010	0.382 5	6.954 0
2004	0.248 3	6.358 7	2011	0.311 6	6.715 7
2005	0.308 1	6.824 1	2012	0.234 3	6.195 3
2006	0.361 8	7.054 4	2013	0.338 1	7.256 2
2007	0.495 2	7.237 1	2014	0.290 5	8.805 6
2008	0.498 7	7.653 2	2015	0.353 9	7.804 3
2009	0.426 2	7.151 8	2016	0.395 2	8.963 1

Class iii is a low-consumption zone, mainly including southern areas such as Hainan, Fujian, and Guangxi. The consumption level of dairy products in this zone is relatively low. On the one hand, there is no dairy development condition, on the other hand, the region has similar alternative drinks at a lower cost such as juice drinks. The region's consumer market is weak in the long term, but it also is a zone with potential for growth in the future, and the consumption needs should be explored.

The iv is a consumption transmission zone, which is mainly distributed in the central and northern parts of Henan, Hebei, and Liaoning. The zone is surrounded by the other three types of zones, and greatly affected by them. Since 2009, the region has been a volatile market, greatly impacted by the external environment and in turn affecting the pattern of dairy consumption at the national level. But it also has a strong consumer market base and an important impact on the national dairy product consumption pattern (Zhong & Xiang, 2012). Generally, China's dairy product consumption market is mainly concentrated in the north and developed regions, and changes in its consumption level is mainly due to differences in regional resource advantages, economic and social environment, and trade circulation levels (Hu & Guo, 2010).

The above parameters show that the estimated values of the population flow variable coefficient are significantly positive at the level of 1%, indicating that the increase of the probability of inter-regional population flow has a positive effect on the promotion of regional dairy consumption, and its unit contribution rate is 0.1592. It could be concluded that the growth rate of dairy consumption will rise 15.92% for every 1 unit increase in inter-regional population movement. The empirical results prove the impact of population movement on inter-regional dairy consumption. The population mobility level increases the emerging consumer groups in the net inflow area, expands the scale of the local dairy market, and thus affects the local dairy consumption level to a certain extent.

In order to test whether there is a difference in the effect of population size on dairy consumption, this paper selects the total net inflow of population to replace the binary variable of population flow, which is included as the main explanatory variable. The results are shown in Table 2. The parameter estimation results demonstrate that there is a significant positive correlation between the population flow scale and local dairy consumption (Lu, 2007; Cheng, 2007). There are differences in the impact of other control variables on dairy consumption. As a result of the regression

results, the estimated coefficient of per capita income, substitute price, and total net import of dairy products is significantly positive at 1%, meaning the city population of is an important factor (Cheng & Ren, 2018). The changes in population flows and the basic market supply and demand relationship have a direct impact on the demand for dairy products.

The regression results of the model reveal that the basic economic factors affecting the consumption demand of dairy products meet the demand elasticity of demand characteristics of normal products at the national scale, especially in terms of price elasticity and substitution elasticity of market demands such as product price and disposable income, and other product market factors. As far as population movements are concerned, the change in the total population of the region brought about by population movements is far greater than the market factors of dairy consumption (Chen, 2005). The elasticity of consumer demand for population movements is far

greater than the per capita disposable income and price factors. In the relatively small areas, this study compares the impact of population movements on the consumption demand of dairy products in the three regions, namely eastern areas, central areas and western areas of China (Xiang, 2013).

The results, illustrated in Table 2, show that the impact of population movement on dairy consumption is in the eastern, central and western regions verify the distribution of dairy consumption patterns and the reality of population movements (Hu & Guo, 2010; Zhu, 2013). A reason for this is that the eastern part of China is the main destination of population flow, thus in terms of the impact of the movement on dairy consumption, the eastern region becomes an important dairy consumption area, further validating the research result.

Table 2 Empirical Analysis of Regional Dairy Consumption and Population Flow

Variable	National	East	Central	West
Migration	1.328**	2.841	1.526	0.972
Per capita disposable income	0.428***	0.685***	0.436***	0.308***
Chicken price	0.302***	0.204*	0.405*	0.391*
Pork price	0.575*	0.637***	0.526*	0.493**
Beef price	0.009*	-0.012**	-1.057***	0.206*
Mutton price	-0.018*	0.008**	-0.379**	0.135***
Dairy price	-0.053**	-0.173*	-0.324*	-0.621**
Gini coefficient	-0.296**	-0.209	-0.108	-0.492
Net import value of dairy products	-0.096	-0.249***	-0.277**	-0.212***
Constant term	2.084***	0.875	1.098	0.199

Conclusions and Recommendations

By designing a model of dairy consumption demand based on population flows, the demand for dairy products is analyzed from the aspects of per capita disposable income, dairy market price, substitute price, and

population movement on the basis of a comparison of three regions, namely the eastern, central and western regions of China. As result of the population movement, the corresponding changes on the scale of the market have a positive impact on the regional pattern of consumption of dairy

products and increase the elasticity of demand. From the perspective of regional distribution, the elasticity of consumption demand for dairy products is mainly in the eastern and central regions. In order to enhance the competitiveness of the domestic dairy market, this paper proposes to establish a good dairy market order on the basis of market demand, as follows.

1. To improve the per capita disposable income and the competitiveness of dairy products. On the one hand, the study has shown that per capita disposable income has contributed to dairy consumption, thus promoting the continuous increase in per capita disposable income conducive to gradually increasing consumption of dairy products. On the other hand, reducing the production cost of dairy products and increasing the advantage of dairy products compared to the substitutes will help promote daily dairy consumption and change residents' daily eating habits to a healthier lifestyle.

2. To increase the flow of the population and lower the barriers between the different regions. As shown above, the flow of the population is one of the important factors affecting dairy consumption. Moreover, regional consumption characteristics vary greatly. Thus, the positive reduction of inter-regional barriers to movement and the reduction of the cost of population movement will help to promote a change in the regional dietary culture and reduce regional differences in the consumption of dairy products, which will eventually lead to an increase in dairy consumption.

3. To reduce economic disparities between regions and ensure the supply of dairy products. The demand for dairy products is affected not only by the efficiency of product supply, but also by the range of product supply. Although

many dairy companies focus on product promotion, if they lack sufficient supply capacity, it is difficult to guarantee the accessibility of residents, which will affect the development of potential demand for dairy products. In fact, there are more alternatives in the market, thus it is necessary to broadly distribute for the dairy industry which would contribute to grasping the potential market opportunities.

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