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How does Food Inequality Interplay with Income Inequality in China?

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Abstract

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Using Chinese Health Nutrition Survey (CHNS) data from 11 survey years, this paper examines the relationship between income inequality and food inequality. Specifically, income inequality refers to the unequal distribution of income at the community level in China, and food inequality is operationalized as the unequal distribution of food access in China. This study has two level of analysis: the household level and the community level. This study examines what determines food access at the household level, and further investigates how income inequality affects the unequal distribution of food access. Results suggest that individual income and geographic indicators play significant roles in determining individual food access and also the unequal distribution of food access at the community level, whereas income inequality casts limited influence on food inequality measured by food access. Major contributions of this study include examining the relationship between two inequality indexes and investigates food access at the aggregated level. However, this study is also limited in terms of operationalizing food inequality.

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I. Introduction

China's economic reform in past decades has captured attention from all over the world. It is well-acknowledged that the great reform boosted the Chinese economy and improved living standard of Chinese people. Some social scientists are very interested in the following consequences along with the great economy boom. Specifically, major research has been done in this field to study social stratification and income inequality in China.

Most of sociologists and economists interested in studying the social cost of economic boom in China have focused on the growing income inequality in China. Scholars reached an unanimous agreement that there has been a great divide between the urban, east coast area and the rural, inner mainland area, especially in terms of income, infrastructure development, and consumption (Xie and Zhou, 2014). Of all factors indicating economic development, income inequality grasped the most attention. It is acknowledged that there is a visible, substantive, and growing income inequality in China (Xie and Zhou, 2014) and that income inequality in China ranks among the highest in the world.

Research shows that income inequality in China is more deeply entrenched than government statistics presents. Xie and Zhou (2014) studies the income inequality by calculating Gini Coefficient from university-based surveys. The Gini coefficient is a common measurement of inequality among literature, with Gini coefficient of 0 indicating perfect equality and Gini coefficient of 1 means maximal inequality. Xie and Zhou (2014) finds that income inequality in China is far surpassed the official statistics published by National Bureau of Statistics. Based on Xie and Zhou's calculation, the Gini Coefficient in China was around 0.3 in 1980, and was 0.55 by 2012, greater than the coefficient of 0.45 in the United States (Xie and Zhou, 2014), signaling the fact that income inequality in China almost doubled in the past four decades. Wu and Perloff

(2004)'s calculation reaffirms Xie and Zhou's argument that income inequality in China has been rising over decades. Wu and Perloff states that the Gini coefficient increased form 0.31 in 1985 to 0.42 in 2001 (2004) and concludes that Chinese income inequality widened substantially from 1985 to 2001 due to increase inequality level within urban and rural areas and also due to the rising rural-urban income gap.

At the same time, income inequality itself brings social costs, too. Much literature has probed into the question that whether a rising income in China brings higher risks of certain diseases and worsen health conditions. Research has produced mixed results (Bakkli, 2016) on this aspect, that increase in individual income does predict higher risks of certain diseases and potentially worsen health conditions on individuals, but fails to confirm that an aggregate level of income indicates a general trend of declining health conditions (Bakkli, 2016). Up to now, relevant scholars have not studied the relationship between the general, aggregated level income inequality and the inequality in health or food.

Besides the negative impact on health conditions and risks of diseases along with the rising income inequality, issues on food access and food insecurity are also triggered by the trend of rising income inequality. Accessing healthy food is a challenge for many families, particularly those living in low-income neighborhoods, communities of color and rural areas, particularly in the United States. And those areas with limited healthy food access are named *Food Deserts.* Many studies have examined the relationship between food insecurity and income. Food insecurity is used as an indicator of income poverty, suggesting a close relationship between the two. Food security levels are measured using the United States Agency for International Development Household Food Insecurity Access model. Findings indicate that 52.8% of

households are food secure, 23.3% are mildly food insecure, 14.3% moderately food insecure, and 9.6% are severely food insecure.

Given the extensiveness of research on food access in the United States, there is a lack of research on food access in China. How do people access food in China, after decades of rising individual income and living standards as a result of economic reform? How is food access influenced by socio-economic factors such as income, education and gender? The question rises as we examine the social cost of rising income as well as income inequality in China.

Therefore, this study strives to answer the following questions: 1). What are food inequality, and what socio-economic factors contribute to food inequality? 2). And how does food inequality changes with the trends in income inequality?

II. Literature Review

Nan Zou Bakkeli (2016) tests the association between income inequality and health conditions in China. This study utilizes Chinese Health and Nutrition Survey (CHNS) and examines the relation between health risks and the Gini Coefficient using linear probability models, in which health risks are measurement of general health conditions of the Chinese, and the Gini Coefficient as the measurement of income inequality. Results show that Gini is significantly associated with higher risks of having abnormal blood pressure and WHR (Waist-Hip Ratio) for women, and increased individual income is associated with higher possibilities of having normal blood pressure and overweightness for women, but abnormal WHR and overweightness for men (Bakkeli, 2016). After taking into account of year fixed effect and country-level units, higher income indicates higher probabilities of having abnormal WHR and

being overweight only for men. The study concludes that aggregated level of income inequality does not predict the probabilities of having health problems, whereas individual level variables do render significant results as discussed above.

Apart from effects of income inequality on health conditions, Du et al (2004) investigates how income inequality affects diet quality in China. Specifically, Du et al (2004) estimates the effect of income on food consumption in China. This study indicates the diet consumption pattern shifted towards more high-fat, more animal products and lower consumption of traditional foods (Du et al, 2004). In addition, Du et al's research reveals a declining trend of overall energy consumed across all income groups, with least reduction of total energy consumed in highest income group and larger decline in low- and middle-income groups. Interestingly, the percentage of high-fat food consumed rose significantly across all income groups (three times in highest income, more than doubled in middle and low income groups). However, there is considerable decline in consumption of traditional Chinese food including rice and wheat products, with the largest decline taking place in the lowest income group. The consumption of animal foods and edible oil, which used to be considered as "luxury" food in China, are increasing, too, across all income groups. The important implications in this study are that flour and rice products have become inferior goods and high-fat diets become superior goods at all income levels.

The declining intake of total energy raises a paradox as consumption of high-fat diet and animal products increases. With similar inquiries, Xu and Zhang (2015) studies the secular declining calorie and protein intake among rural residents in China over the past decades. Results show that the budget squeeze resulting from both non-food essential consumption and operation of the family business leads to a decrease in nutritional intake, where the share of non-food

essential expenditure has increased by ten percentage points in the past ten years. Xu and Zhang (2015) argues that the joint forces of budget squeeze and China's rapidly upgrading diet pattern, with a big drop in grain consumption and an increase in meat and dairy products, are primarily responsible for the decline in nutrition intake. Specifically, the budget squeeze limited rural households' access to food and nutrition, and furthermore, dietary change worsens the situation.

An interesting study done by Barone et al 2014 studies the relationship between existing regional disparity and food security in China from 1996 to 2012. The study uses a set of indicators to determine the degree of food insecurity of various regions in China and measures how these indicators change overtime. One of the highlight of the study is that Barone et al (2014) innovatively constructs food security indicators, which, in this study, was used later to compare with spatial inequality indicators. The set of three food security indicators includes *access to food*, *diet diversity* and *economic vulnerability*. Specifically, access to food measures the "diet quantity", according to Barone et al, and corresponds to household food expenditures (in Yuan per capita) as instruments. (The authors used time series of rural and urban food expenditures per capita deflated to adjust). The second variable, diet diversity, measures "diet quality". This indicator arises in the sense that "who eats more than one type of food products is less exposed to the risks of developing a nutrient deficiency/excess and is projected towards a more balanced diet" (Barone et al, 2014) and also reflects the social-economic standing of a given customer. The third aspect of food security, the economic vulnerability, is measured as the percentage of expenditure on food in total household consumption expenditure. Specifically, the economic vulnerability is equivalent to the Engel's Coefficient in this study, which captures the food consumption behavior. Results reveal that eastern region recorded much higher levels of food access indicator, showing an increase of food expenses concentrated on urban households, much

larger than food consumption increase of rural families. The second indicators, results show that eastern provinces the rural-urban gap persists, while in the central and western provinces shows convergence to similar values of the Engel's coefficient. The diet diversity shows that the eastern and north-eastern region, which were most exposed to foreign food supply that might drive up the consumption standards and preferences, yet the other regions were increasing in a much slower rate. Another highlight from the study is that Berone el al 2014 calculate a Theil Index to measure the food security in an aggregated level. The Theil Index in this study consists of only two indicators: the Access to Food and the Economic Vulnerability. An important result from the Theil Index shows that over time Inequality in Food access had modestly reduced across China.

My research question is to investigate the relationship between two inequalities— Food inequality and income inequality. Similar to Barone et al 2014 's study which studied food insecurity and spatial inequality in China, my study will expand on the food security variable presented in Berone et al 2014 and compare the new food inequality variable to income.

III. Methodology

Data and Sample

As literature suggests (Bakkli, 2015; Xu and Zhang, 2015; Du et al, 2004), this study will use the Chinese Health and Nutrition Survey, an appropriate dataset to study food inequality in China. The dataset is called Chinese Health and Nutrition Survey (CHNS), an ongoing project launched by the Carolina Population Center at the University of North Carolina in collaboration with the National Institute for Nutrition and Health at the Chinese Center for Disease Control and Prevention (CCDC). Conducted by a team of international researchers with background in

public health, social science, demography, the Chinese Health and Nutrition Survey is designated to capture the effects of the health, nutrition, and family planning politics and how social economic transformation of Chinese society is affecting the health and nutritional status of its population (CHNS, 2010). The survey is conducted in multi-years, multi-stage and in random cluster process to draw a sample of about 7200 households with over 30,000 individuals in 15 provinces and municipal cities that "vary substantially in geography, economic development, public resources and health indicators" (CHNS, 2010). This survey is ideal for this study not only because its content but also because of its comprehensive coverage of Chinese cities across the social stratification spectrum.

As discussed in previous paragraph, the dataset includes data collection from multi-years, multi-rounds, and multi-level of analysis. Years of data collection include 1989, 1991, 1993, 1997, 2000, 2004, 2006, 2009 and 2011, and data has been collected at levels such as community, household, individual, job, food item, etc. Among all levels of data, only household level (individual level) data and selected community level data are published by the Carolina Population Center and available online. According to the Carolina Population Center, the community level data involves personal information that could be possibly identifiable by any third parties; therefore the community level data is in restricted usage and for application only. Though it would be idea to analyze data both from the household level and the community level, the amount of time and efforts required by acquiring the community level data does not allow this ideal situation to happen. Also, the community level of data contains several geographical indicators, which requires professional software other than the STATA, unnecessarily raising the level of complexity of this study. After careful consideration, I chose to only rely on the household level data, and to calculate important variables, such as income inequality ratio, from

the existing available variables, which I will discuss in detail in the next subsection. As a result, this study will only conduct analysis mainly on household level due to data acquisition problems and maintaining a consistent level of complexity.

For the purpose of the study, I included data from all 9 years, with the earliest being 1989 and latest being 2011. (The whole 9 years include 1989, 1991, 1993, 1997, 2000, 2004, 2006, 2009 and 2011). The total sample size is 134,717; meaning 134717 individuals participated in the survey throughout the 9 years time span. Table 1 presents the summary statistics of each survey year. Approximately, there are almost equal share of participants each year, making the survey consistent in terms of comparable analysis.

Table 2.

SURVEY YEAR	Freq.	Percent	Cum.
1989	16,722	12.41	12.41
1991	15,971	11.86	24.27
1993	14,866	11.03	35.3
1997	15,008	11.14	46.44
2000	15,867	11.78	58.22
2004	12,922	9.59	67.81
2006	12,491	9.27	77.09
2009	12,743	9.46	86.54
2011	18,127	13.46	100
Total	134,717	100	

As mentioned in previous paragraph, the Chinese Health Nutrition Survey (CHNS) covers a broad range of geographical areas. China is known for its extensiveness of land, so it is necessary to have a comprehensive coverage of different geographic stratums. The CHNS gathers data in urban neighborhood, suburban village, county town neighborhood and rural village. As shown in Table 2, of all effective 108,453 respondents out of the sample 134,717,

about half of them live in rural village (52.83%), 14.9% live in urban neighborhood, 17.06% live in suburban village, and 15.2% live in county town neighborhood. The proportion is approximately the same as the distribution of urban and rural areas in China.

Table 3. Type of Community

TYPE OF COMMUNITY	Freq.	Percent	Cum.
1. URBAN NEIGHBORHOOD	16,154	14.89	14.89
2. SUBURBAN VILLAGE	18,506	17.06	31.96
3. COUNTY TOWN NEIGHBORHOOD	16,493	15.21	47.17
4. RURAL VILLAGE	57,300	52.83	100
Total	108,453	100	

Variables

As mentioned in above sections, this study strives to answers the following questions: 1). What determines food inequality, and 2) How does food inequality changes with respect to income inequality? In order to answer these two driving questions, it is necessary to define food inequality and income inequality in the first place. Barone et al (2014) provides a conceptual framework in measuring food insecurity, which was later compared with spatial inequality indicators. Food inequality is a relatively new concept in economic and sociology literature. Based on the model designed by Barone et al (2014), food inequality is best measured by *Access to Food*, *Food Expenditure* and *Proportion of Healthy Food Consumed*. However, the Chinese Health Nutritional Survey does not contain any survey questions that measure expenditure on

food. As a result, food inequality will only be measured through 2 dimensions: *Access to Food* and *Proportion of Healthy Food Consumed*.

Food Access

By its definition, Food Access measures how a household acquires food items. Food Access is an important measure in health research. Consumer choices on diet are very likely to be influenced by the accessibility and availability of food. According to United States Department of Agriculture, food access is determined by travel time to shopping, availability of healthy foods, and food prices. In this study, Food Access is measured by 1). average minutes spent on buying foods and 2). Number of meals skipped out of a 3-day period. I created variables corresponding to each dimension. They are named Average Minutes Spent Buying Food and Number of Meals Skipped.

For Average Minutes Spent Buying Food, there are 50,032 observations. The respondents were asked to report on average how many minutes they spent on acquiring food items for each household. On average, respondents spend 40.4 minutes per day On the minimum level, people spend 0 minutes and the maximum level people spent 257 minutes. In data cleaning process, this variable is matched for each individual respondents from the household sample for consistency of analysis.

The other dimension of *Food Access* is measured by how many meals were skipped out of a 3-day record. Specifically, the survey asks the individual respondent to report their meals for a consecutive 3 day period. One question in the Chinese Health Nutrition Survey address number of meals each respondent had in this period (out of 9 scale). The variable Number of Meals Skipped was created by subtracting number of meal had from total number of meals a person

should have eaten in the 3-day period (9 meals). This variable involves 110,946 observations, with the average value equal to 1.14, suggesting that respondents skipped 1 to 2 meals on average. There are situations where people did not skipped any meal at all (value=0) and skipped all meals (value=9).

Explanatory Variables

Individual Income

One of the most important explanatory variables is the individual income. In the Chinese Health Nutrition Survey, there is a list of survey questions that inquire individual income as well as household income. The survey classifies individual income into subsections, including income from primary occupations, income from secondary occupations, and other sources of income that are distinct in rural and urban areas (business, farming, fishing, gardening, livestock, non-retirement wages, and retirement income). The Carolina Population Center already has cleaned the individual income variables and constructed the complete, properly inflated individual income variable. According to the Carolina Population Center,

Individual income is conceptualized as the sum of all sources of income and revenue minus expenditures for one household member. It is not a simple division of household income evenly among household members (that is per capita income, which is computed as part of household income). Rather, individual income is built by adding each person's income source.

In one word,

Individual Income=Income from Business+ Income from Farming+ Income from Fishing+ Income from Gardening+ Income from Livestock+ Non-retirement Wages+ Retirement Income.

The summary statistics shows that mean individual income is 108,461 Yuan. The minimum income is -312964, suggesting negative net income for a particular person due to potential debt or any loss. Approximately 2.4% of total participants have negative income across all survey years. The maximum value of individual income is 657,000 Yuan. For analytical purposes, the individual income variable has been scaled down to 1/1000 (See Table 1).

Gender

Gender is another explanatory variable that might indicates significance with food inequality in China. In this context, gender refers to the sex of individual respondent. Of all 107,964 respondents who answered this question, approximately 55.4% are male, and approximately 44.5% of them are female, pointing to a similar male-female ratio as the ratio for the whole Chinese population. A binary variable, gender only takes two values, 0 and 1. In this study, 0 represents male and 1 represents female.

Rural/Urban

This variable records the geographical location that individual and household live. Like gender, Rural/Urban is a binary variable, too. The value of 0 corresponds to living in urban areas, whereas the value of 1 refers to living in rural states. Of all 134,709 respondents, 32.53% of them live in urban areas, including suburban sections. 67.47% of them live in rural areas. Again, this distribution corresponds to the real distribution of rural and urban residents in China.

Urbanization Index

Urbanization Index measures the level of development of a certain community. As reflects in its name, this variable is only for the community level. As a result, sample data in this variable was matched from the community level to the individual level; that is, each individual has an urbanization index score which belongs to the community he or she lives in. Total respondents for this survey question is 108,453, and on average the score is 66.4, with the minimum value 14.3 and maximum value 106.5.

Education

Education is also an important demographic indicator. Again, the Chinese Health Nutritional Survey measures individuals' education level through multiple ways. Of many survey questions, I chose the one that is most suitable for quantitative analysis in STATA. This particular question asks what the highest level of education an individual has attained. The survey offers the following options: 1. Graduated from primary school 2. Lower middle school degree 3. Upper middle school degree 4. Technical or vocational degree 5/ University or college degree 6 master's degree or higher 9 unknown. I took out those response with "9 unknown", and then grouped the rest of responses into 3 dummy variables.

Other Constructed Variables

Income Inequality Index

As discussed in previous sections, income inequality is the key variable to study in this paper. In order to do so, I constructed the income inequality index for each community, by calculating the standard deviation of household income in each community. Many literature (Xie and Zhou, 2014; Campos et al, 2016; Zhang et al, 2016; Xu et al, 2016) has suggested that

standard deviation could give a simple, yet clear sense of income inequality in a particular region. The income inequality index was calculated using the standard deviation function plug-in in the STATA. Of all 108,461 observations, the mean value for the income inequality is 11880.57, with minimum value 649.4 and maximum value 151102.5.

Average Education

In order to coordinate variables into same level of analysis, I created the variable *Average Education* for the community level analysis. Like variable *Education*, *Average Education* also measures the education level, but for each community. *Average Education* is simply the mean value of education in each community.

Food Inequality Indexes

Similarly, in order to conduct analysis at the community level, I also constructed variables that measure the Food Inequality in the community level. Like the construction of Income Inequality variable, Food Inequality Indexes are created by taking the standard deviation of two food-related variables: *Average Minutes Spent Buying Food*, and *Number of Meals Skipped*.

Empirical Techniques

The model is designed to demonstrate the marginal effect of an increase in demographic variables such as income, education, place of living, and current level of inequality on access to food. I use Ordinary Least Squares (OLS) regression to estimate the following equation:

$$Food\ Access = \beta_0 + \beta_1 indinc + \beta_2 incineq + \beta_3 sex + \beta_4 educ + \beta_5 RuralUrban + \beta_6 UrbanIndex + \varepsilon$$

where Food Access represents *Average Minutes Spent on Buying Food* as well as *Number of Meals Skipped*. Two separate equations are presented below:

$$Avg\ Min.Spent\ on\ Buying\ Food = \beta_0 + \beta_1 indinc + \beta_2 incineq + \beta_3 sex + \beta_4 educ + \beta_5 RuralUrban + \beta_6 UrbanIndex + \varepsilon$$

$$Number\ of\ Meals\ Skipped = \beta_0 + \beta_1 indinc + \beta_2 incineq + \beta_3 sex + \beta_4 educ + \beta_5 RuralUrban + \beta_6 UrbanIndex + \varepsilon$$

Then I arrive at the following equation:

$$Food\ Inequality_v = \beta_0 + \beta_1 incineq_v + \beta_2 avgedu_v + \beta_3 UrbanIndex_v + \theta_t + \theta_v + \varepsilon$$

where v denotes the given community. For example, $incineq_v$ denotes the income inequality index for each community, $avgedu_v$ denotes average education level for each community, and $UrbanIndex_v$ denotes the level of urbanization for each community. Model 2 demonstrates that income inequality, average education, overall development of the community/village, as independent variables affects food inequality as the dependent variable. In addition, the model also controls other community fixed level variables.

IV. Results

Table 4,5,6 and 7 presents the OLS estimates the effect of different explanatory, demographic variables on food access and food inequality. Specifically, Table 4 represents the

OLS estimates for food access at the household level, and Table 5 represents the estimates for food inequality at the community level. Table 6 and 7 repeat the work shown in Table 4 and 5, respectively, but divide in separating different survey years. In one word, these tables provide estimates on how income, education, gender, and other community characteristics affect local access to food as well as the distribution of food access in local communities.

Table 4 presents estimates the effect of each explanatory variables on food access. As shown in Table 4, individual income has negative and significant impacts on both variables representing the access to food: Average time spent on acquiring food and number of meals skipped. This result suggests that more earnings lead to less time spent on buying food as well as less meals skipped, indicating an overall increasing access to food. The income distribution seems to be less influential than individual income, only negatively influencing time spent on buying food, which means individuals who live in community with more income inequality tend to spend less time acquiring food. Gender, on the other hand, only significantly influences number of meals skipped. As shown in Table 4, female tend to skip more meals than males. Education shows more interesting results: like individual income, education tends to positively influence both variables of food access, that people with higher level of education are more likely to spend more time purchasing food and to skip more meals at the same time. However, it is notable that education has a stronger influence on average time spend on buying foods than number of meals skipped due to a much larger coefficient (see Table 4). Geographic location also has a significant impact on how much time spent on purchasing food: people living in rural area are likely to spend more time acquiring foods.

Table 5 presents estimates of how community characteristics such as income inequality, average education and urbanization index affect food inequalities. As mentioned in previous

section, food inequality measures the overall distribution of food access in each community. Table 5 presents some interesting results. As shown in Table 5, income inequality in each community has a significant yet negative impact on food inequality index 1, but a slightly positive impact on food inequality index 2. Different from individual education variable in table 3, the average education, on the other hand, does not show any significant impact on any of the two food inequality indexes, meaning the average education level in each community has little impact on food access distribution in one area. Urbanization index shows a significant and positive impact on both two indexes, suggesting that higher level of urbanization might leads to higher level of unequal distribution of food access in communities.

Table 6 and Table 7 reiterate efforts made in Table 3 and 4, but compare OLS estimates across different survey years. Table 6 shows estimates of how individual level factors affect food access and lists results in 3 groups, respectively. Table 6 does suggest certain level of consistency across different survey years. Individual income has a persistently positive effect on time spent on buying food and a consistent, negative effect on number of meals skipped. Education dummy variable 2 shows a consistent impact on both measures of food access across all survey years, suggesting a higher education level is positively related to more time spent on food and more meals skipped. However, income inequality index and household gender only have significant effect on number of meal skipped in the most recent year group. Geographic locations have significant and negative effects on numbers of meals skipped across all survey years, and only have significant, negative impact on time spent on buying food in early years (1989,1991 and 1993) and middle years (1997, 2000 and 2004). Urbanization index presents significant and positive impact on time spent on buying food for all survey year groups, whereas no significant result on number of meals skipped.

Similar to Table 6, Table 7 presents estimates of how each community level explanatory variables affect both food inequality indexes. Table 7 shows that the slightly negative link between income inequality and food inequality index for time spent is only significant in recent years, and income inequality does not have any significant impact on food inequality in terms of number of meals skipped. Average education does not affect any of the food inequality indexes across all survey years, which stays consistent with results shown in Table 5. Urbanization index shows consistently positive impact on inequality index for average time spent, meaning that higher level of urbanization contributes to a higher level of dispersion of average time spent per day on acquiring food, which further implies a higher level of food inequality. Apart from the significant positive implication on the inequality of time spent across all survey years, urbanization index also indicates slightly positive effect on standard deviation of meals skipped, but only for middle-years and recent-years group.

VI. Discussion

As mentioned in above sections, this study strives to answers the following questions: 1). What determines food inequality, and 2) How does food inequality changes with respect to income inequality? In order to answer these two driving questions, I define food inequality as the unequal distribution of food access across different types of communities in China, and income inequality as the unequal distribution of income within each community. As discussed in previous sections, this study takes 2 level of analysis: individual/household level and community level. Specifically, I examined the determinants of food access at the individual/household level, and further analyzed the relationship between income inequality and food inequality, which is a

result of unequal food access distribution, at the community level. I utilized OLS linear regression to estimate research question addressed above.

Results have produced mixed findings. At the individual/household level, individual income plays an important role in determining individual's access to food as expected. In general, individual income does significantly affects how much time people spent buying food as well as how many meals people skipped. Income inequality, compared with individual income, though measured in an aggregated level, cast limited influence on individual's access to food, especially on numbers of meals skipped. In other words, income at individual/household level plays a significant role determining individual food access; however, income inequality in a community is not the most deciding factor in how food access has been distributed. However, we should not ignore the fact that individual income and income inequality in the community where individuals reside in do significantly influence the average time spent on buying food: people with higher income, or who live in communities with higher level of income inequality tend to spend less time acquiring food. And this significant impact remains consistent across all survey years.

Besides income, results reveal that geographic indicators play major roles in determining food access both at the individual/household and the unequal distribution of food access (food inequality) at the community level. Urban citizens, in general, spend less time acquiring food and skipped less meals than rural residents, and this prediction remains strong and significant over 11 survey years. In addition, the level of development of communities positively contributes to the unequal distribution of time spent on buying food across all survey years, yet does not have any significant influence on unequal distribution of meals skipped. The significance of geographic locations over food access itself and the distribution of food access corresponds to the regional inequality in China, which is persistent and even growing in the past 3 decades (Daly et al, 2013).

Due to the special residency permit in China (the *Hukou* system), large, urban or metropolitan areas attract labors, produce higher GDP, and therefore have much higher level of urbanization. However, due to policy reasons the rural areas have been left less underdeveloped compared to urban areas. The importance of geographic location revealed in this study corresponds to the overall regional disparity of China, that highly developed regions often have more access to food and more unequal distribution of food access.

The main contribution of this study relies on presenting the unequal distribution of food access as the proxy for food inequality, and this study also tries to study the relationship between income inequality and food inequality. Though income inequality does influence individual food access, income inequality has very limited influence on the general, aggregated level of food inequality. When accessed in the aggregated community level, two geographic indicators (whether living in rural or urban area and how developed your community is) tend to play the major role in determining regional food inequality.

At the same time, this study has certain limitations as well, which might lead to certain level of bias in data analysis. First of all,, due to lack of previous literature examining the concept of food access as well as food inequality, this study lacks a complete, well-designed conceptual framework. In other words, there could have been a lack of potential explanatory variables in the framework used in this study. This study only includes general demographic indicators such as income, education, gender and geographic indicators, and further research could examine more specific factors under each general ones.

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Table 1. Summary Statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
ID Variables					
Individual ID	134,717	-	-	-5.52E+10	5.52E+11
Household ID	134,717	-	-	1.11E+08	5.52E+08
Community ID	134,717	390714	95666.67	111101	552304
Survey Year	-	-	-	1989	2011
Household Level Variables					
Income					
Individual Income	108,461	7.504657	16.17887	-312.964	657
Education					
Education-No school, primary school	73,575	0.7655725	0.4236433	0	1
Education-middle school, high school	73,575	0.1666055	0.3726258	0	1
Education-college and above	73,575	0.067822	0.2514418	0	1
Gender					
Household Head Gender	107,984	0.4454456	0.4970172	0	1
Demographic Indicator					
Rural/Urban	134,709	0.6746617	0.4685029	0	1
Urbanization Index	108,453	66.36491	18.58809	14.29929	106.4618
Food Variables					
Average	47968	40.40633	42.01963	0	295

Minutes Spent Buying Food Per Day					
Number of Meals Skipped	110,946	1.146314	2.083069	0	9
Community Level Variables					
Income Inequality					
Income Inequality Index	108,461	11880.57	8671.89	649.3995	151102.5
Education					
Average Education	134,717	1.2978	0.2645267	1	2.496644
Food Inequality					
Food Inequality Index1 (time spent)	134,717	139.3893	70.35813	8.43699	403.7379
food Inequality Index2 (skipped meal)	134,578	1.86533	0.5667447	0.1208178	3.25526

Table 2.

SURVEY YEAR	Freq.	Percent	Cum.
1989	16,722	12.41	12.41
1991	15,971	11.86	24.27
1993	14,866	11.03	35.3
1997	15,008	11.14	46.44
2000	15,867	11.78	58.22
2004	12,922	9.59	67.81
2006	12,491	9.27	77.09
2009	12,743	9.46	86.54
2011	18,127	13.46	100
Total	134,717	100	

Table 3. Type of Community

TYPE OF COMMUNITY	Freq.	Percent	Cum.
1. URBAN NEIGHBORHOOD	16,154	14.89	14.89
2. SUBURBAN VILLAGE	18,506	17.06	31.96
3. COUNTY TOWN NEIGHBORHOOD	16,493	15.21	47.17
4. RURAL VILLAGE	57,300	52.83	100
Total	108,453	100	

Table 3b. List of Explanatory Variables

Individual/Household Level	**Community Level**
Income	Income Inequality Index
Education	Average Education
Gender	Urbanization Index

Urbanization Index	
Rural/Urban	

Table 4.

Table 4: OLS Estimates of the Effect of Demographic Variables on Access to Food

VARIABLES	(1) Average Minutes/Day Spent on Buying Food	(2) Number of Meals Skipped (out of 9)
Individual Income	-0.365***	0.00579***
	(0.0819)	(0.00102)
Income Inequality in Each Community	-0.00029***	-0.000
	(0.000)	(0.000)
Gender	-1.923	0.131***
	(2.245)	(0.042)
Education(middle school, high school)	11.64**	0.258***
	(3.642)	(0.0408)
Education(college and above)	1.008	0.228***
	(6.68)	(0.0829)
Living in Urban or Rural Area	-14.95***	-0.423***
	(4.964)	(0.1)
Urbanization Index	0.532***	0.00152
	(0.125)	(0.00247)
Constant	51.18***	1.0106***
	(9.737)	(0.2)
Observations	34,062	60,392
R-squared	0.009	0.026

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5.

Table 5: OLS Estimates of

VARIABLES	(1) Food Inequality Index for Time Spent	(2) Food Inequality Index for Meals Skipped
Income Inequality Index	-0.001**	0.000*
	(0.000)	(0.000)
Average Education	-35.313	0.002
	(24.523)	(0.146)
Urbanization Index	0.707**	0.006**
	(0.340)	(0.003)
Constant	132.287***	1.409***
	(21.354)	(0.137)
Observations	311	309
R-squared	0.048	0.055

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: This regression table is based on communities level analysis, that each variable is measured in the communities level.

Table 6

Household Level

Variables	Average Minutes Spent Buying Food			Number of Meals Skipped		
Years	1989, 1991, 1993	1997, 2000, 2004	2006, 2009, 2011	1989, 1991, 1993	1997, 2000, 2004	2006, 2009, 2011
	1	2	3	1	2	3
Individual Income	-0.612***	-0.203*	-0.161***	0.00709***	0.00416***	0.00654***
	(0.212)	(0.121)	(0.0374)	(0.00208)	(0.00145)	(0.00144)
Income Inequality Index	-0.00083	-0.0003	0.000	0.000	0.000	0.000***
	(0.00055)	(0.00061)	(0.000)	(0.000)	(0.000)	(0.000)
Household Gender	-5.038	-4.302	-1.855	0.0486	-0.0291	0.0894***
	(4.348)	(3.933)	(2.328)	(0.0344)	(0.0312)	(0.029)
Education (middle school, high school)	13.18*	20.64***	6.65*	0.207***	0.264***	0.299***
	(7.455)	(6.35)	(3.484)	(0.0736)	(0.0612)	(0.0565)
Education (college and above)	13.871	8.116	3.715	0.214	0.211**	0.265***
	(15.416)	(10.501)	(6.034)	(0.185)	(0.102)	(0.086)
Rural/Urban	-33.582***	-12.925**	-4.563	-0.474***	-0.464***	-0.346***
	(9.069)	(6.432)	(3.837)	(0.125)	(0.115)	(0.112)
Urbanization Index	0.846***	0.432***	0.354***	-0.000	0.001	0.004
	(0.253)	(0.147)	(0.092)	(0.003)	(0.003)	(0.003)
Constant	76.87***	54.50***	31.26***	1.272***	1.161***	0.701***
	(18.085)	(12.895)	(7.137)	(0.243)	(0.231)	(0.232)
Observations	9,243	11,668	13,151	17,164	21,500	21,728
R-squared	0.019	0.007	0.006	0.016	0.022	0.042

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 7.

Community Level

Variables	**Food Inequality Index 1**			**Food Inequality Index 2**		
Year	**1989, 1991, 1993**	**1997, 2000, 2004**	**2006, 2009, 2011**	**1989, 1991, 1993**	**1997, 2000, 2004**	**2006, 2009, 2011**
	(1)	(3)	(5)	(2)	(4)	(6)
Income Inequality Index	-0.000	0.000	-0.001**	0.000	0.000	0.000
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Average Education	23.217	6.282	-29.832	0.159	-0.029	0.010
	(34.977)	(23.882)	(24.075)	(0.208)	(0.182)	(0.152)
Urbanization Index	1.209***	1.147***	1.028***	0.003	0.007**	0.007***
	(0.344)	(0.293)	(0.321)	(0.003)	(0.003)	(0.003)
Constant	43.069	52.842**	107.255***	1.414***	1.374***	1.333***
	(34.857)	(22.973)	(21.227)	(0.208)	(0.180)	(0.149)
Observations	99	103	109	100	99	112
R-squared	0.135	0.126	0.048	0.029	0.057	0.072

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1