China Agricultural Economic Review

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Received 15 January 2016
Revised 12 April 2016
Accepted 4 May 2016

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Abstract

Purpose – The purpose of this paper is to examine the impacts of large income and expenditure shocks on household food expenditures and determines whether the impacts of large shocks differ among households, especially low-income households.

Design/methodology/approach – The study's data are drawn from a household survey conducted in rural China. Multivariate analysis examines the impacts of large income and expenditure shocks on food expenditures.

Findings – The impacts of large positive income shocks on food expenditure are moderate. However, households reduce their per capita food expenditures within a range of about 25-30 percent after suffering large negative shocks. The greatest impact is found for shocks where expenditures more than double, followed by the impact of shocks where income declines by more than half. Moreover, food expenditures among low-income households are much more sensitive to large negative income and expenditure shocks. The paper concludes with policy implications.

Originality/value – This is the first Chinese study to empirically examine the impacts of different income and expenditure shocks on household food expenditures. The results have important implications for smoothing households' food consumption after they suffer from shocks.

Keywords China, Food expenditure, Idiosyncratic shock, Low-income household

Paper type Research paper

1. Introduction

The impacts of idiosyncratic income and expenditure shocks on household food consumption have attracted much attention from researches and policymakers. Food consumption, considered a better indicator of household welfare than income, is the most crucial and vulnerable component of the consumption of households that have suffered serious shocks (Stephens, 2001; Asfaw and von Braun, 2004). Policymakers often worry about the food security of low-income households and seek to help them deal with adverse shocks through policy instruments such as food stamps, cash transfers, and job loss benefits (Blundell and Pistaferri, 2003; Bloemen and Stancanelli, 2005; Bentolila and Ichino, 2008; Hou, 2010).

Many studies have investigated the impact of a specific idiosyncratic shock on households' total expenditures or food consumption and their adaption strategies, but few have simultaneously examined the impacts of different income and expenditure shocks on household food expenditure. The literature has found significantly negative impacts of health shocks (Asfaw and von Braun 2004; Islam and Maitra, 2012), job loss (Stephens, 2001; Bentolila and Ichino, 2008), income shocks (Dynarski and Gruber, 1997), and crop failure (Hou, 2010) on household food consumption. Studies also suggest that wealthier households

China Agricultural Economic Review
Vol. 9 No. 1, 2017
pp. 2-13

1756-137X
DOI 10.1108/CAER-01-2016-0006

are better able to insure their consumption against idiosyncratic shocks (Townsend, 1994; Jalan and Ravallion, 1999; Mu, 2006; Dartanto and Nurkholis, 2010; Islam and Maitra, 2012). Dercon *et al.* (2005) and Porter (2012), who analyzed different idiosyncratic shocks on household food expenditure, are two exceptions. Dercon *et al.* (2005) examined the impacts of asset loss and the death or illness of household members on food consumption in rural Ethiopia, finding that the impact of illness was more significant than that of other shocks. Porter (2012) analyzed the impacts of both crop failure and illness on rural households' food expenditures using other Ethiopian data, finding insignificant impacts from both shocks.

The overall goals of this study are to explore how households change their food expenditure in response to unexpected idiosyncratic shocks and evaluate whether different shocks have different impacts among households, especially poor ones. Specifically, the study addresses the following three research questions:

RQ1. How did households change their food expenditures, including food consumption at home (AH) and away from home (AFH), after they suffered various kinds of income and expenditure shocks?

RQ2. What are the impacts of various idiosyncratic shocks on food consumption after controlling for income change?

RQ3. Does the response of household food spending to a similar shock differ among households with different income levels?

Answering these questions is important not only for a better understanding of food consumption behaviors under the risk of income or expenditure shocks but also for the important policy implications in developing countries. The study uses a unique data set focusing on four types of large idiosyncratic income and expenditure shocks drawn from a survey conducted in rural China. The results show that the impacts of positive shocks and negative shocks are asymmetric: negative income and expenditure shocks can result in a steep drop in food expenditure, but the impact of positive income shocks is marginal. After the impacts of changed income due to different idiosyncratic income and expenditure shocks are controlled for, the impact of positive income shocks on food expenditure disappears, but the impacts of different negative income and expenditure shocks remain significant, and they vary widely among adverse shock types. Moreover, these impacts differ among households according to their wealth: negative income and expenditure shocks reduce food spending among low-income households more drastically than they do among middle- and high-income households.

The rest of this paper is structured as follows. Section 2 introduces the study's data and sampling methods. The types and definitions of income and expenditure shocks and a descriptive analysis of the relationships between various idiosyncratic shocks and household food expenditures are discussed in Section 3. After discussing the empirical models used in this study, Section 4 describes the impacts of different idiosyncratic shocks on household food expenditures. The final section concludes and outlines several policy implications.

2. Study area, sampling methods, and data

A primary rural household survey was conducted by the authors to collect data for this study in December 2014 in Guangdong, a province in South China. Rural households in Guangdong have the seventh-highest average per capita income among China's 31 provinces (National Bureau of Statistics of China, 2015), but their income disparity is wider than the national average. The survey covered six counties from different regions in Guangdong. Within each county, three townships and three villages from each township were randomly selected. In total, 54 villages were selected for the survey.

In each village, ten households were selected for face-to-face interviews based on the following sampling methods. First, together with village leaders, the authors identified

the households that had experienced a large income or expenditure shock at some point over the past 12 months. A large idiosyncratic income or expenditure shock is defined as one that causes household expenditures or income to increase by more than double or household income to decline by more than half between December 2013 and November 2014[1]. Second, when more than seven households had experienced a large idiosyncratic income and expenditure shock in the past year, the authors randomly selected seven of these households, and the other three were randomly selected among the households that had not suffered a large shock to serve as the control group. Third, when only seven or fewer than seven households in a village had experienced a large idiosyncratic shock in the past year, the authors selected all the households (say, n households), and the rest ($10\text{-}n$) were randomly selected from among the households that had not suffered a large shock to serve as the control group. In total, 540 households were surveyed.

For each household, data were collected on: household characteristics, including basic information on individual household members (e.g. age, gender, and residence in the home in the past three days), household monthly net income, and housing and durable consumable assets valued more than 500 yuan at the time of the survey; household's total daily food expenditure, including food expenditure AH and AFH for each of the past three days[2]; and information on any large income or expenditure shock, including its type and exact time (month).

Among the 540 households, 14 had either incomplete data on food consumption in the past three days or did not meet this study's definition of large idiosyncratic income shock (e.g. their income had declined by less than half). These 14 households were thus excluded from the final analysis. Another 31 households were excluded because their living expenditures increased due to education, housing, or other expenses that would be expected by households and that caused changes in food consumption. The final sample comprised 495 rural households, 234 of which had experienced a large idiosyncratic income or expenditure shock, and 261 of which had not (see column 1, Table I).

3. Households' food expenditure with and without large idiosyncratic shocks

First, to analyze the survey data, the authors divided the sample households into three groups: households with large positive shocks (H_{I}), large negative shocks (H_{II}), and without shocks (H_0). The households with negative shocks were further divided into three groups. As shown in Table I, the samples are nearly equally distributed between the households with large shocks (47.3 percent) and without shocks (53.7 percent) because

	Proportion of samples (%)	Monthly income per capita (yuan) in December 2014
Households with large shocks (H_{I} or H_{II})	47.3	846
Positive shocks: income more than doubled (H_{I})	(15.9)	2,695
Negative shocks (H_{II}):		
Expenditure more than doubled ($H_{\mathrm{II}-1}$)	(48.7)	556
Income more than halved due to economic activities ($H_{\mathrm{II}-2}$)	(31.2)	494
Income fall more than halved due to death or illness of main income earner ($H_{\mathrm{II}-3}$)	(5.1)	355
Households without any big shock (H_0)	53.7	946
All households	100	899

Notes: The samples consist of 495 households. The numbers in parentheses are the proportions of samples within the households with large shocks
Source: Authors' survey in 2014

Table I.
Sample structure and monthly income per capita in the study area

there were 52 of 54 villages where the total number of households with large income or expenditure shocks in the past year was less than seven[3]. Households with large positive income shocks (or whose income more than doubled; H_{I}) accounted for 15.9 percent of the households with large shocks[4]. Most of the households had suffered expenditure increases of more than double ($H_{\mathrm{II}-1}$; 48.7 percent of households with large negative shocks)[5], followed by households whose income had been more than halved ($H_{\mathrm{II}-2}$; 31.2 percent of the households with large negative shocks)[6]. The fewest households were those whose income had been more than halved due to the death (eight households) or illness (four) of the main income earner ($H_{\mathrm{II}-3}$; 5.1 percent only; see Table I). The large variation in per capita monthly income among different groups of households reflects either positive or negative income shocks. The authors also collected unreported information on the monthly income of H_{I} and H_{II} households for the month right before the shocks. The results show that the average monthly income per capita in the month right before the shock for all households with large shocks was 981 yuan, very close to the average monthly income per capita (946 yuan) in December 2014 for households without shocks (the difference is not statistically significant; $t = 0.31$). This implies that the households without shocks constitute a valid control group in this study's econometric analysis, to be presented later.

The definitions and statistics of all variables used in this study are summarized in Table II. In addition to the four types of large income and expenditure shock discussed above, Table II also reports the means and standard deviations of other variables such as the category variables for income group, number, gender, and age of the household members. On average, 3.72 members of a household stayed home during the survey. Among these, fewer than half (49.19 percent) were males, which is reasonable because more males migrate for off-farm employment than do females (Zhi *et al.*, 2013).

Consistent with expectation, Figure 1 shows that the large positive income shocks were positively associated with household per capita food expenditure, while large negative shocks were negatively correlated. For example, households whose income more than doubled had higher total food expenditures (for H_{I}, 15.0 yuan/day, or about 13 percent higher)

Variable	Definition	Mean	SD
H_0	1 = households without any large shock; 0 = otherwise	0.53	0.5
H_{I}	1 = households with a large positive shock (income more than doubled); 0 = otherwise	0.07	0.26
H_{II}	1 = households with a large negative shock; 0 = otherwise	0.4	0.49
$H_{\mathrm{II}-1}$	1 = households with expenditure more than doubled; 0 = otherwise	0.23	0.42
$H_{\mathrm{II}-2}$	1 = households with income more than halved due to economic activities; 0 = otherwise	0.15	0.35
$H_{\mathrm{II}-3}$	1 = households with income more than halved due to death or illness of main income earner (MIE); 0 = otherwise	0.02	0.15
D_L	1 = households in low-income group; 0 = otherwise	0.34	0.47
D_M	1 = households in middle-income group; 0 = otherwise	0.33	0.47
D_H	1 = households in high-income group; 0 = otherwise	0.33	0.47
Pop	Numbers of population that stay at home	3.72	1.98
S-male	Share of male population (%)	49.19	16.33
S-age 16	Share of population aged less than 16 (%)	16.65	18.77
S-age 16-35	Share of population aged 16-35 (%)	28.61	20.75
S-age 35-50	Share of population aged 35-50 (%)	23.54	25.55
S-age 50	Share of population aged over 50 (%)	31.14	26.04

Source: Authors' survey (2014)

Table II. Definitions and statistics of all variables used in this study

than did households without shocks (for H_0, 13.3 yuan/day). On the other hand, the per capita total food expenditures of households that had experienced a large negative shock were always about 20 percent lower than were those of households without shocks, ranging from 17 percent (H_{II-2}, income more than halved through economic activities) to 29 percent (H_{II-1}, expenditure more than doubled; see left-hand side of Figure 1). Similar results were obtained for food expenditure AH between households with and without large shocks (see middle of Figure 1). While food expenditure AFH is smaller, the adverse impacts of negative shocks on food expenditure AFH are also evident from the data (see right-hand side of Figure 1).

While the overall pattern of food expenditure described above was also found among households with different income levels after they had experienced a large income or expenditure shock, interesting differences were observed in the relative changes in food expenditures per capita between poor and rich households that suffered large negative shocks (H_{II}). We first sorted the sample households according to their wealth, measured by the per capita value of housing plus durable consumption assets and then divided them into three equal groups: low-, middle-, and high-income households[7]. As expected, average per capita daily food expenditure was highest for the high-income households (14.0 yuan/day), followed by the middle-income households (13.6 yuan/day), and the low-income households (12.2 yuan/day) among households that did not experience any shock (see row 3, Table III). However, Table III also shows that the percentage difference in per capita food expenditure for low-income households (−25.4 percent) between those with large negative shocks and those without any shocks was much larger than was that for the high-income households (−14.3 percent). This implies that low-income households not only consumed less food than did the high-income households but also cut their food consumption more after suffering a large income or expenditure shock. However, the even greater difference in per capita total

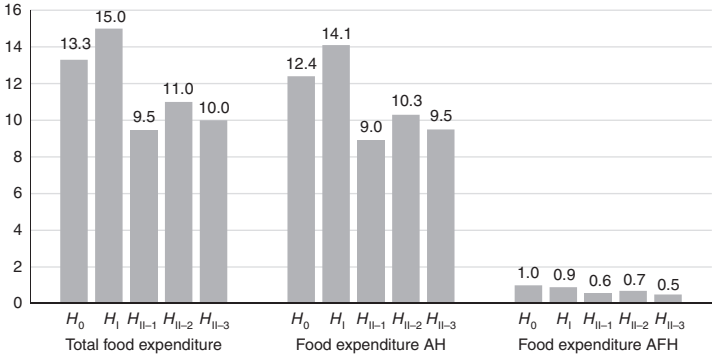

Figure 1.
Per capita total food expenditure (yuan/day), food expenditure AH and AFH by type of shock

Table III.
Per capita total food expenditure (yuan/day) for the households without any shock, with large positive income shocks, and large negative shocks

	Low-income households	Middle-income households	High-income households
Households with large positive shocks (H_I)	13.2 (8.2)	14.3 (5.1)	16.2 (15.7)
Households with large negative shocks (H_{II})	9.1 (−25.4)	10.0 (−26.4)	12.0 (−14.3)
Households without any big shock (H_0)	12.2	13.6	14.0

Notes: The numbers in parentheses are the percentage difference (percent) of total food expenditure of households with large shocks compared with that of households without any shock
Source: Authors' survey, 2014

food expenditures (−26.4 percent) between the households with large negative shocks and those without any shocks among middle-income households is difficult to explain; an explanation may require a multivariate analysis that can control for the impacts of other factors in the surveyed data.

4. Multivariate analysis

4.1 Multivariate model

This section determines the impacts of large income and expenditure shocks on the food expenditures of rural households, especially poor ones, using a multivariate framework. To do this, as in many previous studies (Asfaw and Qian, 2004; Bloemem and Stancanelli, 2005; Islam and Maitra, 2012), we use the following empirical model:

$$\ln E_i = b_0 + b_{1k} H_{Ii} + \sum_k \left(b_{2k} H_{(II-k)i}\right) + b_3 \ln Y_i + b_4 H_{Ii} D_{Mi}$$

$$+ b_5 H_{Ii} D_{Hi} + b_6 H_{IIi} D_{Mi} + b_7 H_{IIi} D_{Hi} + \sum_s (b_{8s} Z_{is}) + u_i \quad (1)$$

where ln E_i in Equation (1) is the log form of per capita daily food expenditure for the ith household in December 2014 when the survey was conducted[8]. H_I is a dummy variable that takes a value of 1 if a household experienced a large positive income shock (income more than doubled) and 0 otherwise. H_{II-k} is a set of three dummy variables ($k = 1, 2, 3$) for three types of negative income or expenditure shocks (see Table II for details). ln$Y$ is the log form of per capita monthly income in December 2014. To analyze how the impacts of large income or expenditure shocks on household food expenditures differ among households, a set of interaction variables were introduced between income groups (D_M and D_H; see Table II) and types of large shock (H_I and H_{II}), using low-income households as the base group for comparison. Z is a set of household characteristics and regional dummies (village dummies). The variables representing household characteristics used in the equations include the number of family members who stay AH, the share of males, and the share of members aged 16-35, 35-50, and 50 or older (see Table II). The b's are coefficients to be estimated, and u_i is the error term that satisfies $E(u_i) = 0$.

4.2 Estimation approach

To see how large income or expenditure shocks affect household food expenditure, Equation (1) is estimated in four steps. First, the monthly income variable (ln$Y$) and the interaction terms between income groups (D_M and D_H) and types of large shock (H_I and H_{II}) are excluded. The estimation results are presented in column 1 of Table IV. Because (as mentioned) the average per capita monthly income of the households without large shocks was similar to that of the households with large shocks right before the shocks occurred, this specification allows us to determine the total impacts of each of the four types of income and expenditure shock on food expenditures. Second, the interaction terms between income groups (D_M and D_H) and types of large shock (H_I and H_{II}) are added to the above specification, which helps us determine whether the impacts on food expenditure of large positive and negative shocks differ among the low-, middle-, and high-income groups. The estimation results are presented in column 2 of Table IV. Third, ln$Y$ is included in the first specification to allow us to divide the impacts on food consumption of the large income and expenditure shocks into the long-term income effect and the effect that cannot be explained by the income variable (ln$Y$), or the "short-term idiosyncratic shock effect." The estimation results are shown in column 3 in Table IV. Finally, the entire model of Equation (1) is estimated. All models are estimated using OLS regression.

	Ln (food expenditure)	Ln (food expenditure)	Ln (food expenditure)	Ln (food expenditure)
H_{I}	0.082 (0.047)*	0.058 (0.070)	0.044 (0.044)	0.052 (0.076)
$H_{\mathrm{II}-1}$	−0.341 (0.041)***	−0.412 (0.048)***	−0.249 (0.040)***	−0.319 (0.047)***
$H_{\mathrm{II}-2}$	−0.234 (0.106)**	−0.332 (0.112)***	−0.106 (0.075)	−0.204 (0.082)**
$H_{\mathrm{II}-3}$	−0.190 (0.041)***	−0.283 (0.052)***	−0.087 (0.036)**	−0.175 (0.048)***
Ln(Y)			0.171 (0.019)***	0.165 (0.019)***
H_{I}*D_M		−0.071 (0.112)		−0.075 (0.103)
H_{I}*D_H		0.091 (0.084)		0.027 (0.087)
H_{II}*D_M		0.076 (0.056)		0.085 (0.050)*
H_{II}*D_H		0.245 (0.067)***		0.204 (0.059)***
Pop	−0.043 (0.010)***	−0.045 (0.010)***	−0.035 (0.009)***	−0.037 (0.009)***
S-male	0.007 (0.001)***	0.006 (0.001)***	0.005 (0.001)***	0.005 (0.001)***
S-age 16-35	0.003 (0.001)**	0.003 (0.001)**	0.002 (0.001)	0.001 (0.001)
S-age 35-50	0.004 (0.001)***	0.004 (0.001)***	0.003 (0.001)***	0.003 (0.001)***
S-age 50	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
Village dummies	Included but not reported			
Constant	2.389 (0.161)***	2.427 (0.158)***	1.369 (0.192)***	1.436 (0.191)***
R^2	0.506	0.526	0.587	0.600

Table IV. Estimated parameters of household per capita daily food expenditure

Notes: The samples consist of 495 observations. Robust standard errors appear in parentheses, and *,**,***Significant at the 10, 5, and 1 percent levels, respectively

4.3 Estimation results

Overall, the estimation results are reasonable. Most of the estimated coefficients are statistically significant, have the expected signs, and are largely consistent with the descriptive analysis presented in the previous section. R^2 values range from about 0.506 to 0.600 (see columns 1-4 in Table IV) and are fairly high for an analysis using cross-section household data. As the study is interested in the impacts of large idiosyncratic income and expenditure shocks, the discussion below focuses on the estimated coefficients of dummy variables H_{I}, $H_{\mathrm{II}-1}$, $H_{\mathrm{II}-2}$, and $H_{\mathrm{II}-3}$ and the interaction terms between the nature of the large shocks (H_{I} or H_{II}) and household wealth (D_m or D_H).

The estimation results show that the impacts of all large income and expenditure shocks on food expenditure are statistically significant and appear large for the negative shocks but moderate for the positive income shocks (see column 1 in Table IV). The estimated coefficient of H_{I}, which is positive (0.082) and statistically significant, shows that per capita daily food expenditures increased by 8.2 percent among households that experienced a large positive income shock. Given the magnitude of the rise in income (more than double), this should be considered a mild impact. However, the estimated coefficients for $H_{\mathrm{II}-1}$, $H_{\mathrm{II}-2}$, and $H_{\mathrm{II}-3}$ suggest that households reduced their food expenditure significantly after suffering a large negative shock. Moreover, the adverse effects on household food expenditure differ among the three types of negative shock. The greatest reduction in food expenditure is found among households with expenditure shocks of more than double, followed by the households whose income was more than halved (see column 1 in Table IV). For example, the estimated coefficient of $H_{\mathrm{II}-1}$ (−0.341; see row 2, column 1) shows that, compared to households without any shocks, the households whose expenditures more than doubled reduced their per capita daily food expenditure by more than 30 percent. When the incomes of households that experienced the other two types of large negative shock fell by more than half (see rows 3 and 4, column 1), their food expenditures declined between 19 and 24 percent. While these findings are generally consistent with studies that also showed declining household food expenditures in response to negative idiosyncratic shocks (Dynarski and Gruber, 1997; Deininger *et al.*, 2007; Islam and Maitra, 2012), this study found

that the impacts are greater and differ significantly among adverse income and expenditure shocks. The large impacts found in this study can be explained by the fact that it used a much stricter criterion for selecting idiosyncratic shocks (e.g. expenditure more than doubled or income more than halved). The greater impact of expenditure shocks than that of adverse income shocks is interesting and supports prioritizing assistance for rural households in improving their food consumption when they suffer income or expenditure shocks.

The estimation results of the model to which were added interaction terms of the nature of the shocks (positive vs negative) and household wealth reveal that the impacts of large income or expenditure shocks differ between poor and rich households (see column 2). In this model specification, for the positive shocks (income more than doubled), the estimated coefficient of variable H_{I} becomes statistically insignificant, and the interaction terms of $H_{\mathrm{I}}{}^{*}D_{M}$ and $H_{\mathrm{I}}{}^{*}D_{H}$ are also statistically insignificant. These results suggest that, for rural households, the increased income from positive income shocks might be largely saved or spent on expenditures other than for food consumption.

The results presented in column 2 of Table IV also show that the impacts of negative shocks (H_{II}) differ significantly among households: high-income households can largely maintain their food consumption levels, but other households cannot. For example, the estimated coefficients for all $H_{\mathrm{II}-1}$, $H_{\mathrm{II}-2}$, and $H_{\mathrm{II}-3}$ become more negative than the results presented in column 1, and the coefficients for $H_{\mathrm{II}}{}^{*}D_{H}$ and $H_{\mathrm{II}}{}^{*}D_{M}$ are positive and statistically significant in $H_{\mathrm{II}}{}^{*}D_{H}$. These results suggest that the lower the household's income, the greater the reduction in food expenditure after a negative income or expenditure shock. For low-income households, per capita food expenditures fell by 41.2,33.2, or 28.3 percent after $H_{\mathrm{II}-1}$, $H_{\mathrm{II}-2}$, or $H_{\mathrm{II}-3}$ shock, respectively (see rows 2 to 4, column 2). However, while high-income households also spent less on food consumption after large negative shocks, their reduction in per capita food expenditure was 24.5 percentage points lower than that of the low-income households (0.245, coefficient for $H_{\mathrm{II}}{}^{*}D_{\mathrm{H}}$; see column 2, Table IV).

Adding $\ln Y$ as an independent variable to the model specification in column 1 provides evidence of the effects of the large income and expenditure shocks through the two channels: change in income (income elasticity) and the short-term food consumption response not captured by the income variable[9]. The estimated coefficient of $\ln Y$ is positive (0.171; see column 3, Table IV) and statistically significant. All estimated coefficients for $H_{\mathrm{II}-1}$, $H_{\mathrm{II}-2}$, and $H_{\mathrm{II}-3}$ become smaller than the results in column 1 because the impacts have been captured by the change in income. The estimated coefficient of H_{I} (income more than doubled) is still positive but is statistically insignificant.

The full model of Equation 1 with both income change and different impacts on poor and rich households from large income or expenditure shocks is presented in column 4 of Table IV. While the overall results are robust across different model specifications, three points are worth mentioning. First, for the large positive income shocks (H_{I}, income more than doubled), the estimated food expenditure elasticity with respect to income (0.165; see column 4) suggests that food expenditure should increase by more than 16 percent; however, the identified impact (8 percent in column 1) is much lower, indicating much higher saving and/or non-food expenditures. Second, after the income impact is controlled for, low-income households further reduced their per capita food expenditure by 31.9 percent when their expenditures more than doubled ($H_{\mathrm{II}-1}$). Finally, for households whose income was more than halved ($H_{\mathrm{II}-2}$ and $H_{\mathrm{II}-3}$), food expenditure decreased by more than 8 percent, as implied by the estimated food expenditure elasticity with respect to income. After the income impact is controlled for, their food expenditure was further reduced by another 20.4 percent ($H_{\mathrm{II}-2}$) and 17.5 percent ($H_{\mathrm{II}-3}$). Adding up the two impacts, the total impacts are more than 28 percent (8 + 20.4 percent) for $H_{\mathrm{II}-2}$ and 25 percent (8 + 17.5 percent) for $H_{\mathrm{II}-3}$.

Interestingly, the estimated coefficients of the interaction terms H_{II}*D_M and H_{II}*D_H are statistically significant, with values of 0.085 and 0.204, respectively. These results suggest that the impact of large negative shocks on the percentage of food expenditure reduction was greatest for low-income households. Middle- and high-income households reduced their food expenditures by 8.5 and 20.4 percent, respectively, less than for low-income households.

Regarding the demographic variables in the per capita food expenditure equations, all the estimated coefficients have the expected signs, and most are statistically significant. The negative coefficients of Pop suggest that per capita food spending is negatively correlated with household size, as larger households may be associated with less food waste, a finding consistent with many studies (e.g. Huang and Bouis, 2001; Jiang and Davis, 2007; Zheng and Henneberry, 2010). The share of the male population, *S*-male, has positive and statistically significant coefficients, suggesting that males consumed more food or spent more on food. Household members between 16 and 35 and between 35 and 50 consumed more food than did children younger than 16, which is also consistent with many studies (e.g. Huang and Bouis, 2001; Gould and Villarreal, 2006; Zheng and Henneberry, 2009).

To check the robustness of the results, propensity score matching (PSM) estimation is used. The PSM estimations are conditional on income levels and household characteristics being the same as in the OLS regressions. The results are presented in Table V, which shows that the PSM estimation results are highly consistent with the results of the OLS regressions. For households with large positive income shocks (H_I), their average treatment effect for the treated (ATT) is estimated to be positive but statistically insignificant, suggesting that, after income is controlled for, households do not increase their food expenditure significantly in response to large income shocks, as suggested by the OLS regression results (see row 2 column 4, Table IV). The ATT of H_{II-1} and H_{II-2} are estimated to be negative and statistically significant, and the estimated ATT (−0.275 for H_{II-1}, −0.155 for H_{II-2}) are similar to the results of the OLS regression. The ATT of H_{II-3} is not statistically significant, perhaps due to the small number of observations (see row 4, Table V).

5. Concluding remarks

Using data on household food expenditures and large income or expenditure shocks collected in rural China, this paper investigates how rural household food expenditures change in response to different income and expenditure shocks and how these impacts differ among different households, especially poor ones. The survey results for the study areas show that the major large negative income or expenditure shocks arise from expenditure increases due to illness and income reductions due to losses in agricultural production or non-agriculture self-employment or from sudden unemployment. On average, rural households reduce their per capita food expenditure by between 25 percent to more than 30 percent.

Table V.
Estimated impacts of large income and expenditure shocks on household food expenditure using propensity score matching (PSM) estimation

	n treatment	*n* control	Average treatment effect for the treated (ATT)	SE	*t*-stat
H_I	35	32	0.071	0.068	1.054
H_{II-1}	114	75	−0.275***	0.056	−4.914
H_{II-2}	73	54	−0.155***	0.068	−2.276
H_{II-3}	12	8	−0.214	0.166	−1.290

Notes: We use the nearest neighbor matching with replacement. Following Smith and Todd (2005), we match the rural households based on the log odds ratio, and standard errors are bootstrapped using 1,000 replications. ***Significant at 1 percent level

The extent of the impacts depends on the type of expenditure or income shock. The greatest impact occurs when expenditure is more than doubled, followed by when income is more than halved. These results imply that, while it is essential to smooth food consumption when households in rural China face various large income or expenditure shocks, more attention should be paid to the large expenditure shocks due to illness and other unexpected large expenditures. The literature has shown that improving rural health insurance and access to formal credit can mitigate the impacts of adverse shocks on food consumption (Gertler and Gruber, 2002; Wagstaff, 2007; Dartanto and Nurkholis, 2010).

The impacts of large income or expenditure shocks on food expenditure vary significantly among households. In general, low-income households are much more sensitive to these shocks, and their food expenditure reductions are greater than are those of high-income households. Improving the ability of low-income households, particularly the poor, to mitigate the adverse effects of large shocks on food consumption is critical. However, when middle-income households in rural China face similarly large negative shocks, their food consumption reductions do not differ significantly from those of low-income households. These results suggest that, while much more attention should be paid to the poor, smoothing the food consumption of many middle-income households is also necessary.

Finally, this study finds that the impacts of large positive income shocks are moderate. The consequent increases in food expenditure are much lower than the value implied by the income elasticity of food expenditure. This may imply a much higher saving rate and/or more non-food expenditure responses to large positive income shocks, though further investigation of this issue is required.

Notes

1. Gertler and Gruber (2002) suggested using measures of more severe shocks to fully assess the ability of household to ensure consumption. Compared with most previous studies, our sampling approach uses a much stricter criterion to define large idiosyncratic income and expenditure shocks.
2. The values of home-produced foods were calculated at local market prices.
3. The average number of households among 54 villages was 823 in December 2014.
4. Large positive income shocks (increases of more than double; H_{I}) include those from existing agricultural production, non-agriculture self-employment, or the recent labor participation of youth.
5. They include cases where expenditures more than doubled ($H_{\mathrm{II}-1}$) due to illness.
6. They include cases where income was more than halved ($H_{\mathrm{II}-2}$) due to losses in agricultural production or non-agriculture self-employment or from sudden unemployment.
7. If households with either type of shock are grouped according to household wealth (three groups × four shocks), some groups have only a few observations; for example, the groups of both middle- and high-income households whose income more than halved due to the death/illness of the main income earner (MIE) have only three observations. Therefore, we analyze food expenditures and large income or expenditure shocks using two aggregate groups: those with large positive (H_{I}) and those with large negative (H_{II}) shocks.
8. We also run a model that includes the share of food expenditure away from home out of total food expenditures to test whether large shocks have different impacts on food AFH and food AH. However, the hypothesis of different impacts is rejected. To save space, we omit this model and regression results.
9. After large income or expenditure shocks, households may adjust their food production within a sufficient time period (e.g. in the next crop season or next year). However, our data show that, on average, only 3.3 months had elapsed between the survey and the income shocks, suggesting that we can ignore the impact of the shocks on food expenditure through their impacts on food production changes.

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Further reading

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