

The Variety Engel Curve in China: Welfare Gains from Dietary Diversity Amid Economic Shocks^{*}

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Abstract

This study analyzes the patterns, sources, and welfare implications of differences in food consumption diversity amidst the backdrop of China's economic growth from 1995 to 2015. Using rich, widely available panel data on food expenditures, we implement an Engel curve approach that incorporates endogenous variety choice. Our analysis reveals a 12% increase in the number of food varieties consumed, which corresponds to a 20% welfare gain. Our decompositional analysis indicates that, in contrast to the benefits of marginal varieties and the costs of accessing them, household expenditure is the primary driver of variety differences. This finding stands in contrast to a seminal study using data from India. Furthermore, we employ a causal inference framework to examine the welfare implications of two epochal events that precipitated significant shifts in the variety Engel curve: China's accession to the WTO and the 2008 global financial crisis.

Keywords: Engel Curves; foodstuffs; dietary variety; economics of household

JEL Codes: D12; O12; R13

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“Variety is the spice of life.”

- *The Task*, by William Cowper (1785)

1 Introduction

The transition from a monotonous, staple-heavy diet to a more diversified one is a ubiquitous feature of economic development. However, dietary diversity remains markedly constrained in many developing countries, which arguably accounts for a substantial portion of the welfare disparity between rich and poor nations.¹ *A priori*, one might assume limited diversity is solely a consequence of low income; however, recent studies suggest it is also contingent upon location-specific factors, such as the retail environment (Li, 2021) or intra-household dynamics, including conflicts of interest within the household (Chiappori & Naidoo, 2020). This notion comports with a long-standing body of literature in consumer theory that examines income-group-specific welfare changes using (food) consumption data (Fajgelbaum & Khandelwal, 2016; Jaravel, 2019; Comin, Lashkari & Mestieri, 2021; Handbury, 2021).

Traditional theory posits that the budget share allocated to food serves as an indicator of household welfare, with the rate of this decline as income rises defining the shape of the food Engel curve.² However, there are at least two reasons why conventional Engel curves may not plenarily capture the welfare gains associated with food consumption. First, wealthier households and countries tend to consume a broader variety of foods than their poorer counterparts, and these endogenous differences in variety complicate efforts to infer welfare gains from a traditional Engel curve perspective (Ligon, 2020; Li,

¹Detailed statistical data can be found in FAO (2012). Dietary diversity is a qualitative measure of food consumption that reflects household access to a variety of foods and serves as a proxy for the nutrient adequacy of individuals’ diets.

²The food Engel curve refers to the empirical observation that as households become wealthier, a smaller fraction of their total expenditures is dedicated to food and other necessities, while a larger fraction is spent on luxuries (Deaton & Muellbauer, 1980; Lewbel, 2008; Chai & Moneta, 2010).

2021). Second, external shocks and household responses to significant economic events have not been incorporated into the estimation of Engel curves (Atkin, Faber, Fally & Gonzalez-Navarro, 2024). While a substantial body of theoretical econometrics literature has established a rigorous technical foundation for estimating Engel curves³, the patterns of food consumption quantity and variety, along with their associated welfare implications, have heretofore received scant attention in the literature and in policy-making processes.

Our paper contributes some of the nascent empirical evidence on this issue. We utilize rich, yet widely available, household-level panel data to analyze the welfare implications of food consumption variety from 1995 to 2015 deploying the theoretical apparatus of Li (2021). This "variety Engel curve" approach incorporates diminishing marginal utility from quantity and transaction costs of accessing variety. Our study extends previous research that estimated and decomposed the variety Engel curve using data from India, by examining the ramifications of two epochal events in China—its accession to the WTO and the 2008 global financial crisis—that plausibly influenced household food consumption diversity.⁴

China's rapid economic growth subsequent to the market-oriented reforms of the 1980s provides an unparalleled setting to examine the economic implications of its dietary transition. In the 1990s⁵, China was one of the world's most impoverished countries, with households consuming a limited number of food varieties (Anderson, 1988; Liu, Shively & Binkley, 2014). By 2015, the number of food varieties consumed had steadily increased (Figure 1). This chronological variation, combined with pronounced cross-sectional heterogeneity between, for example, rural and urban areas or inland and coastal regions, renders China an ideal empirical laboratory to study the dietary transition and its welfare implications. Furthermore, two conspicuous inflections are evident in Figure 1. A preponderance of anecdotal evidence from government officials, journalists, and NGOs

³See e.g. Kakwani (1978), Hausman, Newey & Powell (1995), Lewbel & Pendakur (2008), Battistin & Nadai (2015) **and** Newey & Stouli (2021).

⁴We use the terms dietary diversity and (food) consumption diversity interchangeably.

⁵The first year of our sample period is 1995.

suggests that China's accession to the WTO and the 2008 global financial crisis exerted a profound influence on the consumption patterns of Chinese households.⁶ Our analysis leverages a long-panel household expenditure dataset that includes comprehensive records of consumption across a wide array of food varieties since the 1990s, encompassing data on quantity, price, and other attributes. This rich data allows us to structurally estimate the variety Engel curve without imposing overly strong assumptions.

We begin our analysis with a structural estimation of the variety Engel curve model parameters. Our findings indicate a 12% increase in the number of food varieties consumed between 1995 and 2015, corresponding to a 20% improvement in overall welfare. A decompositional analysis delineates that growth in consumer expenditure on food accounts for approximately 10% of the observed increase in dietary variety over this period. Additionally, growing benefits from new varieties and diminishing access costs contribute 5% and 4% of the increase, respectively. This composition of welfare determinants stands contrast with those observed in India, where consumer food expenditure contributed 4.7%, while the benefits of marginal varieties and access costs contributed 5.1% and 46.9%, respectively (Li, 2021).

As noted, we observe two conspicuous inflections: one in 2002, when China joined the WTO, and another in 2008, during the global financial crisis (Lardy & Subramanian, 2011; Brandt, Van Biesebroeck, Wang & Zhang, 2017). To analyze the two events, we employ a causal inference strategy by implementing a "Difference-in-Differences" approach, comparing two sources of variation—before versus after and regional higher versus lower exposure—within our welfare framework.⁷

⁶See, e.g.: <https://www.cctv.com/wto/sanji/xiaofei.html>.

⁷We combine measures of exposure to China's WTO accession and the 2008 global financial crisis with panel data on the consumption varieties of rural households, collected by the Chinese Ministry of Agriculture's National Fixed-Point Survey (NFPS) from 1995 to 2015. The survey's questionnaire and structure changed significantly in 1995, so we focus on the period thereafter. In addition to its long panel dimension, this dataset is somewhat rare among household surveys by its large sample size and broad geographic coverage (Benjamin, Brandt & Giles, 2005; Chari, Liu, Wang & Wang, 2021). To address a key limitation of the NFPS, which lacks data on urban households, we supplement our primary analysis with data from the Urban Household Survey (UHS), collected by the National Bureau of Statistics.

The first source of variation arises from temporal differences before and after each event. The key identifying assumption is that the timing of these events is plausibly exogenous. China's accession to the WTO was driven by high-level political negotiations and thus should be orthogonal to contemporaneous household behavior. Similarly, the global financial crisis was precipitated by exogenous factors, namely the U.S. real estate mortgage market, rather than by Chinese domestic socioeconomic conditions at the time.

The second source of variation comes from regional geographic conditions—specifically, the extent to which regions were exposed to the WTO accession and the global financial crisis. These geographic attributes are widely considered to be orthogonal to consumers' food consumption decisions. Our identification strategy, therefore, hinges on pairwise comparisons across four scenarios—before and after, across regions with varying degrees of exposure—within our welfare decomposition framework.

Our findings indicate that China's WTO accession resulted in a welfare gain of 23.7%. As indicated by our "Difference-in-Differences" estimations, both the benefits of marginal variety and reductions in the costs of accessing varieties were instrumental in this welfare gain. In contrast, our analysis of the 2008 global financial crisis suggests a welfare loss of up to 16.0%; during this period, household food consumption was characterized by decreasing benefits from marginal varieties and rising access costs.

Our study contributes to two strands of literature. The estimation of food Engel curves, in the intellectual lineage of Working (1943), Leser (1963), and Deaton & Muellbauer (1980), has long been used to analyze changes in household welfare and food demand. Our analysis, implementing the approach of Li (2021), represents a nascent attempt to elucidate the nexus between food consumption and income while accounting for changes in food diversity. Our study also speaks to and informs a venerable body of literature that uses traditional Engel curves and expenditure changes for income-elastic goods—typically foodstuffs—to infer unobserved fluctuations in real income (Costa, 2001; Hamilton, 2001; Almås, 2012; Young, 2012; Nakamura, Steinsson & Liu, 2016; Atkin, Faber & Gonzalez-

Navarro, 2018; Atkin, Faber, Fally & Gonzalez-Navarro, 2024). This approach has been adopted to estimate food Engel curves in China and to deduce its implications for CPI bias (Nakamura, Steinsson & Liu, 2016), inflation (Almås & Johnsen, 2012; Honge Gong & Meng, 2008), and income inequality (Wang & Woo, 2011; Chamon & de Carvalho Filho, 2014).

Our study also interfaces with a burgeoning body of literature on the causes and consequences of changes in dietary diversity (Dabalen & Paul, 2014; Berti, 2015; Sibhatu, Krishna & Qaim, 2015; Korir, Rizov & Ruto, 2023; McIntosh & Zeitlin, 2024). While recent studies in this area concentrate on the roles of cash transfers or conflicts in determining dietary diversity, they have, to our knowledge, not systematically interrogated the welfare implications of such shock-induced alterations in diversity. We utilize household-level panel data and recent methodologies to study the welfare gains from dietary diversity in the context of two major economic shocks in China. Our findings may enrich the scholarly understanding of both the antecedents (shocks) and consequences (welfare gains) of changes in dietary diversity.⁸

The remainder of the paper is organized as follows. Section 2 introduces the variety Engel curve approach. Section 3 presents the empirical results of the estimation of the variety Engel curve. Section 4 presents additional results. Section 5 concludes and discusses the policy implications of our paper.

2 The Variety Engel Curve Model

We adopt the variety Engel curve framework of Li (2021) to model household consumption decisions over both varieties and quantities. In this framework, a household with constant elasticity of substitution (CES) preferences makes its consumption decision in two stages.

⁸Our study may also speak to a line of literature that focuses on the causes and consequences of social, economic, and genetic diversity (e.g. Ashraf & Galor, 2013; Alesina, Harnoss & Rapoport, 2016; Arbatli, Ashraf, Galor & Klemp, 2020; Galor, Klemp & Crisóstomo Wainstock, 2024).

In the first stage, the household chooses the number of distinct varieties to consume, weighing the utility gains from increasing variety against the costs associated with accessing them. In the second stage, given the chosen number of varieties, the household allocates its total expenditure across them to maximize utility. The model is solved via backward induction: we first solve the second-stage allocation problem conditional on a given number of varieties, and then solve for the optimal number of varieties in the first stage.

Formally, for a given number of varieties n , the household solves:

$$\max_{\{q_i\}_i^n} \left(\sum_{i=1}^n z_i q_i^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \quad \text{s.t.} \quad \sum_{i=1}^n p_i q_i \leq X \quad (2.1)$$

where z_i denotes the preference weight (e.g., taste or quality) for variety $i (\in \{1, \dots, n\})$, σ is the elasticity of substitution across varieties, p_i and q_i are the price and quantity of variety i , and X is total expenditure. We assume $\sigma > 1$ to ensure the diminishing marginal utility of quantity for each variety. Solving this second-stage problem yields the standard CES demand function: $q_i = z_i \frac{X}{P(n)} \left(\frac{p_i}{P(n)} \right)^{1-\sigma}$, with $P(n) = \left(\sum_{i=1}^n z_i p_i^{1-\sigma} \right)^{1/(1-\sigma)}$. The term $P(n)$ is the CES price index over the chosen set of varieties. The expenditure (cost-of-living) function associated with utility level U_0 is $X(U_0, P(n)) = U_0 P(n)$. Because $\sigma > 1$, the household experiences diminishing marginal utility from consuming a greater quantity of any single variety, which provides an incentive to expand the number of varieties as expenditure rises.

To explain why households do not consume all available varieties, the model introduces a cost of increasing variety, assumed to follow the function: $VC(n) = F \cdot n^\varepsilon$, where n is the number of varieties consumed, and F, ε are parameters governing the level and curvature of variety access costs. This cost can arise from logistical frictions or market access constraints. The model assumes that varieties are ranked such that their marginal contribution to utility declines according to a specified rule: $z_i p_i^{1-\sigma} = \left[1 + \frac{1-\sigma}{\theta} \right] i^{\frac{1-\sigma}{\theta}}$, where

θ measures the asymmetry across varieties (i.e. the rate at which marginal varieties become less valuable). It allows the CES price index to be simplified to a power function of the variety : $P(n) = n^{-\psi}$, with $\psi = \frac{1}{\sigma-1} - \frac{1}{\theta}$, where ψ governs the benefits from the marginal variety. A higher value implies a steeper variety Engel curve, as visualized in Figure B.1 .

The household's first-stage optimization problem can then be written as:

$$\max_n U = Xn^\psi - Fn^\epsilon \quad (2.2)$$

which yields the optimal variety choice: $n^* = \left(\frac{X\psi}{F\epsilon}\right)^{1/(\epsilon-\psi)}$. Taking logarithms yields the log-linear variety Engel curve: $\ln n = \frac{1}{\epsilon-\psi} \ln\left(\frac{\psi}{F\epsilon}\right) + \frac{1}{\epsilon-\psi} \ln X$, which describes the relationship between expenditure and food consumption variety. This relationship provides a basis for decomposing differences in variety between two periods (indexed 0 and 1) into three interpretable components:

$$\begin{aligned} \ln\left(\frac{n_1}{n_0}\right) = & \underbrace{\frac{1}{\epsilon_1 - \psi_1} \ln\left(\frac{X_1}{X_0}\right)}_{\text{expenditure difference}} \\ & + \underbrace{\frac{1}{\epsilon_1 - \psi_1} \ln\left(\frac{\psi_1}{\psi_0}\right) + \left(\frac{1}{\epsilon_1 - \psi_1} - \frac{1}{\epsilon_1 - \psi_0}\right) \ln\left(\frac{X_0\psi_0}{F_0\epsilon_0}\right)}_{\text{benefits of marginal variety difference}} \\ & + \underbrace{\frac{1}{\epsilon_1 - \psi_1} \ln\left(\frac{F_0\epsilon_0}{F_1\epsilon_1}\right) + \left(\frac{1}{\epsilon_1 - \psi_0} - \frac{1}{\epsilon_0 - \psi_0}\right) \ln\left(\frac{X_0\psi_0}{F_0\epsilon_0}\right)}_{\text{access cost of varieties difference}} \end{aligned} \quad (2.3)$$

As shown in Equation 2.3, the variety difference is decomposed into three components: (1) expenditure difference (X), i.e., how much of the variety difference is driven by income or total spending, (2) benefits of marginal variety difference (ψ), which represents how the benefits of marginal varieties differs across regions or over years affect the decision of variety consumption, reflecting differences in the marginal utility of variety, and (3) access cost of varieties (F, ϵ), which shows how differences in access cost of varieties affect

varieties consumed.⁹

Finally, the model implies an expenditure (cost-of-living) function for a given utility level U_0 : $X(U_0, \eta, F) = U_0^{1-\eta} F^\eta \Psi$, with $\eta = \psi/\varepsilon$, $\Psi = \left(\eta^{\eta/(1-\eta)} - \eta^{1/(1-\eta)} \right)^{\eta-1}$. The welfare gain from a change in the variety consumption can thus be expressed as a compensating variation of expenditure: $1 - \frac{X(U_0, \eta_1, F_1)}{X(U_0, \eta_0, F_0)}$. This expression provides a measure of the welfare change required to hold a household's utility constant following a change in the parameters governing access to variety.

3 Empirical Analyses

This section presents the empirical implementation of the variety Engel curve model. We begin by estimating the structural parameters that govern household variety demand, as implied by the theoretical framework. Based on these estimates, we then quantify the sources and welfare consequences of variety differences, with a particular focus on disentangling the isolated welfare contributions of benefits of marginal variety, and access costs. Building on this framework, we further examine the impact of two major external shocks—China's accession to the WTO and the 2008 global financial crisis—on household-level consumption variety and welfare implication.

3.1 Data

Main Data Source. Our primary data source is the National Fixed-Point Survey (NFP), a household panel survey collected by the Research Center for Rural Economy (RCRE) of the Chinese Ministry of Agriculture and Rural Affairs. We use annual waves from 1995 to 2015, a period chosen for data comparability, as the survey's questionnaire and structure changed substantially in 1995. For this period, our dataset comprises approximately

⁹The decomposition is derived in closed form (see Li (2021)) and provides a basis for both comparative statics and welfare analysis.

270,000 household-year observations.¹⁰

The key advantages of the NFP data for our analysis are its (i) panel structure and (ii) detailed information on consumption varieties at the household-year level, which enables analysis at the household-variety-year level. The NFP provides consumption information broken down into food, clothing, housing, fuel, insurance, medical care, education, transportation, and other categories. Within the food category, it provides detailed information on the quantity of and expenditure on each main food variety. The relevant NFP survey questions on food consumption are asked at the household level regarding the preceding year. Summary statistics for the main food varieties are presented in Panel A of Table A.1.

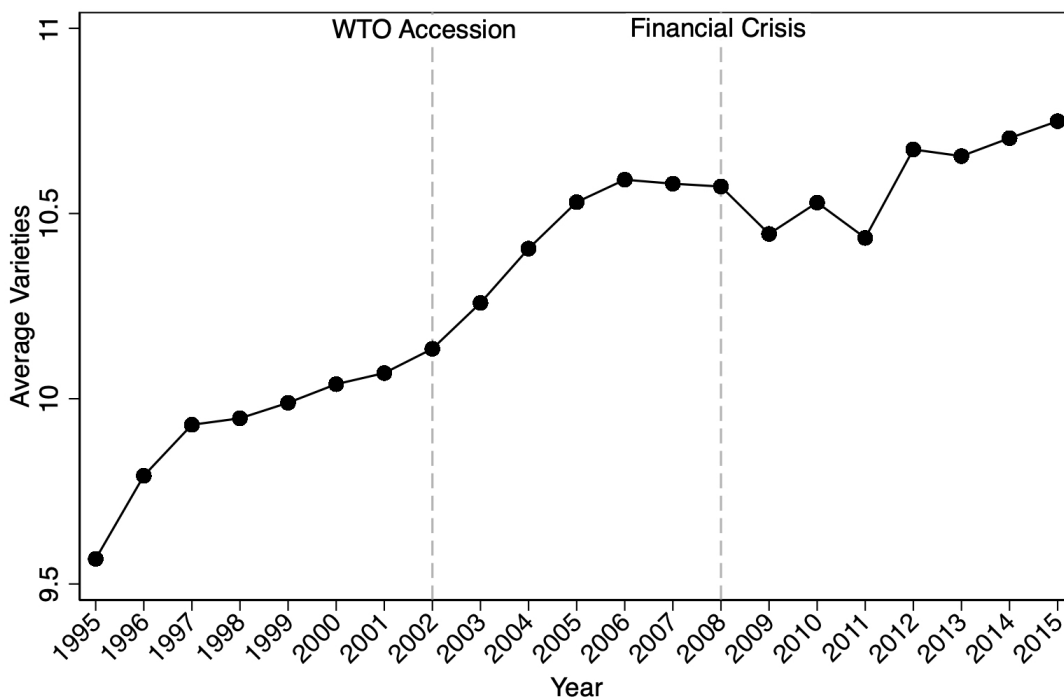


Figure 1: Average Varieties Over Years

Additional Data. A notable limitation of the NFP is its lack of information on urban households. To address this issue, we supplement the NFP with data from the Urban

¹⁰NFP sample villages were selected for representativeness based on a set of observed characteristics; within each chosen village, a random sample of households was drawn for inclusion in the survey.

Household Survey (UHS), collected by the National Bureau of Statistics. The UHS is a rotating panel in which one-third of the sample is replaced each year, with the full sample turning over every three years. To ensure data comparability, we use annual waves from 1995 to 2009. The food variety categorization changed substantially after 2009, which is the latest year with national coverage in our sample. For the 1995–2009 period, our UHS dataset covers approximately 170,000 household-year observations.¹¹

Price Data. Our estimation strategy relies on variety-level price data. Using domestic prices directly, however, may lead to biased estimates due to endogeneity concerns; for instance, local prices may be correlated with unobserved demand shocks or taste heterogeneity. To address this issue, we employ U.S. prices for corresponding varieties as instrumental variables. These price data are obtained from the U.S. Bureau of Labor Statistics and are plausibly exogenous to Chinese household consumption decisions.

3.2 Estimation of the Variety Engel Curve

We begin by estimating the log-linear form of the variety Engel curve: $\ln n = \frac{1}{\epsilon - \psi} \ln \left(\frac{\psi}{F\epsilon} \right) + \frac{1}{\epsilon - \psi} \ln X$. This requires estimating four parameters: (i) the elasticity of substitution σ , (ii) the benefit-of-marginal-variety parameter ψ , and the variety access cost parameters (iii) F and (iv) ϵ .

1. The Elasticity of Substitution (σ)

The parameter σ captures the substitutability across quantities of different varieties and is assumed to be constant across households and over time.¹² We estimate σ using intertemporal variation in relative prices and the corresponding changes in their expenditure shares. The estimation is based on the relationship between the relative prices and expenditure shares of different varieties (conditional on a base variety¹³), which is given

¹¹A probabilistic, stratified, multistage sampling method was used to obtain the sample of urban households in the UHS.

¹²We relax this assumption in a robustness check by allowing σ to vary across time periods. Period-specific estimates of σ and other three parameters are reported and discussed in Appendix C.1.1.

¹³To lend further credibility to our estimates, we also estimate σ conditional on different base varieties;

by:

$$\ln(Share_{hti}/Share_{ht0}) = \alpha_{ti} + \beta \ln(p_{it}/p_{0t}) + \mu_{hti} \quad (3.1)$$

where $\beta = 1 - \sigma$, and $\mu_{hti} = \ln(z_{hti}/z_{ht0})$ represents unobserved heterogeneity in household-specific tastes.

A key concern with OLS estimation of Equation 3.1 is that the price variation, derived from expenditure and quantity data, may be endogenous if taste shocks co-vary with prices or other unobserved factors. This possibility would bias our estimates. We therefore employ an instrumental variable (IV) estimation strategy, which utilizes corresponding price variation in the U.S. as an instrument (Chari, Liu, Wang & Wang, 2021), to re-estimate Equation 3.1:

$$\ln(Share_{hti}/Share_{ht0}) = \alpha_{ti}^{IV} + \beta^{IV} \ln(\widehat{p_{ti}/p_{t0}}) + \mu_{hti}^{IV} \quad (3.2)$$

Table 1 presents the estimation results. The IV results, presented in Column (3) of Panel A (while Columns (1) and (2) show OLS estimates and Columns (4)-(6) show estimates with flexible specifications), yield an estimate of σ is of 1.847, which is statistically significant at the 1% level. This estimate will be used to recover the remaining model parameters.

2. Other Parameters (ψ , F , and ϵ)

We now proceed to infer the benefits of marginal variety parameter, ψ , by leveraging the variation in the base-variety expenditure share across households. The identifying assumption is that, on average, households assign similar taste weights to the base variety, which serves as a common benchmark. Under this assumption, we use the observed decline in the base variety's expenditure share as the total number of varieties increases to infer ψ . We rearrange the household demand expression for the base variety, $X_0 = z_0 X(p_0/n^{-\psi})^{1-\sigma}$, to obtain:

$$\ln(X_0/X)_{ht} = \alpha_t + \beta \ln(n_{ht}) + \mu_{ht} \quad (3.3)$$

see Appendix C.1.4.

where $\beta = (1 - \sigma)\psi$, and μ_{ht} denotes household-specific preferences for the base variety. As suggested by Feenstra (1994), we estimate an aggregate value of ψ by pooling all observations in a single regression. The results, presented in Columns (1)-(3) of Panel B in Table 1, suggest that the average value of ψ for the full sample is approximately 0.514 (Column (3)).¹⁴

Finally, we estimate the variety cost parameters F and ϵ from the intercept and slope, respectively, of the log-linear variety Engel curve:

$$\ln(n_{ht}) = \alpha_t + \beta \ln(X_{ht}) + \mu_{ht} \quad (3.4)$$

where the slope is $\beta = \frac{1}{\epsilon - \psi}$ and the intercept is $\alpha = \frac{1}{\epsilon - \psi} \ln\left(\frac{\psi}{F\epsilon}\right)$. This estimation allows us to back out the implied values of ϵ and F . The estimated coefficients, presented in Columns (4) to (6) of Panel B in Table 1, suggest that our estimate of F is 0.064 and our estimate of ϵ is 7.977. We report estimates over the full sample here; year-specific estimates for F and ϵ are reported in Table C.1.3.

3.3 Decomposition of Variety Growth and Welfare Analysis

The variety Engel curve framework of Li (2021) provides a method for decomposing variety differences into three components: household expenditure levels (X), the benefits of marginal variety (captured by ψ), and the cost of accessing varieties (determined by F and ϵ), as specified in Equation 2.3. We now implement this approach to examine how the average number of varieties differs across regions and over time in China from 1995 to 2015.

The welfare implications are given by the compensating variation: $1 - \frac{X(U_0, \eta_1, F_1)}{X(U_0, \eta_0, F_0)}$. Welfare gains depend on a reference utility level, which corresponds to the average household in a specific region and year. Regions and years with higher marginal benefits of variety (higher

¹⁴We also estimate ψ separately for each year to allow for temporal variation. These year-specific estimates are reported in Appendix C.1.3.

Table 1: Estimation of the Variety Engel Curve using China's NFP Panel Data

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: Elasticity of variety (σ)</i>						
Dependent Var.:	$\ln(\text{Share}_{hti}/\text{Share}_{ht0})$					
	OLS		IV			
$\Delta \ln(p)$	-0.127*** (0.019)	-0.124*** (0.019)	-0.847*** (0.036)	-0.842*** (0.036)	-0.561*** (0.171)	-0.493*** (0.159)
Constant	-1.529*** (0.017)	-1.532*** (0.017)				
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Province×Year FE	No	Yes	No	Yes	No	Yes
Village×Variety FE	No	No	No	No	Yes	Yes
Kleibergen-Paap F			124.105	124.081	90.183	90.426
R-Squared	0.270	0.283	-0.129	-0.131	-0.0665	-0.0590
Observations	1,462,659	1,462,659	1,378,975	1,378,975	1,378,792	1,378,792
<i>Panel B: Other parameters (ψ, F, and ϵ)</i>						
Dependent Var.:	$\ln(X_0/X)_{ht}$			$\ln(n_{ht})$		
$\ln(\# \text{ of Variety})$	-0.535*** (0.044)	-0.529*** (0.046)	-0.435*** (0.040)			
$\ln(X)$				0.135*** (0.006)	0.132*** (0.006)	0.134*** (0.006)
Constant	-0.441*** (0.102)	-0.525*** (0.134)	-0.536*** (0.105)	1.205*** (0.050)	1.191*** (0.059)	1.179*** (0.060)
Controls	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Province×Year FE	No	No	Yes	No	No	Yes
R-Squared	0.611	0.611	0.640	0.526	0.535	0.564
Observations	135,897	134,437	134,426	275,448	270,987	270,987

Notes: This table reports estimates for the variety Engel curve parameters. Panel A shows estimates corresponding to Equation 3.1 (Columns (1)-(2)) and Equation 3.2 (Columns (3)-(6)). Panel B reports estimates corresponding to Equation 3.3 (Columns (1)-(3)) and Equation 3.4 (Columns (4)-(6)). The base variety is corn. The instrumental variable (IV) estimations in Columns (3)-(6) use corresponding variety prices in the U.S. as an instrument. The number of observations differs slightly across columns due to missing U.S. price data. Controls include household income, formal employment status, labor supply, and poverty status, following Li (2021). Robust standard errors clustered at the village level are shown in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

ψ) or lower access costs (lower F and ϵ) will exhibit greater welfare gains, particularly for households with higher expenditure. Welfare differences are expressed as the share of expenditure that a reference household would be willing to forego to face the parameters of a different region or period.

To isolate the effect of variety access costs, we hold the benefits of marginal variety (ψ) constant and allow only the access cost parameters (F and ϵ) to vary across regions and over time. This enables us to quantify the distinct contribution of access costs to welfare. Similarly, we hold the access cost parameters fixed and allow only ψ to vary to isolate the welfare effect of changes in the benefits of marginal variety.

We now turn to an examination of the change in the number of varieties and its associated welfare gains between 1995 and 2015. We categorize our full sample period into sub-periods based on key socioeconomic events: the period before China's WTO accession (Pre-WTO, 1995–2000), the period during WTO accession (WTO Accession, 2000–2003), the period after WTO accession (Post-WTO, 2003–2007), the period during the 2008 global financial crisis (2007–2008), and the period after this crisis (Post-FC, 2009–2015)¹⁵. For each sub-period, we take the beginning year as the benchmark to decompose the observed growth in the number of varieties and quantify the associated welfare changes. We also undertake a comparison over the entire 1995–2015 period.

Table 2 presents the decomposition of variety growth and its welfare implications across key sub-periods. The results indicate substantial heterogeneity in both the sources of variety growth and their associated welfare changes over time.

As shown in Column (6) of Panel A, the consumption of food varieties increased by approximately 12% from 1995 to 2015, with rising household expenditure explaining the majority of this growth (9.9%), particularly in the period after China's WTO accession. This finding contrasts with the analysis of Li (2021) for India, where reductions in access costs played the predominant role in variety expansion. The benefits of marginal variety

¹⁵The results of variety difference decomposition and welfare implication per year are presented in Table C.2.2

Table 2: Variety Difference Decomposition and Welfare Analysis per Period

Period	Pre-WTO 95-00 (1)	WTO Access 00-03 (2)	Post-WTO 03-07 (3)	Financial Crisis 07-08 (4)	Post-FC 09-15 (5)	Overall Period 95-15 (6)
<i>Panel A: Decomposition of difference in variety</i>						
Variety difference ($\Delta n\%$)	0.048	0.022	0.031	-0.001	0.029	0.116
Expenditure component (X)	-0.026	0.021	0.060	0.018	0.036	0.099
Benefits of marginal variety (ψ)	0.011	0.028	0.069	-0.018	0.026	0.044
Access cost of varieties (F, ϵ)	0.130	0.031	0.025	-0.229	0.007	0.035
<i>Panel B: Welfare gains (as the share of expenditure)</i>						
Welfare gain induced by (ψ, F, ϵ)	0.059	0.227	0.103	-0.138	0.229	0.191
Welfare induced by (ψ) only	0.025	0.102	0.181	-0.085	0.077	0.129
Welfare induced by (F, ϵ) only	0.033	0.127	-0.084	-0.053	0.152	0.063

Notes: This table presents the results of variety difference decomposition and welfare gain in different periods. We categorized the full sample period into sub-periods based on key socioeconomic event: China's WTO accession and 2008 global financial crisis. Panel A presents the decomposition of variety changes across periods, using the initial year of each period as the reference point, based on Equation 2.3. The total variety difference is separated into three components: household expenditure levels (X), the marginal utility associated with additional varieties (captured by ψ), and the cost of accessing varieties (determined by F and ϵ). Panel B reports welfare gains under three scenarios: (i) when both the marginal utility of variety (ψ) and the access cost parameters (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ vary, holding ψ constant.

(ψ) contributed more modestly, adding 4.4 % over the full period, with its role being most pronounced in 2003–2007. Reductions in access cost (F, ϵ) became a major constraint during the global financial crisis of circa 2008, suggesting rising frictions in accessing new varieties. Over the entire period, lower access costs account for 3.5% of the increase in variety.

Panel B of Table 2 presents the estimates of welfare gains. By 2015, households experienced welfare gains equivalent to 19% of expenditure (Column (6)). Notably, a large part of these gains is sourced from increased benefits of marginal variety (12.9%), rather than from reductions in access costs (6.3%). This again contrasts with findings from India.¹⁶ Column (2) shows that the period during China's WTO accession (2000–2003)

¹⁶Li (2021) finds that reductions in the cost of accessing varieties account for 25 % of a total 30% welfare

saw the largest welfare gains (22.7%), driven by both decreasing access costs (12.7%) and rising marginal variety benefits (10.2%). In contrast, as shown in Column (4), the global financial crisis period (2007–2008) was the only period with a net welfare decline (–13.8%), caused by a reduction in the benefits of marginal variety and an increase in access costs. Column (5) shows that welfare rebounded by about 23% after the crisis (2009–2015), with approximately 15 % attributable to lower access costs.

3.4 Decomposition Amid Two Economic Shocks

As seen in Figure 1, two significant turning points are evident around 2002 and 2008. Extensive anecdotal evidence suggests that China’s accession to the WTO in late 2001 and the 2008 global financial crisis had a significant impact on the consumption patterns of Chinese households.¹⁷ A central policy question is the extent to which these two shocks led to welfare changes through the channel of household food consumption choices. In this section, we employ a Difference-in-Differences analysis, comparing two sources of variation—before versus after and higher versus lower exposure—within our welfare framework.

1. *China’s Accession to the WTO.*

To understand the impact of China’s WTO accession, we require two sources of variation. The first is temporal (before and after 2002). The second is cross-sectional, measuring the extent to which a locality was exposed to the accession. Following Brandt, Van Biesebroeck, Wang & Zhang (2017), we use regional tariff changes as our measure of cross-sectional variation. We define 1999–2001 as the pre-WTO period and 2002–2004 as the post-WTO period. We construct the tariff exposure variable for each province p and year t as follows:

gain.

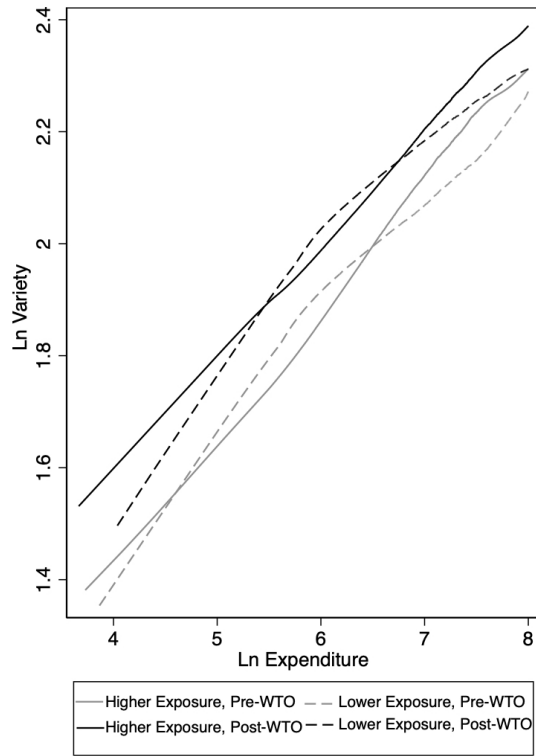
¹⁷See, e.g., <https://www.cctv.com/wto/sanji/xiaofei.html>.

$$Tarri f_{pt} = \sum_{i \in \Omega_{pt}} \lambda_{pit} \tau_{pt} \quad (1)$$

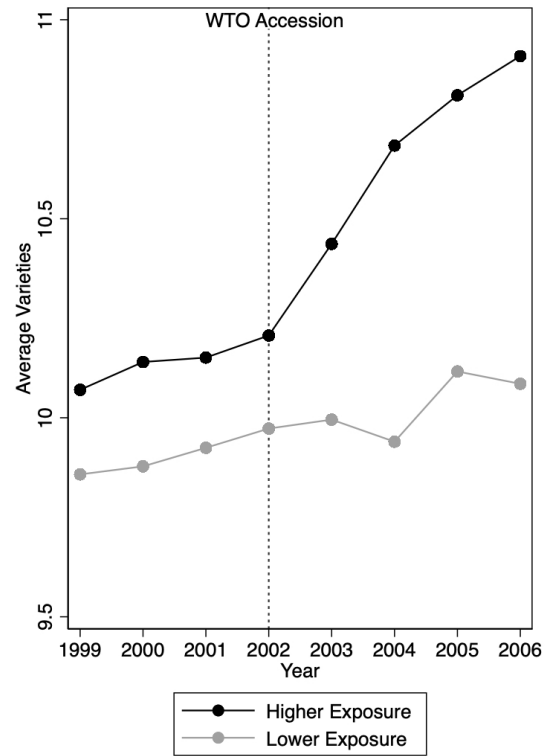
We then undertake a Difference-in-Differences strategy, based on the "interaction" of the two sources of variation. Figure 2 provides motivating evidence for the impact of China's WTO accession on household consumption variety. Panel 2a plots variety Engel curves—nonparametric Lowess regressions of log household variety on log expenditure—for high- and low-exposure provinces, before and after the accession. Panel 2b plots the time-series trends of average household variety from 1999 to 2006 for the two groups. Both groups of provinces experienced an upward shift in their variety Engel curves post-accession, suggesting that households at all income levels consumed a larger number of varieties. However, the shift was more pronounced in high-exposure provinces, suggesting that WTO accession played a role in shaping household consumption behavior.

Our analysis extends beyond a graphical comparison. Table 3 reports the results of variety difference decomposition and welfare comparison. As presented in Column (5) of Panel A, higher-exposure provinces experienced a 3.4% greater increase in food consumption variety. This Difference-in-Differences (DiD) estimate is primarily driven by an increase in the benefits of marginal variety (ψ), contributing 2.3%, and a reduction in access costs (F, ϵ), contributing 1.2%. Column (1) and (2) shows that the contribution from the benefits of marginal variety was higher in more exposure provinces, indicating that consumers in these areas increased their consumption of more marginal varieties. Column (4) and (5) shows the decreasing difference of accession cost between two regions after WTO's accession.

The results of the welfare implications of China's WTO Accession is presented in Panel B of Table 3. Column (5) shows that provinces with higher WTO exposure experienced larger welfare gains, with a DiD estimate of 23.7%. Decomposing the source of these gains, we find that both the benefits of marginal variety and reductions in access costs



(a) Lowess Regression of Log Household Varieties on Log Expenditure



(b) Trend of Variety between Higher- and Lower-exposure Regions

Figure 2: The Effect of China's Accession to WTO on Variety Engel Curve and Average Household Variety

Notes: Panel (a) plots variety Engel curves—nonparametric Lowess regressions of log household variety on log expenditure—for high- and low-exposure provinces, before and after the accession. Panel (b) plots the time-series trends of average household variety from 1999 to 2006 for the two groups.

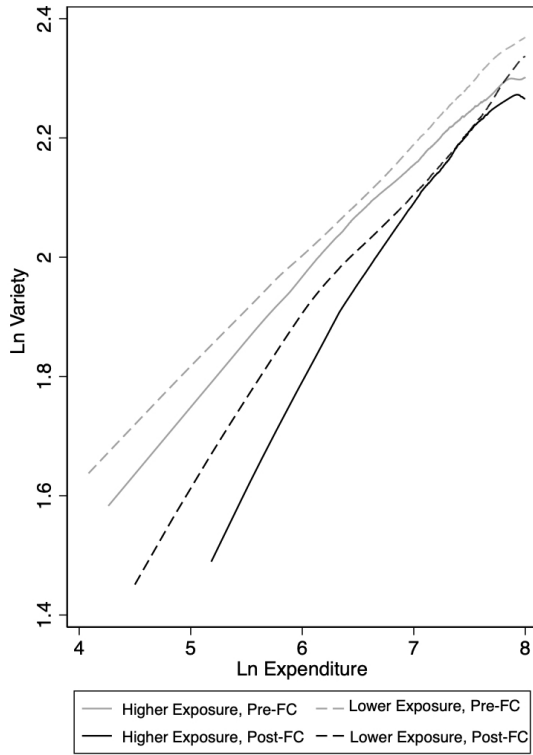
Table 3: The Effect of China's WTO Accession

	Δ Time		Δ Region		DiD
	Lower- exposure (1)	Higher- exposure (2)	Pre- WTO (3)	Post- WTO (4)	(5)
<i>Panel A: Varieties difference decomposition</i>					
Variety difference(% Δn)	0.007	0.040	0.024	0.058	0.034
Expenditure component (X)	0.034	0.030	-0.005	-0.006	-0.001
Benefits of marginal variety (ψ)	-0.008	0.015	0.111	0.076	0.023
Access cost of varieties (F, ϵ)	-0.027	-0.015	-0.084	-0.017	0.012
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Welfare gain induced by (ψ, F, ϵ)	0.079	0.320	0.110	0.347	0.237
Welfare induced by (ψ) only	-0.039	0.093	0.192	0.351	0.132
Welfare induced by (F, ϵ) only	0.120	0.226	-0.073	-0.004	0.106

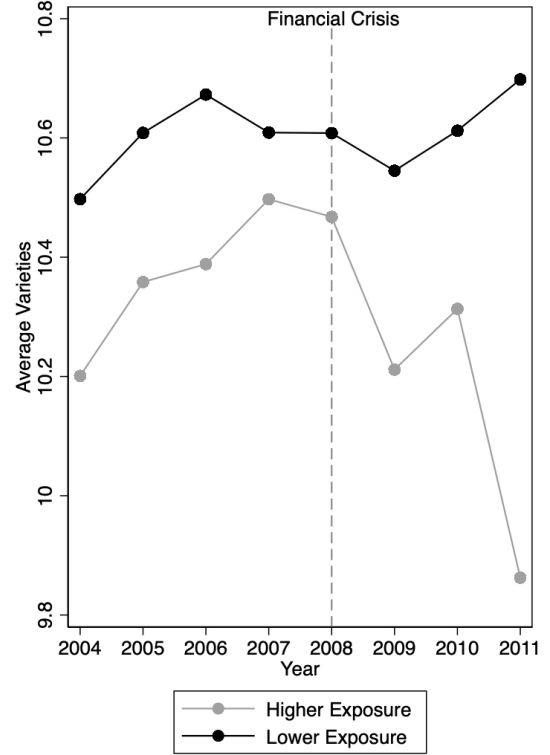
Notes: We define the period 2000–2001 as pre-WTO period and 2003–2004 as post-WTO period. Exposure to the WTO accession shock is identified by the magnitude of tariff reductions experienced by each province. Provinces are categorized as higher- or lower-exposure based on whether their tariff reduction falls above or below the median. Panel A presents the decomposition of the variety difference over time for higher- (Column (1)) and lower-exposure (Column (2)) provinces, and across exposure levels before (Column (3)) and after (Column (4)) the accession. Column (5) reports the DiD estimates according to the difference between Columns (1) and (2). The decomposition is based on Equation 2.3, using the lower-exposure, pre-WTO group as the reference. Panel B reports the impact on welfare under three scenarios: (i) when ψ , F , and ϵ vary; (ii) when only ψ changes; and (iii) when only F and ϵ change.

are crucial: the former (ψ) alone accounts for a gain of 13.2%, while the latter (F, ϵ) explains about 10.6%. These results contrast with those of Li (2021), who finds that access cost reductions are the main driver of welfare gains in India. Our estimates, however, suggest that adjustments in the benefits of marginal variety—that is, a stronger consumer valuation of variety—played an equally, if not more, important role in China's post-WTO period.

To further evaluate the robustness of our findings, we conduct a series of sensitivity analyses examining the impact of China's WTO accession on rural household consumption variety and the corresponding welfare gains. The results are presented in Table C.4.1 ~Table C.4.6.



(a) Lowess Regression of Log Household Varieties on Log Expenditure



(b) Trend of Variety between Higher- and Lower-exposure Regions

Figure 3: The Effect of Global Financial Crisis on Variety Engel Curve and Average Household Variety

Notes: Panel (a) plots variety Engel curves—nonparametric Lowess regressions of log household variety on log expenditure—for high- and low-exposure provinces, before and after the accession. Panel (b) plots the time-series trends of average household variety from 2004 to 2011 for the two groups.

2. The 2008 Global Financial Crisis.

To measure regional exposure to the 2008 financial crisis, we follow Diamond (2016) and Egger (2022) and use the change in migration rates caused by industry-specific shocks before and after 2008. Provinces are categorized as higher- or lower-exposure based on whether their change in migration rate falls above or below the median value.

Figure 3 examines the impact of the 2008 global financial crisis on household food consumption variety. Panel 3a presents Engel curves estimated separately for high- and low-exposure regions, before and after the crisis. Panel 3b plots the time-series trends

Table 4: The Effect of Global Financial Crisis

	Δ Time		Δ Region		DiD
	Lower (1)	Higher (2)	Pre-FC (3)	Post-FC (4)	
<i>Panel A: Variety difference decomposition</i>					
Changes in variety	-0.006	-0.018	-0.019	-0.030	-0.011
Expenditure component (X)	0.050	0.059	0.003	0.012	0.009
Benefits of marginal variety (ψ)	-0.030	-0.115	-0.003	-0.055	-0.052
Access cost of varieties (F, ϵ)	-0.025	0.036	-0.034	-0.007	0.027
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Total welfare change (F, ϵ, ψ)	-0.294	-0.517	0.067	-0.093	-0.160
Welfare induced by (F, ϵ) only	-0.252	-0.365	0.058	-0.027	-0.085
Welfare induced by (ψ) only	-0.044	-0.162	0.009	-0.067	-0.076

Notes: We define 2006–2007 as the pre-financial crisis (Pre-FC) period and 2009–2010 as the post-financial crisis (Post-FC) period. Exposure to the shock is identified by the magnitude of the change in migration rates caused by industry-specific shocks. Provinces are categorized as higher- or lower-exposure based on whether their change in migration falls above or below the median. Panel A presents the decomposition of the variety difference over time for higher- (Column (1)) and lower-exposure (Column (2)) provinces, and across exposure levels before (Column (3)) and after (Column (4)) the financial crisis. Column (5) reports the DiD estimates according to the difference between Column (1) and (2). The decomposition is based on Equation 2.3, using the lower-exposure, pre-FC group as the reference. Panel B reports the impact on welfare under three scenarios: (i) when ψ , F , and ϵ vary; (ii) when only ψ changes; and (iii) when only F and ϵ change.

of average household variety from 2004 to 2011 for the two groups. The trends for the two groups are parallel before 2008. The trend for the higher-exposure region, however, declines sharply after 2008, suggesting a substantial impact from the crisis. Interestingly, variety in the lower-exposure regions increased after 2008, a phenomenon that may be driven by return migration from coastal industrial areas or a reallocation of food varieties from coastal to inland regions.

To estimate the impact of the crisis, we adopt a DiD framework. Table 4 presents the results. Column (1) and (2) of Panel A show that average household variety declined in both groups, with a larger decrease in higher-exposure regions (−1.8%) compared to lower-exposure ones (−0.6%), for a DiD estimate of −1.1%. Column (5) shows that this decline was driven by a decrease in the benefits of marginal variety (ψ), leading to 5.2%

variety fall. Column (3) and (4) shows that the benefits of marginal variety difference between two regions fall from -0.3% before the crisis to -5.5% after the crisis, leading to a DiD estimate of -5.2%. In contrast, column (1) and (2) indicates that the contribution from access costs (F and ϵ) turned positive in higher-exposure regions from -2.5% to 3.6%, likely driven by supply-side adjustments that offset part of the decline.

Panel B reports the welfare estimates. Total welfare fell in all provinces, with a more salient loss in higher-exposure regions (-51.7%). The DiD estimate (Column (5)) implies a welfare loss of 16.0%. Our decomposition suggests that declining benefits of marginal variety (ψ) and deteriorating access conditions (F and ϵ) contributed -7.6% and -8.5 %, respectively. As expected, the crisis led to a contraction in food variety and a notable reduction in welfare. The analyses of the crisis and of WTO accession yield distinct welfare implications: gains from WTO accession were driven by increasing benefits of marginal variety and decreasing access costs, while welfare losses during the crisis were driven by rising access costs and falling benefits of marginal variety.

For further assess the robustness, we provide a series of robustness checks to assess the impact of global financial crisis on rural household consumption variety and associated welfare gains, see Table C.5.1 ~Table C.5.6.

4 Additional Analyses

To address the limitation that the NFP lacks data on urban households, we supplement our primary analysis with data from the Urban Household Survey (UHS).¹⁸ We perform two analyses: estimating the variety Engel curve in urban China and decomposing the welfare gains.¹⁹

¹⁸The UHS is a rotating panel where one-third of the sample is changed each year. For comparability, we use annual waves from 1995 to 2009.

¹⁹Figure 4 shows that the trend in food consumption variety among urban households closely mirrors that in rural areas. Over the 1995–2009 period, the number of consumed varieties generally increased, with two pronounced kinks: an upward turn in 2002 (WTO accession) and a downward turn in 2008 (global financial crisis), which corroborates the pattern observed in rural regions.

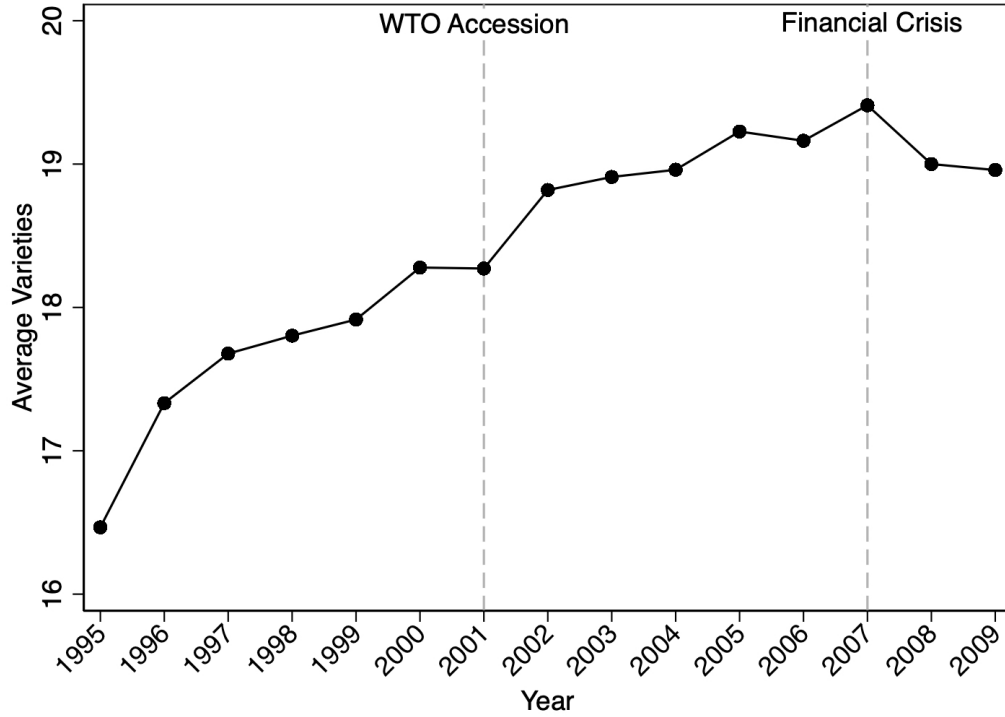


Figure 4: Average Varieties Over Time in Urban China

4.1 The Variety Engel Curve in Urban China

We apply the same framework to examine the variety Engel curve in urban China, estimating the elasticity of substitution (σ) from Equation 3.1, the marginal benefits of variety (ψ) from Equation 3.3, and the variety access cost parameters (F , ϵ) from Equation 3.4.²⁰ Table 5 presents the results. The elasticity of substitution σ is 2.237 and statistically significant, implying a relatively high degree of substitutability across varieties in urban areas. The estimate of ψ is 0.751, recovered from the coefficient on $\ln(\#of\ variety)$ in Column (3) of Panel B. The cost parameters, recovered from the coefficients in Column (6) of Panel B, are $\epsilon=6.246$ and $F=0.0001$, respectively.²¹ The magnitude and significance of these parameters are comparable to those for rural regions, implying a robust association between expenditure and variety across the rural-urban divide.

²⁰Given the rotating panel structure of the UHS, we include additional controls such as household size and total income to account for unobserved heterogeneity.

²¹Year-specific estimates for ψ , F , and ϵ are available in Table C.1.3.

For urban regions from 1995 to 2009, we again decompose differences in variety into three components—expenditure, marginal benefits of variety (ψ), and access costs (F and ϵ)—based on Equation 2.3.²² We also quantify the welfare gains attributable to these changes, with the results presented in Table D.2.2.

4.2 Analysis of WTO Accession and the Financial Crisis in Urban Regions

Table D.3.4 to Table D.3.5 examines how China’s WTO accession and the global financial crisis affected food consumption variety and welfare among urban households. During the WTO accession period, D.3.4 shows that urban households in regions with higher exposure experienced a more prominent increase in consumption variety (4.2% vs. 2.0%), primarily driven by reductions in access costs (F and ϵ) rather than by expenditure growth or preference shifts. This contributed to a welfare gain of 13.5%, with the majority stemming from better access conditions (2.3 %) and increased marginal benefits of variety (6.7 %). These estimates suggest that welfare gains in urban regions were shaped more by improved availability of varieties than by heightened consumer valuation.

In contrast, the analysis of the 2008 global financial crisis, as shown in Table D.3.5 suggests that, despite a modest change in the number of varieties, different forces were at play: consumer valuation of variety (ψ) declined significantly, while access costs slightly improved. The net welfare loss amounted to 26.3%, driven by both reduced preference for variety (–5.8 %) and deteriorating access-related welfare changes (–18.3 %). These estimates suggest that the primary effect of the macroeconomic shock was not a reduction in the number of available varieties, but a weakened demand for diversity and a disruption of access mechanisms.

²²Estimates of the variety difference decomposition and welfare gains for each period are presented in Table D.2.1.

Table 5: Estimation of the Variety Engel Curve Using Urban Household Survey Data

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: Elasticity of variety (σ)</i>						
Dependent Var.:	$\ln(\text{Share}_{hti}/\text{Share}_{ht0})$					
	OLS		IV			
$\Delta \ln(p)$	-0.117*** (0.012)	-0.120*** (0.012)	-0.079*** (0.012)	-0.078*** (0.012)	-1.399*** (0.256)	-1.237*** (0.226)
Constant	0.851*** (0.013)	0.854*** (0.013)				
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Province $\times$ Year FE	No	Yes	No	Yes	No	Yes
City $\times$ Variety FE	No	No	No	No	Yes	Yes
Kleibergen-Paap F			97.352	97.412	31.915	35.414
R-Squared	0.374	0.381	0.006	0.006	-0.433	-0.340
Observations	2,327,824	2,327,824	2,257,230	2,257,230	2,257,230	2,257,230
<i>Panel B: Other parameters (ψ, F and ϵ)</i>						
Dependent Var.:	$\ln(X_0/X)_{ht}$			$\ln(n_{ht})$		
$\ln(\# \text{ of Variety})$	-1.013*** (0.044)	-0.929*** (0.048)	-0.929*** (0.042)			
$\ln(X)$				0.186*** (0.005)	0.186*** (0.005)	0.182*** (0.005)
Constant	-1.309*** (0.131)	-1.447*** (0.135)	-1.444*** (0.119)	1.435*** (0.040)	1.407*** (0.041)	1.436*** (0.041)
Controls	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Province $\times$ Year FE	No	No	Yes	No	No	Yes
R-Squared	0.672	0.676	0.680	0.441	0.443	0.479
Observations	126,818	126,818	126,818	178,626	178,626	178,626

Notes: This table reports estimation results for urban regions. Panel A shows estimates corresponding to Equation 3.1 (Columns (1)-(2)) and Equation 3.2 (Columns (3)-(6)). Panel B reports estimates based on Equation 3.3 (Columns (1)-(3)) and Equation 3.4 (Columns (4)-(6)). The base variety is flour. The instrumental variable estimates use corresponding U.S. variety prices as an instrument. Controls include household income, formal employment status, labor supply, and poverty status, following Li (2021). Robust standard errors clustered at the city level are shown in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels,

5 Concluding Remarks

This study provides an analysis of the patterns, sources, and welfare implications of differences in food consumption diversity in China from 1995 to 2015. Using rich, widely available panel data on food expenditure, we implement an Engel curve approach that endogenizes variety choice. Our analysis reveals a 12% increase in the number of food varieties over this period, corresponding to a 20% welfare gain. A decompositional analysis indicates that the growth in consumer expenditure on food can be attributed to nearly 10% of the observed increase in variety. Concurrently, the benefits of marginal variety and reduced access costs are responsible for 4.4% and 3.5% of the increase, respectively. These sources of welfare gains contrast with those observed in India, where consumer expenditure contributed 4.7% while access costs contributed 47%. We also document significant shifts in the variety Engel curve corresponding to China's 2002 accession to the WTO and the 2008 global financial crisis.

We do not, however, contend that the observed changes in dietary diversity can be fully attributed to these two economic shocks. Rather, our approach—the variety Engel curve à la Li (2021)—provides a robust analytical framework for elucidating the nexus between income and variety and, more essentially, the underlying drivers of shifts in food diversity and their welfare implications amid major economic events.

Although our analysis is centered on China, its findings have broader, *mutatis mutandis*, implications, particularly for other regions undergoing analogous dietary transitions, such as East Asia and Africa. As governments in these countries allocate substantial resources to ameliorate nutritional deficiencies and address food security, a granular understanding of the patterns, sources, and welfare implications of food consumption diversity is paramount for enhancing policy efficacy. Our findings suggest that consumer expenditure, preference architecture for diversity, and the cost of novel varieties play disparate roles in disparate contexts. Thus, our analysis of the variety Engel curve in China holds potentially significant policy lessons, not only for domestic application but

also across the developing world.

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Appendices

A Summary Statistics

This table presents the summary statistics of the variables for both the rural and urban samples. Our primary sample unit is at household-by-year level (Column (1)), which each household consume a different set of varieties (the number of households are presented in Column (2)). The sample spans cross-sectional localities in China over a 21-year period from 1995 to 2015 in rural regions (Panel A) and 1995 to 2009 in urban regions (Panel B). Each row corresponds to a distinct food variety that is consistently recorded across household surveys from 1995 to 2015 in NFP (1995 to 2009 in UHS). The set of varieties is harmonized over time to ensure comparability. All expenditure values are measured in nominal RMB (yuan), and quantity is measured in kilograms (kg) for each variety.

Table A.1: Summary Statistics

Variety	(1) Observations	(2) # of Hhs Consumed	(3) Mean	(4) S.D.	(5) Expenditure
<i>Panel A: Rural regions (NFP: 1995–2015)</i>					
Rice	278,616	178,514	650.824	908.986	1364.627
Soybeans	278,616	137,743	64.715	383.482	179.493
Corn	278,616	78,346	570.096	1489.751	980.140
Vegetable	275,319	273,648	463.963	365.245	592.263
Plant Oil	270,603	262,368	32.086	25.351	129.829
Animal Oil	220,394	187,176	17.614	19.678	98.291
Pork	272,892	269,683	60.659	53.605	682.965
Beef	201,738	140,422	7.020	11.339	110.522
Mutton	177,049	114,994	4.744	9.146	92.070
Milk	151,221	45,916	12.024	44.264	42.508
Poultry	243,772	209,774	15.697	19.888	190.270
Egg	266,031	249,896	19.534	18.477	164.124
Fish	239,584	203,953	24.207	36.973	294.210
Fruit	270,132	262,599	66.958	75.024	124.503
Sugar	261,761	255,847	8.825	15.018	26.157
<i>Panel B: Urban regions (UHS: 1995–2009)</i>					
Rice	179,154	168,920	110.097	105.523	286.543
Flour	179,154	127,269	38.839	67.182	76.865
Potato	179,154	170,372	30.022	38.288	53.497

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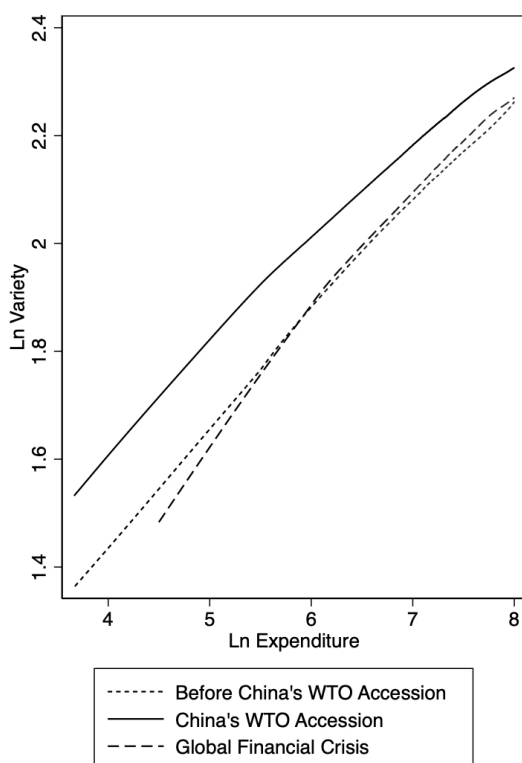
Table A.1 – Continued from previous page

Variety	Observations	# of Hhs Consumed	Mean	S.D.	Expenditure
Plant Oil	179,154	165,756	22.132	21.169	185.235
Pork	179,154	177,335	47.074	38.768	621.651
Beef	179,154	137,055	4.847	8.490	82.323
Mutton	179,154	97,570	2.511	5.408	41.700
Chicken	179,154	155,196	11.684	16.654	152.087
Duck	179,154	74,124	2.767	6.655	31.309
Egg	179,154	176,614	28.071	23.751	158.731
Egg Product	179,154	117,449	1.671	3.332	15.470
Fish	179,154	170,476	21.982	24.858	228.721
Crab	179,154	125,194	3.623	8.657	91.235
Vegetable	179,154	178,612	293.114	197.916	573.678
Cabbage	179,154	131,769	1.253	3.391	35.264
Liquor	179,154	123,586	6.135	13.685	99.698
Fruit Wine	179,154	47,296	0.654	3.071	12.864
Soda	179,154	100,458	4.882	11.401	20.527
Tea	179,154	89,434	0.574	1.383	41.780
Fruit	179,154	177,289	88.989	75.768	287.847
Melon	179,154	164,658	47.681	50.542	73.780
Cake	179,154	169,446	10.101	11.205	131.032
Milk	179,154	138,874	43.985	61.352	189.916
Milk Powder	179,154	73,283	1.146	4.937	42.941
Yogurt	179,154	88,264	6.368	15.710	38.644

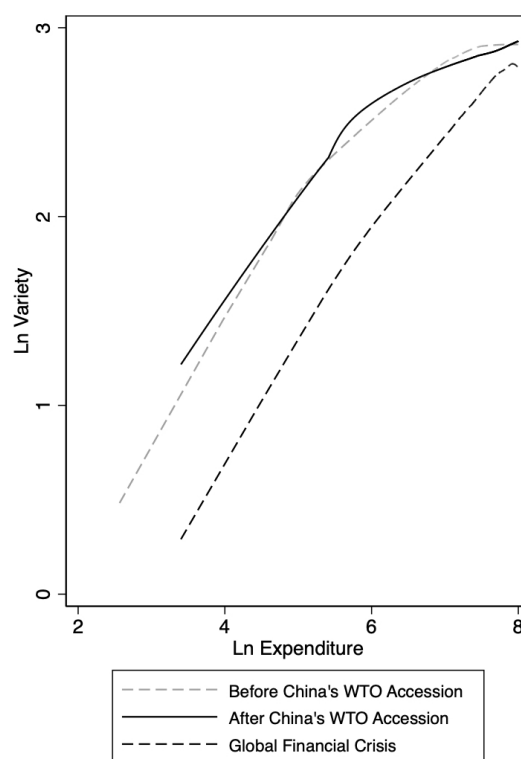
Notes: This table presents descriptive statistics of food consumption varieties for both rural and urban samples. Column (1) reports the total number of observations for each variety. In Panel A (rural sample), variation in the number of observations across varieties is due to missing values in certain survey years. Column (2) shows the number of households that consumed each variety, indicating its prevalence in the sample. Column (3) reports the average quantity consumed, measured in kilograms (kg), while Column (4) provides the standard deviation of consumption quantity. Column (5) presents the average expenditure on each variety, measured in nominal RMB (yuan), summarizing household spending patterns across items.

B The Variety Engel Curve

We examine the relationship between household income and consumption variety by estimating the empirical Engel curve for variety. Figure B.1 plots the estimated Engel curves for both rural (Panel a) and urban (Panel b) households across three key periods: before China's accession to the WTO, during the WTO accession period, and during the global financial crisis. The figure reveals a clear upward shift in the Engel curves over time, particularly after China's accession to WTO, suggesting that rising income levels were associated with a stronger tendency to diversify food consumption.



(a) Variety Engel Curve of Rural Regions in Different Periods



(b) Variety Engel Curve of Urban Regions in Different Periods

Figure B.1: Variety Engel Curve Shifts in Different Periods

Notes: This figure shows the results of nonparametric lowess regression of the log number of varieties consumed on the log of household total expenditure to flexibly capture the shape and shifts of the variety Engel curve over time. For comparability, we exclude households that consumed fewer than two varieties from the sample.

C Rural Regions Additional Analysis

C.1 Additional Parameter Estimation: Using National Fixed Points Survey

To further assess the robustness of our findings, we provide additional estimates of the variety Engel curve parameters under alternative specifications. We first relax the assumption that the elasticity of variety is constant across regions and over years in this section. We then exclude observations with fewer than two varieties consumed, effectively winsorizing the lower tail of the distribution, and re-estimate the variety Engel curve accordingly. Furthermore, we estimate the variety Engel curve parameters: ψ , F and ϵ (holding σ constant) year-by-year. We also change the base variety to estimate the variety Engel curve in order to reinforce the validity of our results.

In Table C.1.1, we divide the sample into four distinct periods: the period before China's WTO accession (1997-2001), China's WTO accession period (2002-2003), financial crisis period (2008-2009), and the period after the financial crisis (2011-2015), and estimate the structural parameters separately for each period. Table C.1.2 reports the estimates results that we drop observations where households consumed fewer than two varieties to address concerns about outliers or misreporting in extremely low-consumption cases. Table C.1.3 presents year-by-year estimates of the variety Engel curve parameters (ψ , F and ϵ , holding σ constant.), capturing potential temporal variation. Finally, Table C.1.4 reports the results obtained by changing the base variety, confirming that our findings are not sensitive to this modeling choice.

Table C.1.1: Additional Parameter Estimation: Different Periods

Dependent Var.:	(1)	(2)	(3)	(4)	(5)	(6)
	$\ln(Share_{hti}/Share_{ht0})$				$\ln(X_0/X)_{ht}$	$\ln(n_{ht})$
	OLS		IV			
<i>Panel A: Pre-WTO period (1997-2001)</i>						
$\Delta \ln(p)$	-0.103*** (0.023)	-0.104*** (0.023)	-0.835*** (0.043)	-0.835*** (0.043)		
$\ln(\# \text{ of Variety})$					-0.426*** (0.050)	
$\ln(X)$						0.137*** (0.001)
Constant	-1.771*** (0.020)	-1.770*** (0.020)			-0.564*** (0.115)	1.218*** (0.069)

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Table C.1.1 – continued from previous page

Dependent Var.:	(1)	(2)	(3)	(4)	(5)	(6)
	$\ln(Share_{hti}/Share_{ht0})$				$\ln(X_0/X)_{ht}$	$\ln(n_{ht})$
	OLS		IV			
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Province×Year FE	No	Yes	No	Yes	Yes	Yes
Kleibergen-Paap F			99.048	99.040		
R^2	0.272	0.275	-0.0877	-0.0876	0.780	0.746
Observations	329,513	329,513	300,671	300,671	486,480	992,850
<i>Panel B: China's WTO accession period (2002-2003)</i>						
$\Delta \ln(p)$	-0.162*** (0.022)	-0.161*** (0.022)	-0.852*** (0.039)	-0.851*** (0.039)		
$\ln(\# \text{ of Variety})$					-0.616*** (0.101)	
$\ln(X)$						0.111*** (0.017)
Constant	-1.668*** (0.018)	-1.669*** (0.018)			-0.068 (0.234)	1.442*** (0.128)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Province×Year FE	No	Yes	No	Yes	Yes	Yes
Kleibergen-Paap F			113.464	113.473		
R^2	0.341	0.344	-0.129	-0.130	0.877	0.819
Observations	139,018	139,018	139,018	103,018	199,905	392,595
<i>Panel C: Financial crisis period (2008-2009)</i>						
$\Delta \ln(p)$	-0.121*** (0.023)	-0.121*** (0.023)	-0.788*** (0.038)	-0.788*** (0.038)		
$\ln(\# \text{ of Variety})$					-0.326*** (0.129)	
$\ln(X)$						0.192*** (0.036)
Constant	-1.254*** (0.025)	-1.254*** (0.025)			-0.846*** (0.305)	0.665*** (0.309)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Province×Year FE	No	Yes	No	Yes	Yes	Yes
Kleibergen-Paap F			111.469	111.465		
R^2	0.408	0.409	-0.133	-0.133	0.873	0.771
Observations	143,277	143,277	143,277	143,277	197,550	398,940

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Table C.1.1 – continued from previous page

Dependent Var.:	(1)	(2)	(3)	(4)	(5)	(6)
	$\ln(Share_{hti}/Share_{ht0})$				$\ln(X_0/X)_{ht}$	$\ln(n_{ht})$
	OLS		IV			
<i>Panel D: Post-financial crisis period (2011-2015)</i>						
$\Delta \ln(p)$	-0.302*** (0.029)	-0.302*** (0.029)	-0.785*** (0.041)	-0.785*** (0.042)		
$\ln(\# \text{of Variety})$					-0.326*** (0.129)	
$\ln(X)$						0.192*** (0.036)
Constant	-1.067*** (0.028)	-1.067*** (0.028)			-0.925*** (0.305)	0.659*** (0.309)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Province×Year FE	No	Yes	No	Yes	Yes	Yes
Kleibergen-Paap F			110.940	108.441		
R^2	0.486	0.489	-0.0293	-0.0400	0.881	0.789
Observations	339,125	339,125	339,125	339,125	187,890	393,885

Notes: This table reports estimates of structural parameters on different periods. Columns (1) and (2) present the estimates of σ (the reported coefficient is $1-\sigma$) corresponding to Equation 3.1. Columns (3) to (4) presents the estimates based on Equation 3.2. Column (5) presents the estimates corresponding to Equation 3.3, and Column (6) shows the estimates based on Equation 3.4. The base variety is corn. In all Columns, the sample is at the household-year-variety unit. The instrumental variable (IV) estimations are reported in Columns (3) - (4), where Varieties' prices of U.S. are used as an IV. Controls include: household income, civilian server family member, labor supply, and poverty households. Panel A, B, C and D reports the variety Engel curve parameters estimates in the periods before China's WTO accession, the period when China was access to WTO, the period when global financial crisis happened and the period after the financial crisis, respectively. Robust standard errors clustered at the village level are shown in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Table C.1.2: Additional Parameter Estimation: Restricted Sample

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: Elasticity of variety (σ)</i>						
Dependent Var.:	$\ln(Share_{hti}/Share_{ht0})$					
	OLS		IV			
$\Delta \ln(p)$	-0.126*** (0.019)	-0.123*** (0.019)	-0.845*** (0.036)	-0.841*** (0.036)	-0.561*** (0.171)	-0.493*** (0.159)
Constant	-1.531*** (0.017)	-1.534*** (0.017)				
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Province×Year FE	No	Yes	No	Yes	No	Yes
Village×Variety FE	No	No	No	No	Yes	Yes
Kleibergen-Paap F			124.030	124.017	90.253	90.496
R-Squared	0.270	0.283	-0.129	-0.131	-0.0666	-0.0590
Observations	1,461,788	1,461,788	1,378,119	1,378,119	1,377,936	1,377,936
<i>Panel B: Other parameters (ψ, F and ϵ)</i>						
Dependent Var.:	$\ln(X_0/X)_{ht}$			$\ln(n_{ht})$		
$\ln(\# \text{ of Variety})$	-0.577*** (0.063)	-0.573*** (0.064)	-0.576*** (0.052)			
$\ln(X)$				0.098*** (0.004)	0.097*** (0.004)	0.099*** (0.004)
Constant	-0.343** (0.148)	-0.426** (0.169)	-0.434*** (0.124)	1.520*** (0.034)	1.497*** (0.044)	1.487*** (0.042)
Controls	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Province×Year FE	No	No	Yes	No	No	Yes
R-Squared	0.610	0.610	0.640	0.633	0.634	0.649
Observations	135,351	133,954	133,943	274,243	269,893	269,893

Notes: This table presents estimation results based on a restricted sample that excludes households consuming fewer than two varieties. Panel A shows estimates of elasticity of substitution (σ), the reported coefficients are $1 - \sigma$. Columns (1) and (2) present the estimates corresponding to Equation 3.1, and Column (4) to (6) shows the estimates results based on Equation 3.2. Panel B reports estimates results of other parameters: ψ, F and ϵ . Column (1) to (3) present the estimates based on Equation 3.3, and Column (4) to (6) report the estimates corresponding to Equation 3.4. The base variety is corn. The sample is at the household-year-variety unit in Panel A and household-year unit in Panel B, respectively. The instrumental variable (IV) estimations are reported in Columns (3) - (6), where corresponding variety prices in US are used as an IV. Controls include: household income, civilian server of family member, labor supply, and poverty households. Robust standard errors clustered at the village level are shown in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Table C.1.3: Additional Parameter Estimation: Year-by-year Estimation

	ψ		ϵ		F	
	(1)	(2)	(3)	(4)	(5)	(6)
1995	0.6311544	0.6072172	7.787349	7.787349	0.0000233	0.0000161
1996	0.5471666	0.5277677	7.935899	7.935899	0.0000116	0.000011
1997	0.7443602	0.7205684	7.995678	7.995678	0.0000163	0.000016
1998	0.4817314	0.4807123	7.778217	7.778217	0.0000102	0.0000186
1999	0.4589498	0.4289374	7.991399	7.991399	4.55e-06	1.94e-06
2000	0.6578701	0.6300535	7.659075	7.659075	0.0000213	0.0000131
2001	0.6140802	0.6077684	7.754044	7.754044	0.0000138	6.11e-06
2002	0.6165132	0.5908941	7.752398	7.752398	0.0000129	3.66e-06
2003	0.7211456	0.7114671	9.01456	9.01456	9.89e-07	2.58e-07
2004	0.6158349	0.5573094	9.735389	9.735389	1.80e-07	1.71e-08
2005	0.6921721	0.6392282	9.287834	9.287834	4.73e-07	1.02e-07
2006	0.7652335	0.7077063	9.217207	9.217207	6.58e-07	5.39e-08
2007	0.8336363	0.8423162	7.071909	7.071909	0.0002129	0.0000114
2008	0.7695765	0.7916467	8.18992	8.18992	0.0000124	4.37e-06
2009	0.6648749	0.641743	6.919392	6.919392	0.0002077	0.0001463
2010	0.5944436	0.5650129	6.936175	6.936175	0.0001601	0.0001336
2011	0.6136473	0.5750899	7.173894	7.173894	0.0001324	0.0001044
2012	0.6092039	0.6127274	8.67259	8.67259	2.67e-06	4.18e-06
2013	0.8812804	0.831897	8.566798	8.566798	8.41e-06	4.07e-06
2014	0.8584914	0.8077702	8.260708	8.260708	0.0000171	4.93e-06
2015	0.7552236	0.7333701	8.056158	8.056158	0.0000184	9.95e-06

Notes: This table reports the estimates of parameters ψ , F and ϵ . Columns (1) and (2) present the estimates of benefits of marginal variety ψ corresponding to Equation 3.3. Column (3) to (4) reports the access cost of varieties parameters F and Column (5) to (6) present parameter ϵ based on Equation 3.4, respectively. The base variety is corn. Columns (1) (3) (5) are estimates without controls, whereas Columns (2) (4) (6) are estimates including controls. Controls include: household income, civilian server of family member, labor supply, and poverty households. Robust standard errors clustered at the village level are shown in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Table C.1.4: Additional Parameter Estimation: Changing Base Variety

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: Elasticity of variety (σ)</i>						
Dependent Var.:	$\ln(\text{Share}_{hti}/\text{Share}_{ht0})$					
	OLS		IV			
$\Delta \ln(p)$	-0.065*** (0.019)	-0.066*** (0.019)	-0.693*** (0.030)	-0.693*** (0.030)	-0.941*** (0.147)	-0.936*** (0.146)
Constant	0.526*** (0.018)	0.525*** (0.018)				
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Province×Year FE	No	Yes	No	Yes	No	Yes
Village×Variety FE	No	No	No	No	Yes	Yes
Kleibergen-Paap F			152.964	152.974	115.020	114.716
R-Squared	0.134	0.138	-0.138	-0.139	-0.260	-0.260
Observations	1,639,383	1,639,383	1,442,302	1,442,302	1,442,250	1,442,250
<i>Panel B: Other parameters (ψ, F and ϵ)</i>						
Dependent Var.:	$\ln(X_0/X)_{ht}$			$\ln(n_{ht})$		
$\ln(\# \text{Variety})$	-1.023*** (0.111)	-1.030*** (0.112)	-0.972*** (0.091)			
$\ln(X)$				0.135*** (0.006)	0.132*** (0.006)	0.134*** (0.006)
Constant	-1.447** (0.272)	-1.343** (0.285)	-1.433*** (0.238)	1.205*** (0.050)	1.191*** (0.059)	1.179*** (0.060)
Controls	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Province×Year FE	No	No	Yes	No	No	Yes
R-Squared	0.654	0.654	0.672	0.526	0.535	0.564
Observations	138,459	135,969	135,968	275,448	270,987	270,987

Notes: This table reports estimation results using beef as the base variety. Panel A shows estimates of elasticity of substitution (σ), the reported coefficients are $1 - \sigma$. Columns (1) and (2) present the estimates corresponding to Equation 3.1, and Column (4) to (6) shows the estimates results based on Equation 3.2. Panel B reports estimates results of other parameters: ψ, F and ϵ . Column (1) to (3) present the estimates based on Equation 3.3, and Column (4) to (6) report the estimates corresponding to Equation 3.4. The sample is at the household-year-variety unit in Panel A and household-year unit in Panel B, respectively. The instrumental variable (IV) estimations are reported in Columns (3) - (6) of Panel A, where corresponding variety prices in US are used as an IV. Controls include: household income, civilian server of family member, labor supply, and poverty households. Robust standard errors clustered at the village level are shown in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

C.2 Year-by-year Decomposition of Variety Difference and Welfare Gains

This section provides a comprehensive temporal analysis of the evolution of consumption variety and its associated welfare impacts in rural China over the period 1995–2015.

To examine how major macroeconomic and institutional shifts influenced household consumption patterns, we partition the data into four distinct subperiods: the pre-WTO accession phase (1995–2000), the WTO accession period (2000–2005), the financial crisis period (2005–2010), and the post-crisis phase (2010–2015). Table C.2.1 presents the decomposition results for each period.

Table C.2.1: Decomposition and Welfare Analysis over Different Period

	Pre-WTO 95-00 (1)	WTO Access 00-05 (2)	Financial Crisis 05-10 (3)	Post-Fin Crisis 10-15 (4)	Overall Period 95-15 (5)
<i>Panel A: Variety growth decomposition over periods</i>					
Changes in variety ($\Delta n\%$)	0.048	0.048	0.000	0.021	0.116
Expenditure component (X)	-0.026	0.049	0.057	0.020	0.099
Benefits of marginal variety (ψ)	0.010	0.011	-0.080	0.065	0.044
Access cost of varieties (F, ϵ)	0.124	0.192	-0.290	0.050	0.035
<i>Panel B: Welfare gains (as the share of expenditure)</i>					
Change in ψ, F, ϵ	0.059	0.245	-0.628	0.303	0.191
Change in ψ only	0.025	0.042	-0.211	0.179	0.129
Change in F, ϵ only	0.033	0.204	-0.416	0.122	0.063

Notes: We split the whole period from 1995-2015 into 4 subperiods: the period before China's WTO accession (1995-2000), the period after China's WTO accession (2000-2005), the period of global financial crisis (2005-2010) and the period after the financial crisis (2010-2015). Column (5) reports the results of the whole period. Panel A presents the decomposition of variety changes across periods, using the initial year of each period as the reference point, following the specification in Equation 2.3. The total variety difference is separated into three components: household expenditure levels, the marginal utility associated with additional varieties (captured by ψ), and the cost of accessing varieties (determined by F and ϵ). Panel B reports welfare gains under three scenarios: (i) when both the marginal utility of variety (ψ) and the access cost parameters (F and ϵ) vary; (ii) when only ψ changes while F and ϵ are held constant; and (iii) when only F and ϵ vary, holding ψ fixed. These decompositions allow us to isolate the distinct contributions of demand-side and supply-side forces to welfare dynamics over time.

To trace the dynamic contributions of income growth, consumer preferences, and access costs to changes in consumption variety and welfare over time, we decompose the variety difference and analyze the corresponding welfare gains on year-by-year basis. Table C.2.2 reports annual decompositions of variety changes and welfare impacts.

Table C.2.2: Year-by-year Decomposition of Variety Difference and Welfare Gains

	Variety Diff.	Variety Diff. Decomposition			Welfare Difference		
	$\Delta n\%$ (1)	ΔX (2)	$\Delta\psi$ (3)	$\Delta(F, \epsilon)$ (4)	only ψ (5)	only F, ϵ (6)	ψ, F and ϵ (7)
1995-1996	0.024	0.015	-0.044	0.046	-0.126	0.038	-0.089
1996-1997	0.014	-0.021	0.104	-0.066	0.253	-0.030	0.223
1997-1998	0.004	0.007	-0.145	0.139	-0.463	0.073	-0.394
1998-1999	0.005	-0.021	-0.013	0.038	-0.034	0.029	-0.005
1999-2000	0.005	-0.005	0.120	-0.108	0.265	-0.064	0.198
2000-2001	0.003	-0.001	-0.024	0.028	-0.067	0.024	-0.042
2001-2002	0.006	-0.004	0.001	0.010	0.004	0.006	0.009
2002-2003	0.014	0.025	0.044	-0.057	0.147	0.045	0.190
2003-2004	0.014	0.059	-0.042	-0.008	-0.184	0.040	-0.143
2004-2005	0.012	-0.033	0.035	0.014	0.118	-0.016	0.103
2005-2006	0.006	-0.007	0.032	-0.019	0.113	-0.016	0.097
2006-2007	-0.001	0.037	0.048	-0.082	0.106	-0.273	-0.160
2007-2008	-0.001	0.021	-0.028	0.005	-0.090	0.128	0.041
2008-2009	-0.012	-0.011	-0.071	0.063	-0.168	-0.106	-0.277
2009-2010	0.008	0.020	-0.044	0.034	-0.097	0.023	-0.075
2010-2011	-0.009	0.028	0.011	-0.061	0.025	-0.010	0.015
2011-2012	0.023	0.010	-0.002	0.024	-0.006	0.129	0.123
2012-2013	-0.002	-0.017	0.133	-0.116	0.345	-0.073	0.276
2013-2014	0.005	0.010	-0.011	0.007	-0.035	-0.027	-0.062
2014-2015	0.004	-0.007	-0.052	0.061	-0.163	0.024	-0.139

Notes: Column (1) reports the change of variety per year. As shown in Column (2)-(4), using the previous year as the reference point, the total variety difference is separated into three components: household expenditure levels (X), the benefits of marginal variety ($\Delta\psi$), and the cost of accessing varieties ($\Delta(F, \epsilon)$), following the specification in Equation 2.3. Column (5) to (7) report welfare gains under three scenarios: (i) when both the marginal utility of variety (ψ) and the access cost parameters (F and ϵ) vary; (ii) when only ψ changes while F and ϵ are held constant; and (iii) when only F and ϵ vary, holding ψ fixed.

C.3 Heterogeneous Analysis: Coastal v.s. Inland Regions

In this section, we explore spatial heterogeneity in rural household consumption variety by comparing coastal and inland provinces.

We examine the shifts in the variety Engel curve between the two regions in 1995 and 2015, as illustrated in Figure C.3.1. The results show that at both points in time, coastal households consistently consume a greater number of food varieties at any given level of expenditure, suggesting structural differences in access and preferences across regions.

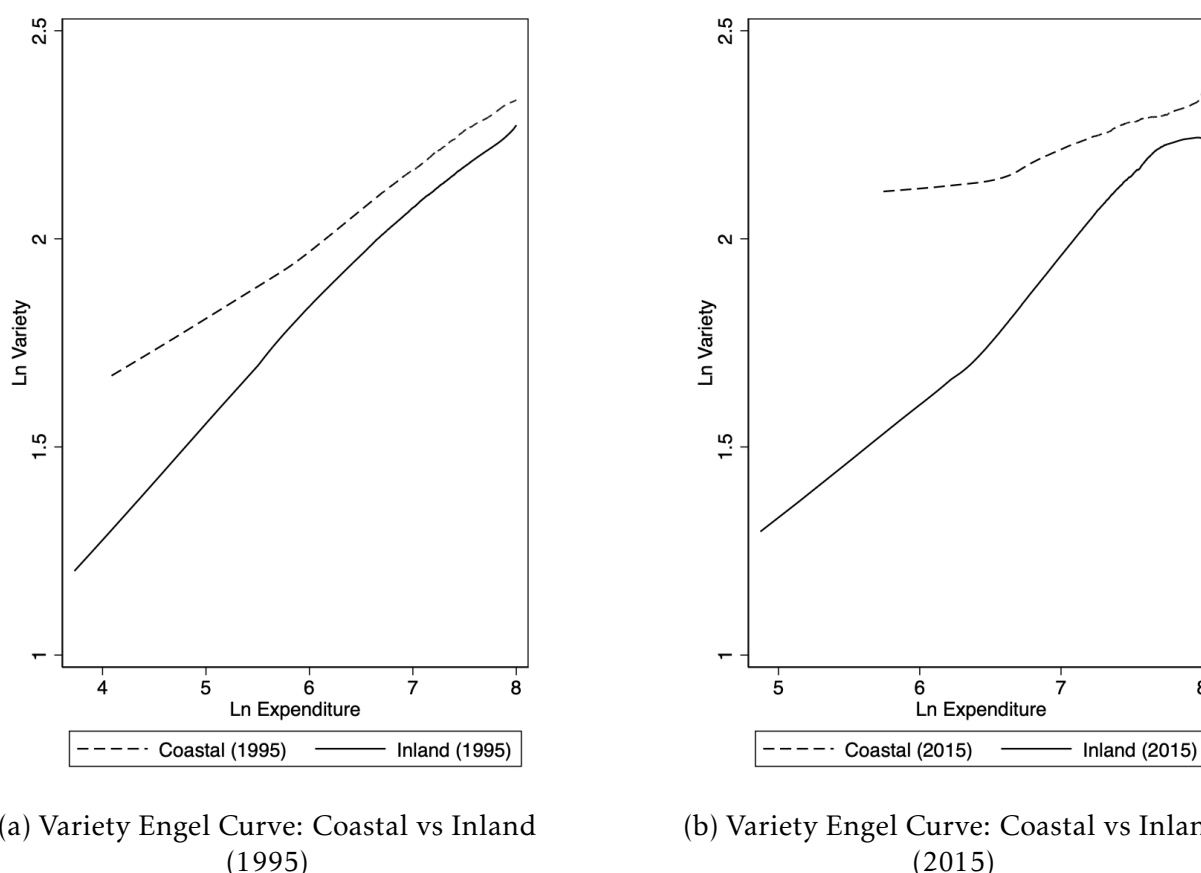


Figure C.3.1: Variety Engel Curve of Coastal and Inland Provinces in 1995 and 2015

Notes: This figure presents the lowest regression of log the number of household consumed variety on log expenditure between coastal and inland regions in 1995 and 2005, respectively. The sample does not include households which consumed less than 2 varieties.

We visualize the evolution of the coastal–inland variety gap over time in Figure C.3.2, which reveals a persistent and widening disparity in food consumption variety between the two regions from 1995 to 2009. This gap expanded most significantly in the years following China’s accession to the WTO, suggesting that trade liberalization disproportionately benefited coastal provinces. However, the pace of divergence slowed noticeably after the onset of the global financial crisis.

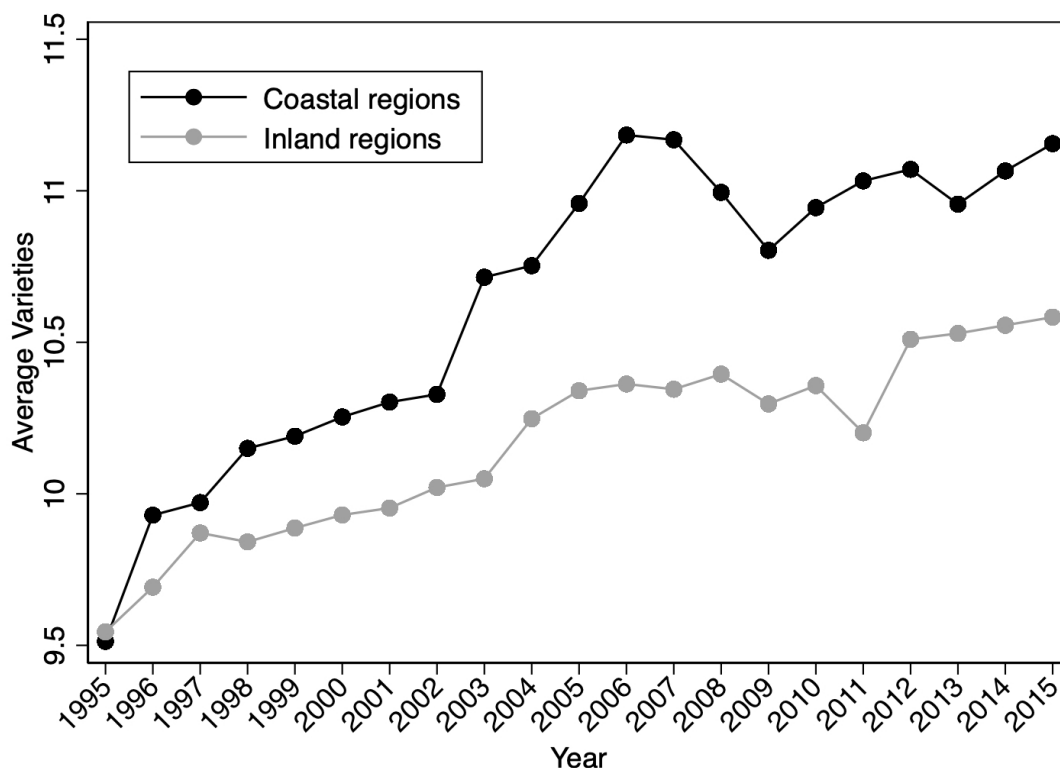


Figure C.3.2: Varieties Difference between Coastal and Inland provinces over time

Notes: This table presents the evolution of the rural coastal–inland gap in food consumption variety from 1995 to 2015. This gap expanded most significantly in the years following China’s accession to the WTO. The pace of divergence slowed noticeably after the onset of the global financial crisis

To further investigate the underlying drivers of this gap, Table C.3.1 decomposes the differences between coastal and inland provinces into three components: household expenditure (ΔX), marginal utility of variety (ψ), and access costs (F, ϵ), and quantifies the associated welfare differences. The results suggest that in most years, differences in benefits of marginal variety and access costs—rather than income—explain the majority of the observed variety gap and welfare disparity between coastal and inland regions.

Table C.3.2 presents the year-by-year decomposition of variety differences and corresponding welfare difference between coastal and inland provinces. This detailed analysis shows that although expenditure differences between regions remained relatively small, both benefits of marginal variety and access cost of varieties played a substantial and varying role in shaping the variety difference and welfare gap over time.

Table C.3.1: Variety Difference Decomposition and Welfare Difference between Coastal and Inland Provinces

	1998 (1)	2003 (2)	2006 (3)	2009 (4)	2012 (5)	2015 (6)
<i>Panel A: Variety difference decomposition between coastal and inland provinces</i>						
Variety difference ($\% \Delta n$)	0.031	0.064	0.076	0.048	0.052	0.053
Expenditure component (X)	0.002	0.004	-0.012	-0.005	0.010	0.009
Benefits of marginal variety (ψ)	0.024	0.010	0.069	0.140	0.053	0.084
Access cost of varieties (F, ϵ)	0.014	0.053	0.023	-0.096	-0.010	-0.053
<i>Panel B: Welfare difference (as the share of expenditure)</i>						
Change in ψ, F, ϵ	0.111	0.178	0.252	0.286	0.390	0.396
Change in ψ only	0.064	0.044	0.233	0.290	0.236	0.286
Change in F, ϵ only	0.046	0.136	0.021	-0.001	0.162	0.122

Notes: Panel A presents the decomposition of variety difference between coastal and inland provinces in different years. The decomposition is based on Equation 2.3, using the inland provinces as the reference point in each year. Panel B reports the welfare difference under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) are different in both coastal and inland provinces; (ii) when only ψ changes, holding F and ϵ constant between coastal and inland provinces; and (iii) when only F and ϵ change, with ψ held constant between coastal and inland provinces.

Table C.3.2: Year-by-year Variety Difference Decomposition and Welfare Difference between Coastal and Inland Provinces

	Variety Diff.	Variety Diff. Decomposition			Welfare Difference		
	$\Delta n\%$ (1)	ΔX (2)	$\Delta\psi$ (3)	$\Delta(F, \epsilon)$ (4)	only ψ (5)	only F, ϵ (6)	ψ, F and ϵ (7)
1995	-0.003	-0.005	0.042	0.015	0.118	0.063	0.180
1996	0.024	-0.005	0.065	-0.020	0.204	0.089	0.292
1997	0.010	0.002	0.142	-0.118	0.474	0.081	0.533
1998	0.031	0.002	0.024	0.014	0.064	0.046	0.111
1999	0.030	0.009	-0.180	0.209	-0.495	0.097	-0.425
2000	0.032	0.008	0.033	-0.001	0.106	0.096	0.200
2001	0.035	0.003	-0.074	0.112	-0.283	0.190	-0.097
2002	0.030	-0.004	-0.035	0.072	-0.127	0.148	0.022
2003	0.064	0.004	0.010	0.053	0.044	0.136	0.178
2004	0.048	-0.008	0.112	-0.059	0.442	0.054	0.486
2005	0.058	-0.003	0.235	-0.170	0.720	-0.006	0.708
2006	0.076	-0.012	0.069	0.023	0.233	0.021	0.252
2007	0.077	-0.002	0.202	-0.121	0.567	0.150	0.666
2008	0.056	-0.007	0.095	-0.027	0.196	-0.171	0.034
2009	0.048	-0.005	0.140	-0.096	0.290	-0.001	0.286
2010	0.055	-0.001	0.081	-0.017	0.143	-0.065	0.077
2011	0.078	0.011	0.133	-0.046	0.247	-0.041	0.205
2012	0.052	0.010	0.053	-0.010	0.236	0.162	0.390
2013	0.040	0.009	0.161	-0.126	0.524	0.057	0.561
2014	0.047	0.009	0.091	-0.052	0.386	0.197	0.544
2015	0.053	0.009	0.084	-0.035	0.286	0.122	0.396

Notes: This table presents the results of the decomposition of variety difference and the welfare comparison between coastal and inland provinces. Column (1) reports the difference of variety per year. Based on Equation 2.3, Column (2)-(4) report the decomposition of variety difference into expenditure difference(ΔX), the benefits of marginal variety difference($\Delta\psi$) and the access cost of varieties difference($\Delta(F, \epsilon)$), using the inland provinces as the reference points in each year. Column (5)-(7) present the welfare difference under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) are different; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant between coastal and inland provinces.

C.4 Robustness Checks for the Effect of China’s WTO Accession

In this section, we provide a series of robustness checks to assess the impact of China’s accession to the WTO on rural household consumption variety and associated welfare gains.

We adopt a Difference-in-Differences (DiD) framework by comparing higher- and lower-exposure provinces—classified based on the magnitude of tariff reductions—before and after WTO entry. To ensure robustness, we employ multiple definitions of pre- and post-WTO periods and test whether the estimated effects hold across specifications. Across all settings, we consistently decompose variety changes into three components: household expenditure (X), marginal benefits of variety (ψ), and access costs (F, ϵ) in Panel A. Panel B in each table quantifies the welfare implications under various counterfactual scenarios.

Specifically, Tables C.4.1 and C.4.2 define 2000–2001 as the pre-accession period and 2002–2003 as the post-accession period. While Table C.4.1 assumes a constant elasticity of substitution (σ), Table C.4.2 relaxes this assumption by allowing σ to vary across time, using the period-specific estimates reported earlier.

To further isolate the WTO effect and address potential transitional noise in 2002, Tables C.4.3 and C.4.4 redefine the post-accession period as 2003–2004 while keeping 2000–2001 as the pre-accession period, thereby excluding 2002 from the comparison. Again, Table C.4.4 incorporates time-varying σ , while Table C.4.3 maintains the constant elasticity assumption.

Finally, Tables C.4.5 and C.4.6 adopt a broader time window, defining 1999–2001 as the pre-accession period and 2003–2005 as the post-accession period. This longer comparison horizon allows for a more stable assessment of medium-run effects. As before, Table C.4.6 relaxes the constant σ assumption, whereas Table C.4.5 holds it fixed.

Table C.4.1 presents the results of the decomposition of variety changes and the associated welfare impacts, using 2000–2001 as the pre-WTO accession period and 2002–2003 as the post-accession period. In this baseline specification, we maintain the assumption of a constant elasticity of substitution (σ) over time, with the value estimated at 1.847, as reported in Table 1.

Table C.4.1: The Effect of China's WTO Accession, 2000-2001 v.s. 2002-2003

	Δ Time		Δ Region		DiD
	Lower-exposure	Higher-exposure	Pre-WTO	Post-WTO	
<i>Panel A: Varieties difference decomposition</i>					
Variety difference (% Δn)	0.008	0.017	0.024	0.033	0.009
Expenditure component (X)	0.007	0.009	-0.005	-0.005	0.002
Benefits of marginal variety (ψ)	0.000	0.148	0.111	0.288	0.177
Access cost of varieties (F, ϵ)	0.001	-0.146	-0.084	-0.258	-0.174
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Change in F, ϵ, ψ	0.074	0.402	0.110	0.427	0.317
Change in ψ only	0.002	0.384	0.192	0.565	0.372
Change in F, ϵ only	0.072	0.025	-0.073	-0.130	-0.057

Notes: This table reports effect of China's WTO accession on variety consumption, decomposition of variety difference and welfare change. We define the period 2000-2001 as pre-WTO and 2002-2003 as post-WTO. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median of the magnitude of tariff reductions experienced by each province before and after China's entry into the WTO. Panel A presents the decomposition of variety difference over time for higher exposure (Column (1)) and lower exposure (Column (2)) provinces. Column (3) to (4) present decomposition of variety difference across different exposure extent provinces before and after China's accession to WTO. The decomposition is based on Equation 2.3, using the lower exposure province before China's accession to WTO as the reference point. Panel B reports the corresponding welfare impact under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant.

Table C.4.2 presents the decomposition of variety differences and the corresponding welfare impacts, using the same pre- and post-accession periods as in Table C.4.1 (2000–2001 and 2002–2003, respectively). Unlike the baseline specification, this analysis relaxes the assumption of a constant elasticity of substitution (σ) over time by incorporating period-specific estimates from Table C.1.1, where σ is estimated at 1.835 prior to WTO accession and 1.851 afterward.

Table C.4.2: The Effect of China's WTO Accession, 2000-2001 v.s. 2002-2003, Different Parameters

	Δ Time		Δ Region		DiD
	Lower-exposure (1)	Higher-exposure (2)	Pre-WTO (3)	Post-WTO (4)	(5)
<i>Panel A: Varieties difference decomposition</i>					
Variety difference ($\% \Delta n$)	0.008	0.017	0.024	0.033	0.009
Expenditure component (X)	0.008	0.009	-0.005	-0.005	0.001
Benefits of marginal variety (ψ)	-0.002	0.143	0.111	0.287	0.176
Access cost of varieties (F, ϵ)	0.004	-0.141	-0.084	-0.257	-0.173
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Change in F, ϵ, ψ	0.065	0.395	0.112	0.426	0.314
Change in ψ only	-0.008	0.374	0.194	0.563	0.369
Change in F, ϵ only	0.074	0.027	-0.074	-0.129	-0.055

Notes: This table reports effect of China's WTO accession on variety consumption, decomposition of variety difference and welfare change. We define the period 2000-2001 as pre-China's accession to WTO (pre-WTO) and the period 2002-2003 as post-China's accession to the WTO (Post-WTO). We relaxes the assumption of a constant elasticity of substitution (σ) over time by incorporating period-specific estimates from Table C.1.1, where σ is estimated at 1.835 prior to WTO accession and 1.851 afterward. The intensity of exposure to the WTO accession shock is identified based on the magnitude of tariff reductions experienced by each province before and after China's entry into the WTO. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median. Panel A presents the decomposition of variety difference over time for higher exposure (Column (1)) and lower exposure (Column (2)) provinces. Column (3) to (4) present decomposition of variety difference across different exposure extent provinces before and after China's accession to WTO. The decomposition is based on Equation 2.3, using the lower exposure province before China's accession to WTO as the reference point. Panel B reports the corresponding impact of China's WTO accession on welfare gains under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant.

Table C.4.3 reports the decomposition of variety changes and the corresponding welfare effects, using 2000–2001 as the pre-WTO accession period and 2003–2004 as the post-accession period. The year 2002 is excluded to mitigate transitional noise associated with the timing of WTO entry. This specification retains the assumption of a constant elasticity of substitution (σ), with the value fixed at 1.847 as reported in Table 1.

Table C.4.3: The Effect of China's WTO Accession, 2000-2001 v.s. 2003-2004

	Δ Time		Δ Region		DiD
	Lower-exposure (1)	Higher-exposure (2)	Pre-WTO (3)	Post-WTO (4)	
(5)					
<i>Panel A: Varieties difference decomposition</i>					
Variety difference ($\% \Delta n$)	0.007	0.040	0.024	0.058	0.034
Expenditure component (X)	0.034	0.030	-0.005	-0.006	-0.001
Benefits of marginal variety (ψ)	-0.008	0.015	0.111	0.076	0.023
Access cost of varieties (F, ϵ)	-0.027	-0.015	-0.084	-0.017	0.012
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Change in F, ϵ, ψ	0.079	0.320	0.110	0.347	0.237
Change in ψ only	-0.039	0.093	0.192	0.351	0.132
Change in F, ϵ only	0.120	0.226	-0.073	-0.004	0.106

Notes: This table reports effect of China's WTO accession on variety consumption, decomposition of variety difference and welfare change. We define the period 2000-2001 as pre-WTO and 2003-2004 as post-WTO. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median of the magnitude of tariff reductions experienced by each province before and after China's entry into the WTO. Panel A presents the decomposition of variety difference over time for higher exposure (Column (1)) and lower exposure (Column (2)) provinces. Column (3) to (4) present decomposition of variety difference across different exposure extent provinces before and after China's accession to WTO. The decomposition is based on Equation 2.3, using the lower exposure province before China's accession to WTO as the reference point. Panel B reports the corresponding welfare impact under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant.

Table C.4.4 presents the decomposition of variety differences and the corresponding welfare impacts, using the same pre- and post-accession periods as in Table C.4.3 (2000–2001 and 2003–2004, respectively). This analysis relaxes the assumption of a constant elasticity of substitution (σ) over time by incorporating period-specific estimates from Table C.1.1, where σ is estimated at 1.835 prior to WTO accession and 1.851 afterward.

Table C.4.4: The Effect of China's WTO Accession, 2000-2001 v.s. 2003-2004, Different Parameters

	Δ Time		Δ Region		DiD
	Lower- exposure (1)	Higher- exposure (2)	Pre- WTO (3)	Post- WTO (4)	(5)
<i>Panel A: Varieties difference decomposition</i>					
Variety difference ($\% \Delta n$)	0.007	0.040	0.024	0.058	0.034
Expenditure component (X)	0.034	0.030	-0.005	-0.006	-0.001
Benefits of marginal variety (ψ)	-0.009	0.013	0.111	0.076	0.023
Access cost of varieties (F, ϵ)	-0.025	-0.013	-0.084	-0.017	0.012
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Change in F, ϵ, ψ	0.070	0.311	0.112	0.346	0.241
Change in ψ only	-0.049	0.081	0.194	0.350	0.156
Change in F, ϵ only	0.123	0.230	-0.074	-0.004	0.070

Notes: This table reports effect of China's WTO accession on variety consumption, decomposition of variety difference and welfare change. We define the period 2000-2001 as pre-China's accession to WTO (pre-WTO) and the period 2003-2004 as post-China's accession to the WTO (Post-WTO). We relaxes the assumption of a constant elasticity of substitution (σ) over time by incorporating period-specific estimates from Table C.1.1, where σ is estimated at 1.835 prior to WTO accession and 1.851 afterward. The intensity of exposure to the WTO accession shock is identified based on the magnitude of tariff reductions experienced by each province before and after China's entry into the WTO. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median. Panel A presents the decomposition of variety difference over time for higher exposure (Column (1)) and lower exposure (Column (2)) provinces. Column (3) to (4) present decomposition of variety difference across different exposure extent provinces before and after China's accession to WTO. The decomposition is based on Equation 2.3, using the lower exposure province before China's accession to WTO as the reference point. Panel B reports the corresponding impact of China's WTO accession on welfare gains under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant.

Table C.4.5 reports the decomposition of variety changes and the corresponding welfare effects, adopting a broader time window, defining 1999–2001 as the pre-accession period and 2003–2006 as the post-accession period. This longer comparison horizon allows for a more stable assessment of medium-run effects. The year 2002 is excluded to mitigate transitional noise associated with the timing of WTO entry. This specification retains the assumption of a constant elasticity of substitution (σ), with the value fixed at 1.847 as reported in Table 1.

Table C.4.5: The Effect of China's WTO Accession, 1999-2001 v.s. 2003-2006

	Δ Time		Δ Region		DiD
	Lower- exposure (1)	Higher- exposure (2)	Pre- WTO (3)	Post- WTO (4)	
<i>Panel A: Varieties difference decomposition</i>					
Variety difference ($\% \Delta n$)	0.014	0.054	0.024	0.065	0.040
Expenditure component (X)	0.050	0.038	-0.005	-0.008	-0.012
Benefits of marginal variety (ψ)	0.010	0.046	0.111	0.102	-0.009
Access cost of varieties (F, ϵ)	-0.049	-0.036	-0.084	-0.034	0.050
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Change in ϵ, ψ	0.064	0.352	0.110	0.387	0.277
Change in ψ only	0.029	0.195	0.192	0.361	0.166
Change in F, ϵ only	0.035	0.158	-0.073	0.026	0.123

Notes: This table reports effect of China's WTO accession on variety consumption, decomposition of variety difference and welfare change. We define the period 1999-2001 as pre-WTO and 2003-2006 as post-WTO. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median of the magnitude of tariff reductions experienced by each province before and after China's entry into the WTO. Panel A presents the decomposition of variety difference over time for higher exposure (Column (1)) and lower exposure (Column (2)) provinces. Column (3) to (4) present decomposition of variety difference across different exposure extent provinces before and after China's accession to WTO. The decomposition is based on Equation 2.3, using the lower exposure province before China's accession to WTO as the reference point. Panel B reports the corresponding welfare impact under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant.

Table C.4.6 presents the decomposition of variety differences and the corresponding welfare impacts, using the same pre- and post-accession periods as in Table C.4.3 (1999–2001 and 2003–2006, respectively). This analysis relaxes the assumption of a constant elasticity of substitution (σ) over time by incorporating period-specific estimates from Table C.1.1, where σ is estimated at 1.835 prior to WTO accession and 1.851 afterward.

Table C.4.6: The Effect of China's WTO Accession, 1999-2001 v.s. 2003-2006, Different Parameters

	Δ Time		Δ Region		DiD
	Lower- exposure (1)	Higher- exposure (2)	Pre- WTO (3)	Post- WTO (4)	
<i>Panel A: Varieties difference decomposition</i>					
Variety difference ($\% \Delta n$)	0.014	0.054	0.024	0.065	0.040
Expenditure component (X)	0.050	0.038	-0.005	-0.008	-0.013
Benefits of marginal variety (ψ)	0.006	0.043	0.111	0.102	0.037
Access cost of varieties (F, ϵ)	-0.046	-0.033	-0.084	-0.034	0.013
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Change in F, ϵ, ψ	0.055	0.344	0.112	0.385	0.289
Change in ψ only	0.019	0.184	0.194	0.360	0.166
Change in F, ϵ only	0.036	0.162	-0.074	0.026	0.126

Notes: This table reports effect of China's WTO accession on variety consumption, decomposition of variety difference and welfare change. We define the period 1999-2001 as pre-China's accession to WTO (pre-WTO) and the period 2003-2006 as post-China's accession to the WTO (Post-WTO). We relaxes the assumption of a constant elasticity of substitution (σ) over time by incorporating period-specific estimates from Table C.1.1, where σ is estimated at 1.835 prior to WTO accession and 1.851 afterward. The intensity of exposure to the WTO accession shock is identified based on the magnitude of tariff reductions experienced by each province before and after China's entry into the WTO. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median. Panel A presents the decomposition of variety difference over time for higher exposure (Column (1)) and lower exposure (Column (2)) provinces. Column (3) to (4) present decomposition of variety difference across different exposure extent provinces before and after China's accession to WTO. The decomposition is based on Equation 2.3, using the lower exposure province before China's accession to WTO as the reference point. Panel B reports the corresponding impact of China's WTO accession on welfare gains under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant.

C.5 Robustness Checks for the Effect of 2008 Global Financial Crisis

In this section, we provide a series of robustness checks to assess the impact of the 2008 global financial crisis on rural household consumption variety and associated welfare gains.

We adopt a Difference-in-Differences (DiD) framework by comparing higher- and lower-exposure provinces—classified based on the magnitude of migration rate reductions—before and after the crisis. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median. To ensure robustness, we employ multiple definitions of pre- and post-FC periods (e.g., 2007 vs. 2009; 2006–2007 vs. 2009–2010; 2006–2007 vs. 2009–2011) and test whether the estimated effects hold across specifications. Across all settings, we consistently decompose variety changes into three components: household expenditure (X), marginal benefits of variety (ψ), and access costs (F, ϵ). Panel B in each table quantifies the welfare implications under various counterfactual scenarios.

Specifically, Tables C.5.1 and C.5.2 define 2007 as the pre-FC period and 2009 as the post-FC period. While Table C.5.1 assumes a constant elasticity of substitution (σ), Table C.5.1 relaxes this assumption by allowing σ to vary across time, using the period-specific estimates reported earlier.

To further isolate the 2008 global financial crisis effect and address potential transitional noise in 2008, Tables C.5.3 and C.5.4 redefine the post-FC period as 2009–2010 while keeping 2006–2007 as the pre-FC period, thereby excluding 2008 from the comparison. Again, Table C.5.4 incorporates time-varying σ , while Table C.5.3 maintains the constant elasticity assumption.

Finally, Tables C.5.5 and C.5.6 adopt a broader time window, defining 2005–2007 as the pre-FC period and 2009–2011 as the post-FC period. This longer comparison horizon allows for a more stable assessment of medium-run effects. As before, Table C.5.6 relaxes the constant σ assumption, whereas Table C.5.5 holds it fixed.

Table C.5.1 presents the results of the decomposition of variety changes and the associated welfare impacts, using 2007 as the pre-FC accession period and 2009 as the post-FC period. In this baseline specification, we maintain the assumption of a constant elasticity of substitution (σ) over time, with the value estimated at 1.847, as reported in Table 1.

Table C.5.1: The Effect of Global Financial Crisis, 2007 v.s. 2009

	Δ Time		Δ Region		DiD
	Lower- Exposure	Higher- Exposure	Pre-FC	Post-FC	
	(1)	(2)	(3)	(4)	
<i>Panel A: Variety difference decomposition</i>					
Changes in variety	-0.006	-0.028	-0.011	-0.032	-0.021
Expenditure component (X)	0.015	0.011	0.007	0.005	-0.002
Benefits of marginal varieties (ψ)	-0.060	-0.246	0.120	-0.026	-0.186
Access cost of varieties (F, ϵ)	0.035	0.189	-0.147	-0.036	0.154
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Change in F, ϵ, ψ	-0.140	-0.808	0.331	-0.038	-0.369
Change in ψ only	-0.142	-0.833	0.322	-0.063	-0.385
Change in F, ϵ only	0.003	0.032	0.016	0.025	0.009

Notes: This table reports effect of 2008 global financial crisis on variety consumption, decomposition of variety difference and welfare change. We define the period 2007 as pre-FC and 2009 as post-FC. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median of the magnitude of the migration rate change caused by different industrial shocks before and after 2008. Panel A presents the decomposition of variety difference over time for higher exposure (Column (1)) and lower exposure (Column (2)) provinces. Column (3) to (4) present decomposition of variety difference across different exposure extent provinces before and after the global financial crisis. The decomposition is based on Equation 2.3, using the lower exposure province before the financial crisis as the reference point. Panel B reports the corresponding welfare impact under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant.

Table C.5.2 presents the decomposition of variety differences and the corresponding welfare impacts, using the same pre- and post-FC periods as in Table C.5.1 (2007 and 2009, respectively). This analysis relaxes the assumption of a constant elasticity of substitution (σ) over time by incorporating period-specific estimates from Table C.1.1, where σ is estimated at 1.851 prior to financial crisis accession and 1.788 afterward.

Table C.5.2: The Effect of Global Financial Crisis, 2007 v.s. 2009, Different Parameter

	Δ Time		Δ Region		DiD
	Lower- Exposure	Higher- Exposure	Pre-FC	Post-FC	
	(1)	(2)	(3)	(4)	
<i>Panel A: Variety difference decomposition</i>					
Changes in variety	-0.006	-0.028	-0.011	-0.032	-0.021
Expenditure component (X)	0.015	0.011	0.007	0.005	-0.004
Intensive margin component (ψ)	-0.063	-0.260	0.126	-0.027	-0.153
Variety cost component (F, ϵ)	0.038	0.202	-0.152	-0.035	0.117
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Change in F, ϵ, ψ	-0.151	-0.883	0.349	-0.040	-0.389
Change in ψ only	-0.154	-0.918	0.341	-0.068	-0.409
Change in F, ϵ only	0.004	0.040	0.014	0.027	0.013

Notes: This table reports effect of 2008 global financial crisis on variety consumption, decomposition of variety difference and welfare change. We define the period 2007 as pre-financial crisis (pre-FC) and the period 2009 as post-financial crisis (Post-FC). We relaxes the assumption of a constant elasticity of substitution (σ) over time by incorporating period-specific estimates from Table C.1.1, where σ is estimated at 1.851 prior to the financial crisis and 1.788 afterward. The intensity of exposure to the financial crisis shock is identified based on the magnitude of the migration rate change caused by different industrial shocks before and after 2008. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median. Panel A presents the decomposition of variety difference over time for higher exposure (Column (1)) and lower exposure (Column (2)) provinces. Column (3) to (4) present decomposition of variety difference across different exposure extent provinces before and after the financial crisis. The decomposition is based on Equation 2.3, using the lower exposure province before the financial crisis as the reference point. Panel B reports the corresponding impact of financial crisis on welfare gains under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant.

Table C.5.3 presents the results of the decomposition of variety changes and the associated welfare impacts, using 2006-2007 as the pre-FC accession period and 2009-2010 as the post-FC period. In this baseline specification, we maintain the assumption of a constant elasticity of substitution (σ) over time, with the value estimated at 1.847, as reported in Table 1.

Table C.5.3: The Effect of Global Financial Crisis, 2006-2007 v.s. 2009-2010

	Δ Time		Δ Region		DiD
	Lower- Exposure (1)	Higher- Exposure (2)	Pre-FC (3)	Post-FC (4)	
<i>Panel A: Variety difference decomposition</i>					
Changes in variety	-0.006	-0.018	-0.019	-0.030	-0.012
Expenditure component (X)	0.050	0.059	0.003	0.012	0.009
Intensive margin component (ψ)	-0.030	-0.115	-0.003	-0.055	-0.052
Variety cost component (F, ϵ)	-0.025	0.036	-0.034	-0.007	0.027
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Change in F, ϵ, ψ	-0.294	-0.517	0.067	-0.093	-0.160
Change in ψ only	-0.044	-0.162	0.009	-0.067	-0.076
Change in F, ϵ only	-0.252	-0.365	0.058	-0.027	-0.085

Notes: This table reports effect of 2008 global financial crisis on variety consumption, decomposition of variety difference and welfare change. We define the period 2006-2007 as pre-FC and 2009-2010 as post-FC. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median of the magnitude of the migration rate change caused by different industrial shocks before and after 2008. Panel A presents the decomposition of variety difference over time for higher exposure (Column (1)) and lower exposure (Column (2)) provinces. Column (3) to (4) present decomposition of variety difference across different exposure extent provinces before and after the global financial crisis. The decomposition is based on Equation 2.3, using the lower exposure province before the financial crisis as the reference point. Panel B reports the corresponding welfare impact under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant.

Table C.5.4 presents the decomposition of variety differences and the corresponding welfare impacts, using the same pre- and post-FC periods as in Table C.5.3 (2006-2007 and 2009-2010, respectively). This analysis relaxes the assumption of a constant elasticity of substitution (σ) over time by incorporating period-specific estimates from Table C.1.1, where σ is estimated at 1.851 prior to financial crisis accession and 1.788 afterward.

Table C.5.4: The Effect of Global Financial Crisis, 2006-2007 v.s. 2009-2010, Different Parameters

	Δ Time		Δ Region		DiD
	Lower- Exposure	Higher- Exposure	Pre-FC	Post-FC	
	(1)	(2)	(3)	(4)	
<i>Panel A: Variety difference decomposition</i>					
Changes in variety	-0.006	-0.018	-0.019	-0.030	-0.012
Expenditure component (X)	0.050	0.059	0.003	0.012	0.009
Intensive margin component (ψ)	-0.031	-0.121	0.003	-0.057	-0.090
Variety cost component (F, ϵ)	-0.024	0.042	-0.034	-0.005	0.066
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Change in F, ϵ, ψ	-0.316	-0.560	0.071	-0.100	-0.171
Change in ψ only	-0.047	-0.175	0.010	-0.072	-0.082
Change in F, ϵ only	-0.270	-0.392	0.062	-0.029	-0.091

Notes: This table reports effect of 2008 global financial crisis on variety consumption, decomposition of variety difference and welfare change. We define the period 2006-2007 as pre-financial crisis (pre-FC) and the period 2009-2010 as post-financial crisis (Post-FC). We relaxes the assumption of a constant elasticity of substitution (σ) over time by incorporating period-specific estimates from Table C.1.1, where σ is estimated at 1.851 prior to the financial crisis and 1.788 afterward. The intensity of exposure to the financial crisis shock is identified based on the magnitude of the migration rate change caused by different industrial shocks before and after 2008. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median. Panel A presents the decomposition of variety difference over time for higher exposure (Column (1)) and lower exposure (Column (2)) provinces. Column (3) to (4) present decomposition of variety difference across different exposure extent provinces before and after the financial crisis. The decomposition is based on Equation 2.3, using the lower exposure province before the financial crisis as the reference point. Panel B reports the corresponding impact of financial crisis on welfare gains under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant.

Table C.5.5 presents the results of the decomposition of variety changes and the associated welfare impacts, using 2005-2007 as the pre-FC accession period and 2009-2011 as the post-FC period. In this baseline specification, we maintain the assumption of a constant elasticity of substitution (σ) over time, with the value estimated at 1.847, as reported in Table 1.

Table C.5.5: The Effect of Global Financial Crisis, 2005-2007 v.s. 2009-2011

	Δ Time		Δ Region		DiD
	Lower- Exposure (1)	Higher- Exposure (2)	Pre-FC (3)	Post-FC (4)	
<i>Panel A: Variety difference decomposition</i>					
Changes in variety	-0.001	-0.028	-0.021	-0.047	-0.026
Expenditure component (X)	0.066	0.072	0.003	0.012	0.009
Intensive margin component (ψ)	0.014	-0.236	0.023	-0.149	-0.250
Variety cost component (F, ϵ)	-0.081	0.124	-0.056	0.063	0.205
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Change in F, ϵ, ψ	-0.245	-0.698	0.107	-0.211	-0.318
Change in ψ only	0.022	-0.398	0.077	-0.215	-0.292
Change in F, ϵ only	-0.267	-0.318	0.031	0.006	-0.025

Notes: This table reports effect of 2008 global financial crisis on variety consumption, decomposition of variety difference and welfare change. We define the period 2005-2007 as pre-FC and 2009-2011 as post-FC. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median of the magnitude of the migration rate change caused by different industrial shocks before and after 2008. Panel A presents the decomposition of variety difference over time for higher exposure (Column (1)) and lower exposure (Column (2)) provinces. Column (3) to (4) present decomposition of variety difference across different exposure extent provinces before and after the global financial crisis. The decomposition is based on Equation 2.3, using the lower exposure province before the financial crisis as the reference point. Panel B reports the corresponding welfare impact under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant.

Table C.5.6 presents the decomposition of variety differences and the corresponding welfare impacts, using the same pre- and post-FC periods as in Table C.5.5 (2005-2007 and 2009-2011, respectively). This analysis relaxes the assumption of a constant elasticity of substitution (σ) over time by incorporating period-specific estimates from Table C.1.1, where σ is estimated at 1.851 prior to financial crisis accession and 1.788 afterward.

Table C.5.6: The Effect of Global Financial Crisis, 2005-2007 v.s. 2009-2011, Different Parameters

	Δ Time		Δ Region		DiD
	Lower-Exposure (1)	Higher-Exposure (2)	Pre-FC (3)	Post-FC (4)	
<i>Panel A: Variety difference decomposition</i>					
Changes in variety	-0.001	-0.028	-0.021	-0.047	-0.026
Expenditure component (X)	0.066	0.072	0.003	0.012	0.009
Intensive margin component (ψ)	0.015	-0.249	0.024	-0.155	-0.179
Variety cost component (F, ϵ)	-0.081	0.136	-0.057	0.069	0.126
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Change in F, ϵ, ψ	-0.263	-0.761	0.114	-0.227	-0.341
Change in F, ϵ only	-0.287	-0.340	0.032	0.008	-0.024
Change in ψ only	0.024	-0.434	0.083	-0.233	-0.316

Notes: This table reports effect of 2008 global financial crisis on variety consumption, decomposition of variety difference and welfare change. We define the period 2005-2007 as pre-financial crisis (pre-FC) and the period 2009-2011 as post-financial crisis (Post-FC). We relaxes the assumption of a constant elasticity of substitution (σ) over time by incorporating period-specific estimates from Table C.1.1, where σ is estimated at 1.851 prior to the financial crisis and 1.788 afterward. The intensity of exposure to the financial crisis shock is identified based on the magnitude of the migration rate change caused by different industrial shocks before and after 2008. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median. Panel A presents the decomposition of variety difference over time for higher exposure (Column (1)) and lower exposure (Column (2)) provinces. Column (3) to (4) present decomposition of variety difference across different exposure extent provinces before and after the financial crisis. The decomposition is based on Equation 2.3, using the lower exposure province before the financial crisis as the reference point. Panel B reports the corresponding impact of financial crisis on welfare gains under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant.

D Urban Regions Additional Analysis

D.1 Additional Parameter Estimation: Using Urban Household Survey

To further assess the robustness of our findings, we provide additional estimates of the variety Engel curve parameters under alternative specifications. First, we relax the assumption that the elasticity of variety is constant across regions and over time. Second, we test the sensitivity of the results to the choice of base variety.

Table D.1.1 presents structural parameter estimates for four distinct periods: before China's WTO accession (1997-2001), during its accession (2002-2003), during the financial crisis (2008-2009), and after the financial crisis (2011-2015).

Table D.1.1: Additional Parameter Estimation: Different Period

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: Pre-WTO period (1999-2002)</i>						
Dependent Var.:	$\ln(\text{Share}_{hti}/\text{Share}_{ht0})$				$\ln(X_0/X)_{ht}$	$\ln(n_{ht})$
	OLS		IV			
$\Delta \ln(p)$	-0.086*** (0.015)	-0.086*** (0.016)	-0.082*** (0.013)	-0.082*** (0.013)		
$\ln(\# \text{Variety})$					-.117*** (0.065)	
$\ln(X)$						0.166*** (0.001)
Constant	0.826*** (0.017)	0.826*** (0.018)			-0.950*** (0.191)	1.653*** (0.050)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Province×Year FE	No	Yes	No	Yes	Yes	Yes
Kleibergen-Paap F	None	None	77.377	77.422	None	None
R^2	0.381	0.385	0.004	0.004	0.668	0.404
Observations	505,908	505,908	497,761	497,761	722,900	1,042,850
<i>Panel B: China's WTO accession period (2003-2004)</i>						
$\Delta \ln(p)$	-0.173*** (0.010)	-0.173*** (0.010)	-0.064*** (0.012)	-0.064*** (0.012)		
$\ln(\# \text{Variety})$					-1.057*** (0.071)	
$\ln(X)$						0.197*** (0.007)
Constant	0.842***	0.842***			-1.200***	1.313***

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Table D.1.1 – continued from previous page

Dependent Var.:	$\ln(Share_{hti}/Share_{ht0})$				$\ln(X_0/X)_{ht}$	$\ln(n_{ht})$
	OLS		IV			
	(0.010)	(0.010)			(0.209)	(0.057)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Province×Year FE	No	Yes	No	Yes	Yes	Yes
Kleibergen-Paap F	None	None	101.454	101.443	None	None
R^2	0.365	0.366	0.009	0.009	0.651	0.457
Observations	661,191	661,191	644,455	644,455	858,450	1,202,575
<i>Panel C: Financial crisis period (2007-2009)</i>						
$\Delta \ln(p)$	-0.119*** (0.021)	-0.122*** (0.020)	-0.023 (0.026)	-0.022 (0.026)		
$\ln(\#Variety)$					-0.755*** (0.127)	
$\ln(X)$						0.176*** (0.020)
Constant	1.306*** (0.023)	1.309*** (0.023)			-2.696*** (0.382)	1.422*** (0.168)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Province×Year FE	No	Yes	No	Yes	Yes	Yes
Kleibergen-Paap F	None	None	50.980	50.980	None	None
R^2	0.394	0.406	0.003	0.003	0.767	0.540
Observations	164,274	164,274	152,319	152,319	206,800	287,275

Notes: This table reports estimates of structural parameters on different periods. Columns (1) and (2) present the estimates of σ (the reported coefficient is $1 - \sigma$) corresponding to Equation 3.1. Columns (3) to (4) presents the estimates based on Equation 3.2. Column (5) presents the estimates corresponding to Equation 3.3, and Column (6) shows the estimates based on Equation 3.4. The base variety is corn. In all Columns, the sample is at the household-year-variety unit. The instrumental variable (IV) estimations are reported in Columns (3) - (4), where Varieties' prices of U.S. are used as an IV. Controls include: household income, civilian server family member, labor supply, and poverty households. Panel A, B, C and D reports the variety Engel curve parameters estimates in the periods before China's WTO accession, the period when China was access to WTO, the period when global financial crisis happened and the period after the financial crisis, respectively. Robust standard errors clustered at the village level are shown in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Table D.1.2 presents year-by-year recovered estimates of the variety Engel curve parameters, capturing potential temporal variation. The estimates of Column (1) and (2) were based on Equation 3.3. Column (3) to (6) reports the recovered estimates based on Equation 3.4.

Table D.1.2: Additional Parameter Estimation: Year-by-year Estimation

	ψ		ϵ		F	
	(1)	(2)	(3)	(4)	(5)	(6)
1995	0.7269632	0.6269956	9.448577	9.448577	2.70e-09	3.93e-07
1996	0.8317276	0.7566037	8.251598	8.251598	8.39e-08	3.50e-06
1997	0.7837883	0.6817217	8.35996	8.35996	4.26e-08	2.36e-06
1998	0.7490715	0.634827	7.825364	7.825364	1.65e-07	6.90e-06
1999	0.8062719	0.7077374	8.023855	8.023855	1.08e-07	5.46e-06
2000	0.8712393	0.7265017	7.781772	7.781772	2.47e-07	0.0000114
2001	0.9142261	0.8183057	8.11543	8.11543	1.09e-07	0.0000111
2002	0.9783202	0.8177109	6.357694	6.357694	0.0000753	0.0000683
2003	0.9521214	0.8025222	6.089881	6.089881	0.0001572	0.0001565
2004	0.7679852	0.6559756	5.825718	5.825718	0.0001929	0.0002059
2005	0.8826001	0.7357257	5.955051	5.955051	0.0001971	0.0002099
2006	0.8373587	0.7374578	5.920023	5.920023	0.0001968	0.0002347
2007	0.5657878	0.5317317	7.483113	7.483113	4.96e-07	8.09e-07
2008	0.7713079	0.6897265	6.138693	6.138693	0.0001059	0.000142
2009	0.5502471	0.4919384	6.12829	6.12829	0.0000425	0.0000562

Notes: This table reports the estimates of parameters ψ , F and ϵ . Columns (1) and (2) present the estimates of benefits of marginal variety ψ corresponding to Equation 3.3. Column (3) to (4) reports the access cost of varieties parameters F and Column (5) to (6) present parameter ϵ based on Equation 3.4, respectively. The base variety is corn. Columns (1) (3) (5) are estimates without controls, whereas Columns (2) (4) (6) are estimates including controls. Controls include: household income, civilian server of family member, labor supply, and poverty households. Robust standard errors clustered at the village level are shown in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Table D.1.3: Additional Parameter Estimation: Changing Base Variety

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: Elasticity of variety (σ)</i>						
Dependent Var.:	$\ln(\text{Share}_{hti}/\text{Share}_{ht0})$					
	OLS		IV			
$\Delta \ln(p)$	-0.110*** (0.011)	-0.111*** (0.011)	-0.085*** (0.011)	-0.084*** (0.011)	-1.247*** (0.260)	-1.300*** (0.256)
Constant	-1.620*** (0.013)	-1.618*** (0.013)				
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Province×Year FE	No	Yes	No	Yes	No	Yes
Village×Variety FE	No	No	No	No	Yes	Yes
Kleibergen-Paap F			104.331	104.267	32.298	32.962
R-Squared	0.028	0.033	0.007	0.007	-0.605	-0.646
Observations	3,169,797	3,169,797	3,070,281	3,070,281	3,070,281	3,070,281
<i>Panel B: Other parameters (ψ, F and ϵ)</i>						
Dependent Var.:	$\ln(X_0/X)_{ht}$			$\ln(n_{ht})$		
$\ln(\# \text{Variety})$	-0.138*** (0.030)	-0.109*** (0.030)	-0.114*** (0.031)			
$\ln(X)$				0.186*** (0.005)	0.186*** (0.005)	0.182*** (0.005)
Constant	-1.465** (0.087)	-1.486** (0.884)	-1.466*** (0.087)	1.435*** (0.040)	1.407*** (0.040)	1.436*** (0.041)
Controls	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Province×Year FE	No	No	Yes	No	No	Yes
R-Squared	0.124	0.135	0.149	0.441	0.443	0.479
Observations	178,113	178,113	178,113	178,626	178,626	178,626

Notes: This table reports estimation results using vegetable as the base variety. Panel A shows estimates of elasticity of substitution (σ), the reported coefficients are $1 - \sigma$. Columns (1) and (2) present the estimates corresponding to Equation 3.1, and Column (4) to (6) shows the estimates results based on Equation 3.2. Panel B reports estimates results of other parameters: ψ, F and ϵ . Column (1) to (3) present the estimates based on Equation 3.3, and Column (4) to (6) report the estimates corresponding to Equation 3.4. The sample is at the household-year-variety unit in Panel A and household-year unit in Panel B, respectively. The instrumental variable (IV) estimations are reported in Columns (3) - (6) of Panel A, where corresponding variety prices in US are used as an IV. Controls include: household income, civilian server of family member, labor supply, and poverty households. Robust standard errors clustered at the village level are shown in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

D.2 Year-by-year Analysis and Coastal v.s. Inland Regions Heterogeneous Analysis

This section provides a temporal analysis of variety growth and its welfare implications in rural China from 1995 to 2009. It also explores spatial heterogeneity in household consumption variety by comparing coastal and inland provinces.

1. Year-by-year Decomposition of Variety Difference and Welfare Difference Analysis

We divide the full sample into three key periods—pre-WTO accession (1996–2000), WTO accession (2001–2005), and the global financial crisis (2007–2008)—to analyze how these economic shocks shaped consumption variety and welfare. Table D.2.1 presents the decomposition results for each period.

To capture within-period dynamics, we also estimate the structural parameters of the variety Engel curve on a year-by-year basis. Table D.2.2 reports the annual decompositions of variety changes and welfare impacts, offering a more granular perspective on the drivers of variety growth.

Table D.2.1: Decomposition and Welfare Analysis over Different Period

	Before WTO 96-00 (1)	WTO accession 01-05 (2)	Financial crisis 07-08 (3)	Overall period 95-05 (4)
<i>Panel A: Variety difference decomposition over periods</i>				
Changes in variety ($\% \Delta n$)	0.053	0.051	-0.021	0.155
Expenditure component (X)	-0.022	0.272	0.033	0.266
Benefits of marginal variety (ψ)	0.054	0.108	0.172	0.118
Access cost of varieties (F, ϵ)	0.008	-0.147	-0.211	-0.073
<i>Panel B: Welfare difference (as the share of expenditure)</i>				
Change in ψ, F and ϵ	0.065	0.101	-0.046	0.102
Change in ψ only	0.113	0.213	0.248	0.224
Change in F, ϵ only	-0.052	-0.123	-0.301	-0.237

Notes: Panel A presents the decomposition of variety changes across periods, using the initial year of each period as the reference point, following the specification in Equation 2.3. The total variety difference is separated into three components: household expenditure levels, the marginal utility associated with additional varieties (captured by ψ), and the cost of accessing varieties (determined by F and ϵ). Panel B reports welfare gains under three scenarios: (i) when both the marginal utility of variety (ψ) and the access cost parameters (F and ϵ) vary; (ii) when only ψ changes while F and ϵ are held constant; and (iii) when only F and ϵ vary, holding ψ fixed. These decompositions allow us to isolate the distinct contributions of demand-side and supply-side forces to welfare dynamics over time. The base variety is flour.

Table D.2.2: Year-by-year Decomposition of Variety Difference and Welfare Gains

Year	Variety Diff.	Variety Diff. Decomposition			Welfare Diff.		
	$\Delta n\%$ (1)	ΔX (2)	$\Delta \psi$ (3)	$\Delta(F, \epsilon)$ (4)	only ψ (5)	only F, ϵ (6)	ψ, F and ϵ (7)
1995-1996	0.051	0.012	-0.032	0.075	-0.082	0.054	-0.026
1996-1997	0.020	-0.001	0.023	-0.030	0.058	-0.008	0.050
1997-1998	0.007	-0.008	-0.002	0.037	-0.005	-0.004	-0.009
1998-1999	0.006	-0.005	-0.091	0.095	-0.234	0.043	-0.188
1999-2000	0.020	-0.006	0.123	-0.092	0.243	-0.076	0.175
2000-2001	0.000	0.003	-0.011	-0.008	-0.024	-0.016	-0.040
2001-2002	0.030	0.215	0.055	-0.087	0.126	-0.02	0.107
2002-2003	0.005	0.005	0.038	-0.040	0.081	-0.071	0.014
2003-2004	0.003	0.032	-0.170	0.156	-0.397	0.029	-0.367
2004-2005	0.014	0.005	0.160	-0.146	0.296	-0.05	0.251
2005-2006	-0.003	0.011	-0.024	0.004	-0.053	-0.005	-0.059
2006-2007	0.013	0.006	-0.286	0.269	-1.520	0.476	-0.854
2007-2008	-0.021	0.033	0.172	-0.211	0.248	-0.301	-0.046
2008-2009	-0.002	0.007	-0.310	0.292	-0.661	0.196	-0.500

Notes: This table reports the detailed results of varieties difference decomposition and welfare analysis from 1995 to 2009. We decompose the variety change with taking the previous year as the reference year. The Column (5) reports the welfare gains when the relative intensive margin and variety cost parameters stay constant and only expenditure change; Column (6) reports the welfare gains when expenditure and variety cost stay the same and only relative intensive change; Column (7) is the case when expenditure and relative intensive hold and only variety cost change. We also report the case when all parameters change.

2. Urban Regions Heterogeneous Analysis: Coastal v.s. inland Regions

To explore spatial heterogeneity in rural household consumption variety between coastal and inland provinces, we first visualize the evolution of the coastal-inland variety gap over time.

Figure D.2.1 highlights a persistent and widening disparity in variety consumption from 1995 to 2009.

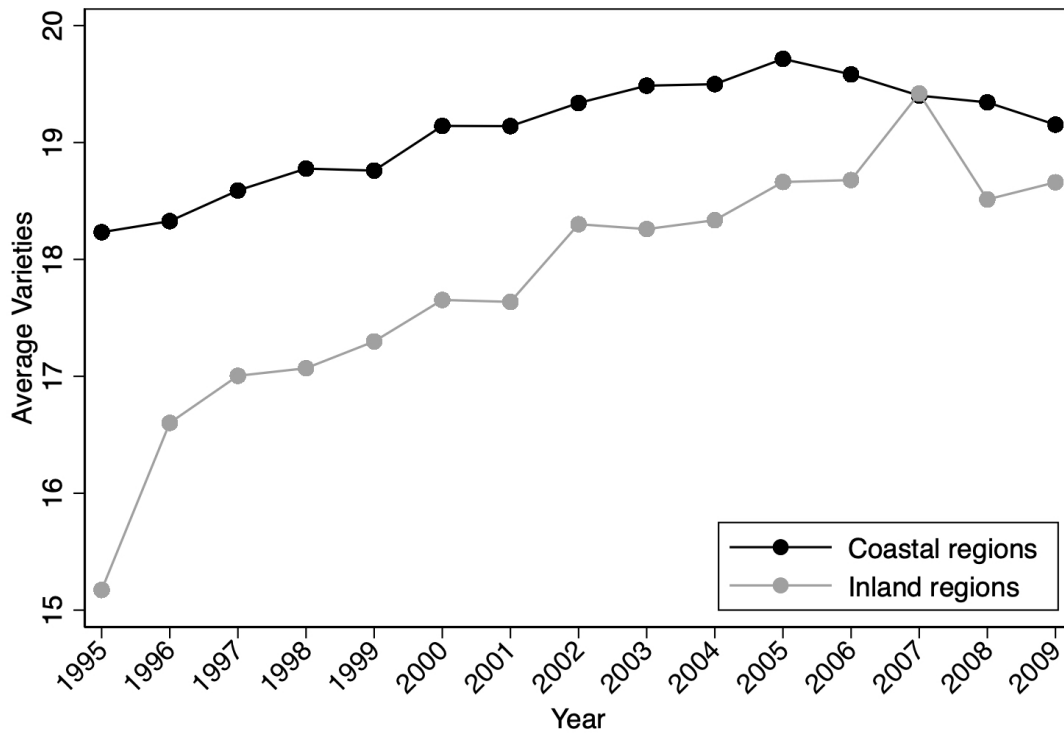


Figure D.2.1: Variety Gap between Coastal and Inland Regions over Years in Urban Areas

To further investigate the underlying drivers of this gap, Table D.2.3 decomposes the differences into three components: household expenditure, the marginal utility of variety (ψ), and access costs (F, ϵ), and it quantifies the associated welfare differences. The results suggest that in most years, differences in preferences and access costs—rather than income—explain the majority of the observed variety gap and welfare disparity.

Table D.2.3: Coastal-Inland Variety Gap Decomposition and Welfare Difference

	1996 (1)	2000 (2)	2003 (3)	2006 (4)	2009 (5)
Panel A: Variety difference decomposition between coastal and inland					
Variety Difference ($\Delta n\%$)	0.099	0.081	0.065	0.047	0.026
Expenditure difference (X)	0.027	0.037	0.031	0.039	0.014
Benefits of marginal varieties (ψ)	0.020	0.024	0.114	0.023	0.034
Access cost of varieties (F, ϵ)	0.013	0.013	-0.103	-0.013	-0.344
Panel B: Welfare difference (as the share of expenditure)					
Change in F, ϵ, ψ	0.278	0.213	0.407	0.174	0.657
Change in F, ϵ only	0.287	0.198	0.171	0.175	0.015
Change in ψ only	0.104	0.083	0.264	0.051	0.555

Notes: Panel A presents the decomposition of variety difference between coastal and inland provinces in different years. The decomposition is based on Equation 2.3, using the inland provinces as the reference point in each year. Panel B reports the welfare difference under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) are different in both coastal and inland provinces; (ii) when only ψ changes, holding F and ϵ constant between coastal and inland provinces; and (iii) when only F and ϵ change, with ψ held constant between coastal and inland provinces.

Table D.2.4 provides a year-by-year decomposition of these variety differences and the corresponding welfare impacts. This detailed analysis shows that although expenditure differences between the regions remained relatively small, both preference shifts and supply-side access constraints played a substantial and varying role in shaping the welfare gap over time. These findings highlight the importance of regional infrastructure and market integration in supporting consumption diversity and rural welfare.

Table D.2.4: Year-by-year Variety Difference Decomposition and Welfare Difference between Coastal and Inland Provinces

Years	Variety Diff.	Variety Diff. Decomposition			Welfare Diff.		
	$\Delta n\%$ (1)	ΔX (2)	$\Delta\psi$ (3)	$\Delta(F, \epsilon)$ (4)	only ψ (5)	only F, ϵ (6)	Welfare (7)
1995	0.184	0.032	0.100	0.064	0.298	0.075	0.410
1996	0.099	0.027	0.020	0.013	0.104	0.287	0.278
1997	0.089	0.027	-0.044	0.108	-0.209	0.272	-0.093
1998	0.095	0.031	-0.103	0.186	-0.449	0.319	-0.406
1999	0.081	0.033	0.028	0.074	0.087	0.140	0.201
2000	0.081	0.037	0.024	0.013	0.083	0.198	0.213
2001	0.082	0.037	-0.098	0.162	-0.390	0.287	-0.264
2002	0.055	0.033	0.010	0.011	0.031	0.241	0.193
2003	0.065	0.031	0.114	-0.103	0.264	0.171	0.407
2004	0.062	0.037	0.116	-0.091	0.244	0.147	0.382
2005	0.055	0.038	-0.016	0.043	-0.037	0.202	0.088
2006	0.047	0.039	0.023	-0.013	0.051	0.175	0.174
2007	-0.001	0.005	-0.005	0.151	-0.012	-0.111	-0.021
2008	0.044	0.036	0.170	-0.147	0.353	0.095	0.469
2009	0.026	0.014	0.346	-0.344	0.555	0.015	0.657

Notes: This table presents the results of the decomposition of variety difference and the welfare comparison between coastal and inland provinces. Column (1) reports the difference of variety per year. Based on Equation 2.3, Column (2)-(4) report the decomposition of variety difference into expenditure difference(ΔX), the benefits of marginal variety difference($\Delta\psi$) and the access cost of varieties difference($\Delta(F, \epsilon)$), using the inland provinces as the reference points in each year. Column (5)-(7) present the welfare difference under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) are different; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant between coastal and inland provinces.

D.3 Robustness Checks for the Effect of China's WTO Accession and 2008 Global Financial Crisis: Using Urban Household Survey

This section presents a series of robustness checks on the impact of WTO accession and the global financial crisis on rural household consumption variety and the associated welfare gains.

We adopt a Difference-in-Differences (DiD) framework by comparing higher- and lower-exposure provinces—classified based on the magnitude of tariff reduction—before and after each shock. To ensure robustness, we employ multiple definitions of pre- and post-WTO periods. Across all settings, we consistently decompose variety changes into three components: expenditure, marginal benefits of variety (ψ), and access costs (F, ϵ). Panel B in each table quantifies the welfare implications under various counterfactual scenarios.

Table D.3.1: Robustness Checks for the Effect of China's WTO Accession, 2000 v.s 2003

	Δ Time		Δ Region		DiD
	Lower-exposure	Higher-exposure	Pre-WTO	Post-WTO	
<i>Panel A: Varieties difference decomposition</i>					
Variety difference ($\% \Delta n$)	0.020	0.042	0.061	0.079	0.018
Expenditure component (X)	0.255	0.247	0.012	0.004	-0.008
Benefits of marginal variety (ψ)	-0.063	-0.031	-0.171	-0.163	0.008
Access cost of varieties (F, ϵ)	0.022	0.002	0.152	0.193	0.041
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Change in F, ϵ, ψ	0.083	0.176	-0.421	-0.286	0.135
Change in ψ only	0.181	0.224	-0.520	-0.453	0.067
Change in F, ϵ only	-0.139	-0.116	0.236	0.246	0.023

Notes: This table reports effect of China's WTO accession on variety consumption, decomposition of variety difference and welfare change. We define the year 2000 as pre-China's accession to WTO (pre-WTO) and the year 2003 as post-China's accession to the WTO (Post-WTO). The intensity of exposure to the WTO accession shock is identified based on the magnitude of tariff reductions experienced by each province before and after China's entry into the WTO. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median. Panel A presents the decomposition of variety difference over time for higher exposure (Column (1)) and lower exposure (Column (2)) provinces. Column (3) to (4) present decomposition of variety difference across different exposure extent provinces before and after China's accession to WTO. The decomposition is based on Equation 2.3, using the lower exposure province before China's accession to WTO as the reference point. Panel B reports the corresponding impact of China's WTO accession on welfare gains under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant.

Table D.3.2: Robustness Checks for the Effect of China's WTO Accession 2, 2001 v.s. 2002

	Δ Time		Δ Region		DiD
	Lower- exposure (1)	Higher- exposure (2)	Pre- WTO (3)	Post- WTO (4)	(5)
<i>Panel A: Varieties difference decomposition</i>					
Variety difference ($\Delta n\%$)	0.033	0.033	0.065	0.064	0.000
Expenditure component (X)	0.246	0.199	0.013	0.005	-0.047
Benefits of marginal varieties (ψ)	-0.010	0.047	-0.203	-0.100	0.103
Access cost of varieties (F, ϵ)	0.007	-0.080	0.301	0.157	-0.087
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Change in F, ϵ, ψ	-0.119	0.161	-0.445	-0.086	0.280
Change in ψ only	-0.135	0.057	-0.515	-0.298	0.192
Change in F, ϵ only	-0.019	0.119	0.149	0.293	0.138

Notes: This table reports effect of China's WTO accession on variety consumption, decomposition of variety difference and welfare change. We define the year 2001 as pre-China's accession to WTO (pre-WTO) and the year 2002 as post-China's accession to the WTO (Post-WTO). The intensity of exposure to the WTO accession shock is identified based on the magnitude of tariff reductions experienced by each province before and after China's entry into the WTO. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median. Panel A presents the decomposition of variety difference over time for higher exposure (Column (1)) and lower exposure (Column (2)) provinces. Column (3) to (4) present decomposition of variety difference across different exposure extent provinces before and after China's accession to WTO. The decomposition is based on Equation 2.3, using the lower exposure province before China's accession to WTO as the reference point. Panel B reports the corresponding impact of China's WTO accession on welfare gains under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant.

Table D.3.3: Robustness Checks for the Effect of China's WTO Accession 3, 2000-2001 v.s. 2002-2003

	Δ Time		Δ Region		DiD
	Lower- exposure (1)	Higher- exposure (2)	Pre- WTO (3)	Post- WTO (4)	
<i>Panel A: Varieties difference decomposition</i>					
Changes in variety ($\% \Delta n$)	0.027	0.037	0.063	0.072	0.010
Expenditure component (X)	0.251	0.213	0.013	0.005	-0.008
Benefits of marginal varieties (ψ)	0.044	0.078	-0.183	-0.125	0.058
Access cost of varieties (F, ϵ)	-0.099	-0.122	0.223	0.166	-0.023
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Change in F, ϵ, ψ	-0.012	0.166	-0.416	-0.171	0.178
Change in F, ϵ only	-0.137	-0.038	0.185	0.253	0.099
Change in ψ only	0.087	0.177	-0.499	-0.350	0.090

Notes: This table reports effect of China's WTO accession on variety consumption, decomposition of variety difference and welfare change. We define the period 2000-2001 as pre-China's accession to WTO (pre-WTO) and the period 2002-2003 as post-China's accession to the WTO (Post-WTO). The intensity of exposure to the WTO accession shock is identified based on the magnitude of tariff reductions experienced by each province before and after China's entry into the WTO. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median. Panel A presents the decomposition of variety difference over time for higher exposure (Column (1)) and lower exposure (Column (2)) provinces. Column (3) to (4) present decomposition of variety difference across different exposure extent provinces before and after China's accession to WTO. The decomposition is based on Equation 2.3, using the lower exposure province before China's accession to WTO as the reference point. Panel B reports the corresponding impact of China's WTO accession on welfare gains under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant.

Table D.3.4: Robustness Checks for the Effect of China's WTO Accession 4, 2000-2001 v.s. 2003-2004

	Δ Time		Δ Region		DiD
	Lower- exposure (1)	Higher- exposure (2)	Pre- WTO (3)	Post- WTO (4)	(5)
<i>Panel A: Varieties difference decomposition</i>					
Changes in variety ($\%\Delta n$)	0.020	0.042	0.063	0.085	0.022
Expenditure component (X)	0.264	0.248	0.013	0.014	0.001
Benefits of marginal varieties (ψ)	-0.007	-0.040	-0.183	-0.140	0.043
Access cost of varieties (F, ϵ)	-0.059	-0.096	0.223	0.183	-0.037
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Change in F, ϵ, ψ	-0.116	0.028	-0.416	-0.232	0.144
Change in ψ only	-0.014	0.084	-0.499	-0.343	0.089
Change in F, ϵ only	-0.116	-0.086	0.185	0.188	0.030

Notes: This table reports effect of China's WTO accession on variety consumption, decomposition of variety difference and welfare change. We define the period 2000-2001 as pre-China's accession to WTO (pre-WTO) and the period 2002-2003 as post-China's accession to the WTO (Post-WTO). The intensity of exposure to the WTO accession shock is identified based on the magnitude of tariff reductions experienced by each province before and after China's entry into the WTO. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median. Panel A presents the decomposition of variety difference over time for higher exposure (Column (1)) and lower exposure (Column (2)) provinces. Column (3) to (4) present decomposition of variety difference across different exposure extent provinces before and after China's accession to WTO. The decomposition is based on Equation 2.3, using the lower exposure province before China's accession to WTO as the reference point. Panel B reports the corresponding impact of China's WTO accession on welfare gains under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant.

Table D.3.5: Robustness Checks for the Effect of Financial Crisis

	Δ Time		Δ Region		DiD
	Lower-exposure	Higher-exposure	Pre-FC	Post-FC	
	(1)	(2)	(3)	(4)	(5)
<i>Panel A: Variety difference decomposition</i>					
Variety difference	-0.003	-0.001	-0.206	-0.204	0.002
Expenditure component (X)	0.003	0.009	-0.014	-0.007	0.006
Benefits of marginal variety (ψ)	-0.258	-0.329	1.757	0.404	-0.071
Access cost of varieties (F, ϵ)	0.286	0.294	-2.033	-0.748	0.008
<i>Panel B: Welfare difference (as the share of expenditure)</i>					
Change in F, ϵ, ψ	-0.551	-0.814	0.482	0.382	-0.263
Change in ψ only	-0.501	-0.559	0.703	0.402	-0.058
Change in F, ϵ only	-0.105	0.288	-0.638	-0.132	-0.183

Notes: This table reports effect of 2008 global financial crisis on variety consumption, decomposition of variety difference and welfare change. We define the period 2008 as pre-FC and 2009 as post-FC. Provinces are then categorized as higher-exposure or lower-exposure based on whether their intensity of exposure falls above or below the median of the magnitude of the migration rate change caused by different industrial shocks before and after 2008. Panel A presents the decomposition of variety difference over time for higher exposure (Column (1)) and lower exposure (Column (2)) provinces. Column (3) to (4) present decomposition of variety difference across different exposure extent provinces before and after the global financial crisis. The decomposition is based on Equation 2.3, using the lower exposure province before the financial crisis as the reference point. Panel B reports the corresponding welfare impact under three scenarios: (i) when both the marginal utility of variety (ψ) and access costs (F and ϵ) vary; (ii) when only ψ changes, holding F and ϵ constant; and (iii) when only F and ϵ change, with ψ held constant.