Routledge
Taylor & Francis Group

Economic Research-Ekonomska Istraživanja

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rero20

The causes of internal habit formation among Chinese urban residents: a multi-layer model perspective

Xuepin Wu & Yongjun Ma

To cite this article: Xuepin Wu & Yongjun Ma (2023) The causes of internal habit formation among Chinese urban residents: a multi-layer model perspective, Economic Research-Ekonomska Istraživanja, 36:3, 2193839, DOI: 10.1080/1331677X.2023.2193839

To link to this article: https://doi.org/10.1080/1331677X.2023.2193839

Published online: 25 May 2023.

ECONOMIC RESEARCH-EKONOMSKA ISTRAŽIVANJA
2023, VOL. 36, NO. 3, 2193839
https://doi.org/10.1080/1331677X.2023.2193839

The causes of internal habit formation among Chinese urban residents: a multi-layer model perspective

Xuepin Wu and Yongjun Ma

School of Economics, Hainan University, Haikou, Hainan, China

ABSTRACT

Economic growth faces serious challenges due to the COVID-19 pandemic. To promote swift economic recovery, the focus has turned to consumption's role as a driver of economic growth. To explore the influence of external social environment variables on internal habits, this study improves Naik and Moore's consumption model and constructs a multi-layer statistical model with habit-forming effects. The study shows, first, that internal habit effects are significantly present in all types of the population's consumption expenditures, and there are significant cross-regional differences. Second, we find significant moderating effects of inclusive digital finance, education levels, income disparities, and regional economic differences on internal habit formation. Furthermore, the internal habit effect is more influenced by inclusive digital finance and income disparity and less by education and regional economic disparity. Finally, the study proposes policy recommendations for building an inclusive digital financial services infrastructure, improving access to education, reducing income disparities, and balancing regional development. To a certain extent, this study reveals the intrinsic link between the external consumption environment and internal habit effects, providing a new perspective for the government's use in formulating consumption policies that promote economic growth.

ARTICLE HISTORY
Received 10 November 2022
Accepted 15 March 2023

KEYWORDS
Consumption structure; internal habitual causes; multi-layer statistical model; urban residents' consumption

JEL CODES
C15; E21; O18

1. Introduction

In December 2022, the Central Committee of the Communist Party of China and the State Council issued the Outline of the Strategic Plan for Expanding Domestic Demand (2022-2035). Firmly implementing a strategy to expand domestic demand and fostering a complete domestic demand system is an inevitable choice to speed up construction of a new double-cycle development pattern. International economic and political relations are becoming increasingly complex, and COVID-19 exacerbates the counter-globalization trend. The global economic cycle has weakened significantly,

CONTACT Yongjun Ma 1750091436@qq.com

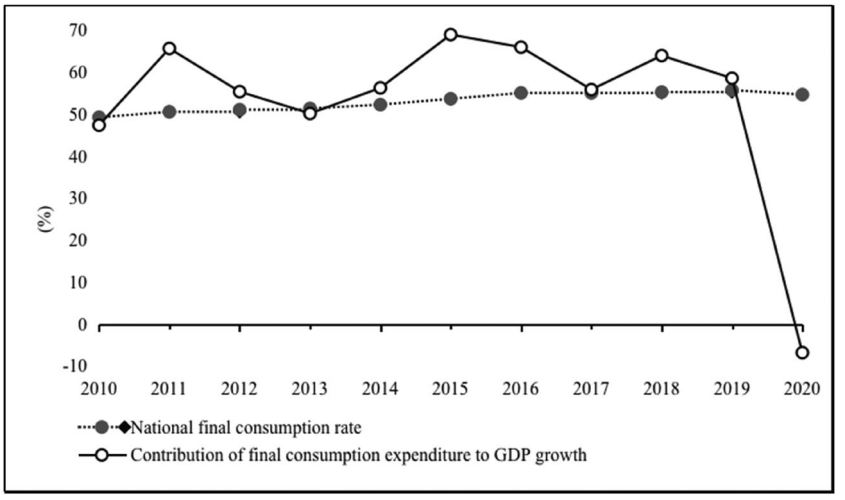

Figure 1. Final consumption rate.
Source: National Bureau of Statistics of China

squeezing the Chinese economy, which was originally based on an external demand-driven development model. However, domestic consumption's fundamental role in China's economy has continued to grow. Figure 1 shows that the national final consumption rate consistently trended upwards over 2010-2020, remaining above 50% for 11 consecutive years. The contribution of final consumption expenditures to GDP growth also maintained a continuous upward trend from 2010 to 2019. It fell sharply to −6.8% in 2020 after the COVID-19 outbreak, but rose to 65.4% in 2021. This shows that consumption has become China's main economic growth engine. Compared to many other countries worldwide, the final consumption rate of China's population is still at a relatively low level (Zhao, 2019). The internal habit effect is the actual cause of China's underconsumption (Jiang & Shi, 2018; Zhai et al., 2021). Once a consumer habit is formed, it is difficult to change. The theory of internal habits suggests that consumption depends on an individual's current income and is influenced by their past consumption (Duesenberry, 1949). Internal habit formation can be understood as rigidity of consumption, that is, 'it is easy to go from frugality to luxury, but difficult to go from luxury to frugality'. As the Chinese population's standard of living continues to rise, consumers will find it more difficult to tolerate a decline in their standard of living (Yan & Hang, 2010). They will, therefore, also become more risk averse. From this perspective, consumption behaviour with habitual preferences is similar to consumption behaviour resulting from prudence (Deaton, 1992). Because utility comes from effective consumption rather than current consumption, high consumption in the current period will lead to a lower level of utility in the following period. Consumers that form habits want to smooth their level of consumption but, more importantly, they want to smooth growth in consumption (Byrne et al., 2022). The more significant habit formation's influence, the greater the consumer's awareness of savings (Carroll et al., 1992; Zhao et al., 2019). This is consistent with China's low current consumption and high savings (Waxman et al., 2020). Although it has been well documented that internal habits are essential for

influencing consumption (Ravina, 2019; Goh et al., 2019; Chan, 2020; van Bilsen et al., 2020; Wu & Xiong,2023), few scholars have explored the factors that influence internal habit formation. In the post-epidemic period, this research has important practical implications for consumption in economic recovery.

Consumption is a complex psychosocial phenomenon (Ryu & Kim, 2022). It is not only influenced by consumers' income levels but also by their external social environment (Desbouys et al., 2019), including social factors such as digital financial inclusion, income disparities, education levels, and regional economic levels. In research around the factors influencing internal habit effects, it is necessary for a model to consider the broader social context in which economic activity takes place. Granovetter (1985) points out that 'the social organizations we study, and their behaviour are subject to social relations, and it would be a serious mistake to analyse them as separate individuals'. How can external social and environmental factors be introduced into a model? In 1972, Lindley proposed a multilayer statistical model suitable for considering external social factors, which is mainly applied to data with nested structural characteristics (Lindley & Smith, 1972). For data with nested characteristics, applying multilayer models can not only correctly deal with parameter problems caused by single linear models (Wang et al., 2021), but can also analyse micro and macro effects and cross-layer interactions (Xu et al., 2020). Thus, introducing external social environment variables into a model to explore factors that influence internal habit effects rather than only considering variables at the same level as consumers is a novel research perspective.

This study also makes the following marginal contribution. In previous studies, income, household assets, regional differences, price levels, habitual preferences, and habit formation have been seen as the essential variables that influence consumption. Scholars have also qualitatively or quantitatively analysed how these factors affect consumption. During their empirical analyses, the data used are most often at the same level and are empirically validated using a single linear regression model; only a few scholars use data at different hierarchical levels for multi-layer models. The primary reason for this is that it is difficult to match data at different levels in the same econometric model and use it for empirical analysis. Therefore, in terms of its research perspective, this study takes the external consumption environment as its entry point to explore how and why the external environment plays a role in forming consumption habits. A multi-layer statistical model with internal habit effects is constructed by improving Naik and Moore (1996) consumption model. This solves the problem of modelling nested consumption data and operationalises it for exploring the external environment's influence on urban residents' consumption habits. The rest of the paper is organized as follows. Section 2 discusses the literature review and theoretical analysis, while Section 3 explains the multilayer model construction. Section 4 describes the variable descriptions and empirical analysis. Section 5 presents the conclusion, policy recommendations, limitations and future research.

2. Literature review and theoretical analysis

Habit formation theory has been gaining attention in mainstream research since the 1990s and is closely linked to modern consumption theories such as precautionary

savings theory and buffer reserve theory. Habit formation theory suggests that consumers' consumption behaviour is influenced by their pre-consumption level and the consumption behaviour of their surrounding group. This is due to the 'ratchet' and 'demonstration' effects, that is, internal and external habit formation. Pollak (1970) first introduced internal habit formation in a linear expenditure system (LES). Philips (1973) built on Pollak's research by using state variables to introduce prior behaviour's effects into an LES model, thus capturing the effects of income changes and prior behaviour on the consumption structure. Pollak (1976) extended these findings to an LES model of external habit formation. Kapteyn et al. (1997) also studied interdependent preferences in an LES, that is, external habit formation. Wu and Han (2021) combine an LES model, habit formation theory, and a panel data model to theoretically extend the panel LES model. Using the Naik and Moore model for estimation, Long et al. (2002) showed that the consumption habits of urban residents significantly contribute to consumption. Qi and Wang (2007) used the Dynan model to study the consumption data of rural residents in Beijing and showed that habit formation significantly impacts residents' consumption. Some scholars have also combined habit formation with buffer reserve theory models to construct an expectation-confirmation model (ECM) that incorporates habit formation and income uncertainty, verifying that past consumption levels also significantly affect current consumption levels (Hang & Shen, 2008; Hang, 2009). When introduced into intertemporal optimization analysis of households' consumption and saving decisions, consumption habits, wealth accumulation, preference changes, and precautionary saving motives can also show that consumption habits influence residents' consumption (Lei, 2009). First proposed by Deaton and Muellbauer (1980), the almost ideal demand system (AIDS) is widely used because it allows for linear approximation, backward indirect utility functions, and tests of demand theory. For example, Yan and Hang (2010) used an AIDS model to empirically analyse data from a household survey of rural residents in 26 Chinese provinces. They showed that rural residents exhibited significant internal habit formation for all consumption expenditures. Overall, methodologically, research on habit formation has focused on introducing internal habit formation into different consumption demand system models, such as the LES, AIDS, Naik and Moore, Dynan, and ECM, to empirically demonstrate the impact of habit formation on residents' consumption. However, few scholars have constructed multi-layer statistical models to analyse how internal habit formation affects urban residents in various types of consumption expenditure, and few have explained the causes of internal habit formation from the perspective of the external consumption environment.

Changes in the external consumption environment and institutions can impact consumption behaviour (Amoah & Addoah, 2021). For urban consumer spending, what external consumption environment variables influence internal habits? How do these external consumer environment variables influence internal habits? Based on existing literature, this study examines several external consumption environment variables that are closely related to consumption (inclusive digital finance, education, the income gap, and regional economic level) to answer these questions. It theoretically analyses the potential pathways through which these variables affect internal habits.

2.1. Impact of inclusive digital finance on internal habits

With the rapid development of China's Internet economy and the improvement in infrastructure construction, inclusive digital finance and digital payments have profoundly changed residents' consumption habits. Moreover, the emergence of Internet platforms like Alipay, WeChat, Taobao, and JD has extensively promoted widespread use of inclusive digital finance in residents' social lives (Li et al., 2020). Inclusive digital finance not only creates employment and entrepreneurial opportunities but also improves income levels and liquidity constraints and promotes consumer spending and consumption upgrading through the convenience of digital payments (McAdam et al., 2019; Geng & He, 2021; Yu et al., 2022; Sun & Tang, 2022). Moreover, inclusive digital finance has a more pronounced effect on consumption promotion among rural and poor households (Song et al., 2020). Studies have shown that income growth and vulnerability mitigation effects are essential action mechanisms for digital finance to change the population's consumption habits (Yang et al., 2022). Inclusive digital finance can, on the one hand, contribute to the population's increase in income by increasing entrepreneurship and employment opportunities (Ji et al., 2021; Zhao et al., 2022). On the other hand, inclusive digital finance can reduce the income uncertainty the population faces by mitigating the impact of exogenous shocks (Ozili, 2020). As inclusive digital finance continues to grow, the liquidity constraints (Liu et al., 2022), income inequality (Yu & Wang, 2021), and consumption inequality (Luo & Li, 2022) the residents face are also effectively improved. Inclusive digital finance significantly reduces three types of poverty: education, health care, and income poverty (Zhou & Wang, 2021; Lin & Zhang, 2022). Digital financial inclusion can also positively and significantly affect accumulation of household wealth (Liu et al., 2022). It can enhance households' resilience by improving their ability to exploit risk-taking and social networks (Wang & Wang, 2022). Ultimately, inclusive digital finance leads to lower precautionary savings, eases liquidity constraints, and enhances risk smoothing, thus improving urban residents' consumer spending and consumption upgrading (Jiang & Jiang, 2020). Digital finance has, therefore, led to a change in the population's habitual preferences.

2.2. The influence of education level on internal habits

According to the latest figures from China's Ministry of Education, the total number of students enrolled in higher education in China exceeds 44.3 million, with the gross enrolment rate rising from 30% in 2012 to 57.8% in 2021. With 240 million people in higher education and an average of 13.8 years of education for the new workforce, there has been a significant change in the workforce's quality structure. The increase in the number of years of education has also led to a shift in the population's consumption attitudes, patterns, and habits (Hidaka et al., 2018; Cheng, 2021). When accumulated through educational expansion, human capital can reduce income inequality (Coady & Dizioli, 2018; Panori & Psycharis, 2019; Castelló-Climent & Doménech, 2021). Furthermore, as the education level increases, residents' life satisfaction and happiness increase (Lakshmanasamy & Maya, 2020) and so does the population's income level (Wang et al., 2018). This leads to an increase in personal

consumption capacity, higher willingness to consume, and optimization of the consumption structure (Yan et al., 2021). On the one hand, education changes consumption behaviour by changing individuals' consumption perceptions (Al-Nuaimi & Al-Ghamdi, 2022). On the other hand, an increase in the education level can significantly reduce income uncertainty, reducing individuals' incentive for preventive savings (Ben-David et al., 2018). This study argues that individual preferences for consumption habits vary according to their education level.

2.3. Impact of the income gap on internal habits

Although China's economy has recently achieved years of continuous growth, the income gap among residents has shown a general trend of widening (Huo & Chen, 2022). However, digital financial inclusion (Li et al., 2023), educational attainment (Anderloni et al., 2012), infrastructure (Huang et al., 2020), and foreign direct investment (Song et al., 2022) helps reduce the income gap. A widening income gap discourages consumer spending (Zhou & Meng, 2022) and leads to consumption inequality (Aguiar & Bils, 2015). The widening income gap also has significant adverse effects on farm entrepreneurship, education levels, low- and middle-income classes, and underdeveloped areas (Yin et al., 2020). In addition, a widening income gap can lead to an increase in the liquidity constraints low-income earners face (Chen et al., 2021) and a subsequent rise in total household savings (Gan et al., 2018). This is an essential manifestation of the change in the population's internal habits because of the widening income gap. Specifically, the lower- and middle-income groups are more sensitive to the income gap's impact, as they have a more significant and majority marginal propensity to consume. In the case of China's pro-poor economic growth scenario (Luo et al., 2021), the lower- and middle-income groups must maintain more cautious consumption behaviour to enhance their risk-smoothing ability. Ultimately, China needs more consumer demand.

2.4. The impact of regional economic differences on internal habits

After the economic reform and opening, the Chinese government implemented a strategy of unbalanced regional economic development and tilted development towards the east to promote the national economy's rapid development. The unbalanced development strategy has led to rapid widening of the regional economic disparities in China, with the east considerably ahead of the west, and the south faster than the north. Studies have shown that regional economic differences generate significant consumption differences (Wang et al., 2021). For example, fossil energy consumption (Liu et al., 2019), electricity consumption (Sun et al., 2018), and water consumption (Long et al., 2022) all vary significantly by region. Meanwhile, a panel-extended linear expenditure model incorporating the theory of internal habit formation has also been constructed to empirically analyse whether internal habits have significant regional differences (Wu & Xiong, 2023). The regional differences reflect the differences in the populations' income levels due to uneven economic growth (Su et al., 2015). Moreover, people with different income levels have different attitudes

towards risk (Wang et al., 2019). Compared to developed regions, residents of less developed regions have lower income levels and face more significant income uncertainty. Consequently, people in less developed regions are also more cautious in their consumption and change their habitual preferences to increase their risk resilience.

As seen above, the social environment and one's factors can directly or indirectly affect internal habits. Therefore, when considering the factors that influence the study of internal habits, it is appropriate to cut through several representative social environment factors, such as inclusive digital finance, education, income gaps, and regional economic levels. Finally, this study provides reliable theoretical support for expanding domestic demand and unblocking the dual cycle.

3. Research methodology

3.1. Constructing a multi-layer model of life cycle-persistent income consumption theory

3.1.1. Habit formation theory

Habit formation is a special utility theory that fully accounts for psychological stocks. Habit formation theory suggests that the utility generated in the present period depends on current consumption and the stock of past habits. Given the current consumption level, the greater the amount of past consumption, the smaller the utility of current consumption. If an individual forms a stock h_t through past consumption, the time-evolving situation of h_t is:

$$h_t = (1-\theta)h_{t-1} + c_{t-1};\ \ 0 < \theta < 1 \tag{1}$$

where h_t is the customary stock at time t. θ is the inventory depreciation rate. c_{t-1} is lagged one-period consumption. Because past consumption habits play a role in habit formation, the habits in equation (1) have a long-term influence. θ equals 1, indicating that only the previous period's consumption influences the current consumption decision. The closer θ is to zero, the greater the weight of consumption habits formed by past consumption. For convenience, θ is usually assumed to be equal to 1, that is, the stock of habits is equal to the level of consumption expenditure in the previous period. Thus, unlike traditional utility functions, the utility function under habit formation is indivisible in time and has the following form.

$$u_t = u(c_t - \alpha h_t) \tag{2}$$

where u_t is utility at time t and c_t is consumption expenditure in period t. α is the habit formation parameter ($0 < \alpha < 1$), which reflects the extent to which the habit stock (h_t) affects consumer utility. The greater α is, the greater the effect of the habit stock (h_t) and the smaller the utility generated by current consumption expenditure (c_t).

3.1.2. Internal habit model based on life-cycle-persistent income

Scholars have proposed several theoretical models for analysing consumption habits. Considering the ease of data processing and understanding of the model, this study draws on Cui and Fan (2011) and uses the life-cycle-persistent income consumption

model with habitual preferences proposed by Naik and Moore (1996) as the theoretical basis for the empirical analysis. According to the life-cycle-persistent income hypothesis, a consumer utility function depends on total consumption now and over the consumer's remaining lifetime. Subject to the constraints of the discounted value of current and future lifetime income and the sum of current assets, consumers seek to maximize lifetime utility. Assume that the consumer is faced with the following maximization problem.

$$\max E_t \sum_{n=0}^{\infty} \frac{1}{(1+\beta)^n} u(\overline{c_{t+n}}) \tag{3}$$

and is subject to a lifetime budget constraint as follows:

$$\sum\nolimits_{n=0}^{\infty} \frac{1}{(1+r)^n} E_t(c_{t+n}) = A_t + \sum\nolimits_{n=0}^{\infty} \frac{1}{(1+r)^n} E_t(Y_{t+n}) = W_t \tag{4}$$

where E_t is the expected value, β is the time preference rate, μ is the utility function, c_t is the consumption expenditure for the period, and $\overline{c_t}$ is the relative consumption expenditure. r is the true interest rate, A_t is the initial asset value in period t, and W_t is the expected wealth value in period t, which is the sum of the initial asset value and expected future income.

Different theories make different specific assumptions about the form of the utility function u. The theory of consumption habits used in this study suggests that the utility function $u(c_{it}, x_{it})$ of individual i at moment t depends on current consumption c_{it} and habit level x_{it} and can only generate utility if the consumption level is greater than the habit level x_{it}.The level of the consumption habits of individual consumer i at moment t is as follows:

$$x_{it} = x_{i0} e^{-a_i^t} + b_i \int_0^t e^{a_i(s-t)} c_{is} ds \tag{5}$$

where x_{it} is the level of the consumption habits of individual i at moment t, c_{is} is the consumption expenditure of individual i at moment s, x_{i0} is the initial condition, and both a_i and b_i are constants.

The utility function of individual i in the current period is set as:

$$u(c_{it}, x_{it}) = \frac{(c_{it} - x_{it})^{\gamma_i}}{\gamma_i} \tag{6}$$

where c_{it} is the consumption expenditure of individual i at moment t. $\gamma_i (0 < \gamma_i < 1$ is the parameter associated with an individual's risk aversion. Given a consumption investment strategy and regulatory conditions, Constantinides (1990) proves the existence of a unique optimal consumption as follows:

$$c_{it} = x_{it} + h_i \left[w_{it} - \frac{x_{it}}{r + a_i - b_i} \right] \tag{7}$$

where h_i is the risk-free asset return and w_{it} is the expected value of wealth for individual i in period t. In addition, as data regarding wealth expectations are difficult to obtain, relevant real data can be used in the empirical analysis instead.

Since the general form of x_{it} is extremely complex, to facilitate the empirical analysis, this study draws on Naik and Moore (1996) and abbreviates the habit levels as follows:

$$x_{it} = \tau_{i0} + \tau_{i1} c_{i,t-1} \tag{8}$$

Equation (8) shows that the habit level formed by past consumption is influenced only by consumption in the lagged period. From equation (7), it is clear that individual optimal consumption is a function of the habit level and expected value of wealth. Substituting equation (8) into equation (7) yields individual optimal consumption:

$$c_{it} = \lambda_{i0} + \beta_{i1} W_{it} + \psi_{i2} C_{i,t-1} \tag{9}$$

Of these, $\lambda_{i0} = \tau_{i0}(1 - \mathrm{k_i})$, $\alpha_{i1} = h_i$, $\alpha_{i2} = \tau_{i1}(1 - \mathrm{k_i}$, $k_i = 1 - h_i/(\gamma + \alpha_i - \mathrm{b_i})$. α_{i1} reflects the size of wealth's effect on current consumption, λ_{i0} is the size of the fixed consumption level, α_{i2} reflects the size of the effect of the previous period's consumption on current consumption, W_{it} is the expected value of wealth for individual i in period t, and ε_{it} is the random error term.

3.1.3. Improvements to Naik and Moore (1996) model of consumption habits

As data regarding the expected value of wealth (W_{it}) are not readily available, to facilitate empirical analysis, this study uses persistent income (y_{it}^p) as a proxy for wealth expectations. Drawing on Hang (2009), persistent income is the average of total expected income over the plan period:

$$y_{it}^p = \frac{1}{T+1}\left[E_t \sum_{m=1}^{T} y_{i,\mathrm{t}+m}\right] \tag{10}$$

Assume that the expected real income of individual i in the future period $t + m$ is:

$$E_t(y_{i,t+m}) = (1+\omega)^m y_{it} \quad m = 1,\ 2 \ldots\ldots, T \tag{11}$$

where ω is a constant indicating the average growth rate of expected real income, and y_{it} indicates real income per capita. Substituting equation (11) into equation (10), after sorting, the formula is:

$$y_{it}^p = \left[\frac{1-(1+\omega)^{T+1}}{-(T+1)\omega}\right] y_{it} \tag{12}$$

Substituting equation (12) into equation (9), the formula is:

$$C_{it} = \alpha_{i0} + \alpha_{i1}\left[\frac{1-(1+\omega)^{T+1}}{-(T+1)\omega}\right] y_{it} + \alpha_{i2} C_{i,t-1} + \varepsilon_{it} \tag{13}$$

The econometric model can be written as follows:

$$C_{it} = \alpha_{i0} + \beta_{1i} y_{it} + \psi_{2i} C_{i,t-1} + \varepsilon_{it} \tag{14}$$

3.1.4. Multi-layer model based on life-cycle-persistent income consumption theory

The term 'embeddedness' was first mentioned by Polanyi (1944) in *The Great Transformation* and was applied to analyse economic theory. Polanyi argued that the human economy is deeply embedded in economic and non-economic institutions, and that it is crucial to take non-economic institutions into account. In this study, consideration of external environmental factors is embedded into the model when studying what causes the internal habits of urban residents. A more comprehensive analysis of what causes internal habits is a reasonable choice of perspective. A multi-layer statistical theoretical consumption model with internal habit effects is constructed as follows:

$$\begin{aligned} &\text{Layer}-1: Lnc_{(it)j}^{(k)} = \lambda_{0j}^{(k)} + \beta_{1j}^{(k)} LnY_{(it)j} + \psi_{2j}^{(k)} LnC_{(i,t-1)j}^{(k)} + e_{(it)j} \\ &\text{Layer}-2: \lambda_{0j}^{(k)} = \gamma_{00} + \gamma_{01} P_{1j} + \gamma_{02} Q_{2j} + \gamma_{03} L_{3j} + \gamma_{04} M_{4j} + \mu_{0j} \\ &\qquad\qquad \psi_{2j}^{(k)} = \gamma_{20} + \gamma_{21} P_{1j} + \gamma_{22} Q_{2j} + \gamma_{23} L_{3j} + \gamma_{14} M_{4j} + \mu_{2j} \end{aligned} \tag{15}$$

where, k =1,2, … 7 (denoting the $k-$ th consumption category), i =1,2, … 149 (denoting the i-th prefecture-level city), j =1,2, … … 27 (denoting the j-th province), t =2010, 2011 … 2020. t is the layer one random error and u is the layer two random error. $LnY_{(it)j}$ is the logarithm of per capita consumption expenditure on goods (services) in category k for urban residential consumers in the i-th prefecture-level city of the j-th province at moment t. $\psi_{2j}^{(k)}$ is the coefficient of the internal habit effect variable, which indicates the size of the internal habit effect of consumers in the j-th province at the i-th prefecture level on the kth category of goods (services) in period $t-1$. $LnY_{(it)j}$ is the logarithm of the income level of the i-th consumer in the j-th province at moment t. $\beta_{1j}^{(k)}$ is the marginal propensity to consume of the i-th prefecture consumer in the j-th province at moment t. $\lambda_{0j}^{(k)}$ is the autonomous consumption expenditure of consumer i on category k goods (services), which is influenced by the level of consumer income, internal habit effects, and other factors. P, Q, I, and M represent different socioeconomic factors. Model (15) shows that both the internal habit effect coefficient ($\psi_{2j}^{(k)}$) and model intercept term ($\lambda_{0j}^{(k)}$) have individual effects, and their embedded socioeconomic factors vary with the province where they are located. If the coefficient of internal habit effect ($\psi_{2j}^{(k)}$) is significant, it indicates that there is an internal habit effect for urban residents of the i-th prefecture-level city in the j-th province on the k-th category of goods (services). Then, the region's external economic environment factors are embedded to analyse the causes of the internal habit effect.

3.2. Data description

3.2.1. Variable selection

3.2.1.1. Variable selection and indicator selection. Based on the theoretical analysis model of factors from an embedded perspective, consumption is influenced not only

by income level and internal habits but also by the external economic environment where consumption occurs.

3.2.1.2. Layer 1 variables. The per capita consumption expenditure in the current period of urban residents in 149 prefecture-level cities in 27 provinces is selected as the explained variable in Layer 1, and the per capita disposable income of residents in each province and the consumption expenditure of urban residents in the previous period are selected as the explanatory variables in Layer 1. The data for each province span from 2010 to 2020.

3.2.1.3. Layer 2 variables. The Peking University Digital Financial Inclusion Index, years of education per capita, Theil Index, and dummy variables reflecting developed regions for 27 provinces are selected as the explanatory variables in Layer 2 to analyse the moderating effect of these variables on internal habits and thus the impact they have on residents' consumption, where the Peking University Digital Inclusion Index is calculated in Guo et al. (2020). The urban Theil index is calculated using the formula: $T = \sum_{s=1}^{N} y_s lny_s/p_s$. N is the number of regions, y_s is the proportion of urban residents' income in region s to the overall urban residents' income in all regions. p_s is the proportion of the urban population in region s to the overall urban population. The formula for calculating the years of education per capita in urban areas is the (number of illiterate people * 1 + number of people with elementary school education * 6 + number of people with junior high school education * 9 + number of people with high school and secondary school education * 12 + number of people with college and bachelor's degree or higher education * 16)/total population over 6 years old). For the dummy variables reflecting whether regions are developed, refer to Liu (2017). According to the per capita income level, Liaoning, Jiangsu, Zhejiang, Shandong, Fujian, and Guangdong are classified as developed regions. In contrast, Hebei, Shanxi, Inner Mongolia, Anhui, Jiangxi, Henan, Hubei, Hunan, Guangxi, Hainan, Yunnan, Shaanxi, Jilin, Heilongjiang, Sichuan, Guizhou, Gansu, Qinghai, Ningxia, Xinjiang, and Tibet are classified as non-developed regions.

3.2.2. Data sources

3.2.2.1. Layer-1 data. Urban per capita consumption and per capita disposable income data are obtained from the statistical yearbooks of 149 prefecture-level cities in 27 provinces for each year. All data are deflated using the price index of the urban residents' consumption classification and the consumer price index of residents in each province to eliminate the influence of price inflation.

3.2.2.2. Layer-2 data. The relevant raw data for calculating the Peking University Digital Inclusive Finance Index (F) is obtained from the statistical yearbooks of each province and city. The residents' income and population for calculating the Theil Index (T) are obtained from each year's statistical yearbooks and demographic yearbooks in 27 provinces. The formula for calculating the Theil Index is used to obtain $'T'$. The original data for years of education per capita (E) are obtained from each year's statistical yearbook of 27 provinces and cities and the seventh population census of China, using the average years of education formula to obtain $'E'$. Layer-2 data span 2011 to 2020.

4. Results

4.1. Analysis of the null model

The null model is used to decompose the variance of urban residents' consumption expenditure into two components explained by the basic factors in Layer-1 and the social embeddedness factors in Layer-2. The intra-group correlation coefficient is calculated to decide whether a multi-layer statistical model is needed, where the intra-group correlation coefficient = inter-group variance/(intra-group variance + inter-group variance), and the null model is constructed as follows:

$$\text{Layer}-1:\ Lnc_{(it)j}^{(k)} = \lambda_{0j}^{(k)} + e_{(it)j}$$
$$\text{Layer}-2:\ \lambda_{0j}^{(k)} = \gamma_{00} + \mu_{0j}$$

$$k = 1,\ 2\ldots 7;\ j = 1, 2,\ \ldots 27;\ i = 1, 2,\ \ldots 149;\ t = 2010,\ 2011\ldots 2020$$

where, k =1, 2, … 7 denotes the consumption category, i =1, 2, … 149 denotes the i-th prefecture-level city, t =2010, 2011, … 2020 denotes the year t, $Lnc_{(it)j}^{(k)}$ denotes the logarithm of per capita consumption expenditure for goods (services) in category k in year t for urban consumers in prefecture i of the j-th province. e is a random error in Layer-1. u is a random error in Layer-2.

Table 1 shows that the variances between groups are all significant at the 1% significance level, indicating that the per capita consumption expenditures of urban residents for seven categories of goods (services) $Lnc_{(it)j}^{(k)}$ vary significantly across regions. Cohen (1988) argued that when the intra-group correlation coefficient is above 0.059, the data need to be analysed at multiple levels. Combining the intra-group correlation coefficients in Table 1 shows that the intra-group correlation coefficients for all seven categories of consumer spending range from 0.1534 to 0.6908, all above 0.059, indicating that a multilayer model should be developed for the analysis.

4.2. Analysis of the results of the internal consumption habit effect on residents' consumption

The logarithm of urban residents' per capita disposable income ($LnY_{(it)j}$) and the logarithm of urban residents' per capita consumption expenditure ($Lnc_{(i,t-1)j}^{(k)}$) with a one period lag are introduced into the model to examine the impact of income and internal habit effects on residents' consumption.

Table 1. Decomposition results of consumption expenditure variation.

Expenditure	Intercept	intra-group variance	Inter-group variance	ICC
Food	8.4346***	0.0416	0.0479***	0.5352
Clothing	7.3302***	0.0837	0.0463***	0.3562
Housing	7.8841***	0.1609	0.0619***	0.2778
Home services	7.0311***	0.1173	0.0619***	0.3454
Medical Care	7.0069***	0.0815	0.0494***	0.3774
Transportation	7.7687***	0.1623	0.0294***	0.1534
Education & Entertainment	7.5028***	0.1051	0.2348***	0.6908

Note: ***indicate significance at the 1% significance level.
Source: authors' estimations.

Table 2. Regression results after introducing variables into layer 1.

Expenditure	λ_{0j} (Intercept, γ_{00})	β_{1j} (Intercept, γ_{10})	ψ_{2j} (Intercept, γ_{20})	Covariance (μ_{0j})	Covariance (μ_{2j})
Food	7.8518***	0.0576***	0.8641***	0.7794***	0.0043***
	(37.89)	(2.99)	(47.96)	(103.41)	(57.49)
Clothing	7.1431***	0.0182	0.8634***	0.7817***	0.0056***
	(31.12)	(0.78)	(44.44)	(55.72)	(63.78)
Housing	4.7012***	0.3144***	0.7431***	8.2881***	0.0147***
	(7.08)	(4.84)	(26.43)	(127.84)	(79.34)
Home Services	6.0172***	0.0998*	0.7955***	2.5779***	0.0273***
	(14.76)	(3.59)	(21.65)	(55.86)	(206.23)
Medical Care	5.1468***	0.1834***	0.6535***	5.0213***	0.0368***
	(10.19)	(3.78)	(15.75)	(116.46)	(181.85)
Transportation	4.7285***	0.3008***	0.6981***	11.9316***	0.0448***
	(6.36)	(4.05)	(15.74)	(179.49)	(446.43)
Education & Entertainment	6.1268***	0.1356**	0.7651***	3.0261***	0.0267***
	(14.65)	(3.40)	(21.17)	(91.74)	(86.39)

Note: Intercept and slope terms t-values are in parentheses, variance terms are χ^2-values in parentheses, ***, **, *indicate significance at 1%, 5%, and 10% significance levels, respectively.
Source: authors' estimations.

$$\text{Layer}-1:\ Lnc_{(it)j}^{(k)} = \lambda_{0j}^{(k)} + \beta_{1j}^{(k)} LnY_{(it)j} + \psi_{2j}^{(k)} Lnc_{(i,\,t-1)j}^{(k)} + e_{(it)j}$$
$$\text{Layer}-2:\ \lambda_{0j}^{(k)} = \gamma_{00} + \mu_{0j}$$
$$\psi_{2j}^{(k)} = \gamma_{20} + \mu_{2j}$$

As Table 2 shows, autonomous consumption expenditures for food and clothing are larger. At the same time, those for housing, home services, transportation, medical care, and education and entertainment are smaller. The regression coefficients of urban residents' per capita disposable income spent on food, housing, home services, medical care, transportation, and education and entertainment are all significant, which indicates that the increase in disposable income promotes residents' consumption expenditures in the six categories of goods (services). The regression coefficients of consumer spending in the previous period are all positive. Moreover, they are all significant at the 1% significant level, indicating that internal habit effects significantly contribute to consumer spending. Specifically, urban residents experience larger internal habit effects for food, clothing, and home services, while they have smaller internal effects for housing, medical care, and education and entertainment. This indicates that urban residents are more cautious when spending on food, clothing, and home services.

Meanwhile, according to Table 2, the cross-provincial variance of the slope of the logarithm of urban consumer spending($Lnc_{(i,\,t-1)j}^{(k)}$)with a one period lag is statistically significant (all p-values are less than 0.001). This indicates that the regression coefficient of $Lnc_{(i,\,t-1)j}^{(k)}$ is random and its regression coefficient value is significantly different among provinces; that is, the relationship between $Lnc_{(i,\,t-1)j}^{(k)}$ and $Lnc_{(it)j}^{(k)}$ is significantly different between provinces. This difference needs to be explained by introducing social embeddedness variables, in other words, by exploring the causes of habit formation within Chinese urban residents. Similarly, autonomous consumption expenditures $\lambda_{0j}^{(k)}$ need to be explained by introducing social embeddedness variables.

4.3. Analysis of the causes of the internal habit effect parameters

To analyse how other factors moderate the effect of layer one internal habit parameters on urban residents' consumption, that is, the cross-layer interaction, it is necessary to introduce embeddedness variables into the model in Layer 2 with random coefficients(λ_{0j}、ψ_{2j}) as explanatory variables, with the full model constructed as follows:

$$\begin{aligned}
\text{Layer}-1:\ Lnc_{(it)j}^{(k)} &= \lambda_{0j}^{(k)} + \beta_{1j}^{(k)} LnY_{(it)j} + \psi_{2j}^{(k)} Lnc_{(i,\,t-1)j}^{(k)} + e_{(it)j} \\
\text{Layer}-2:\ \lambda_{0j}^{(k)} &= \gamma_{00} + \gamma_{01}F_{1j} + \gamma_{02}E_{2j} + \gamma_{03}T_{3j} + \gamma_{04}D_{4j} + \mu_{0j} \\
\psi_{2j}^{(k)} &= \gamma_{20} + \gamma_{21}F_{1j} + \gamma_{22}E_{2j} + \gamma_{23}T_{3j} + \gamma_{14}D_{4j} + \mu_{2j}
\end{aligned}$$

Among these, F, E, T、, and D denote the Peking University Digital Inclusive Finance Index, years of education per urban resident, Theil Index reflecting the income gap, and dummy variables reflecting whether regions are developed, respectively. The empirical results are shown in Table 3.

As shown in Table 3, digital inclusive finance (F) has a significant effect on food, transportation, and education and entertainment, indicating that with continuous improvement in inclusive finance, residents will increase their autonomous consumption expenditure on food. At the same time, they will reduce their autonomous consumption expenditures on medical care and transportation. The years of education per capita (E) significantly contribute to clothing, housing, home services, medical care, transportation, and educational and entertainment consumption expenditures. At the same time, they have a significant inhibiting effect on food. This means that improving urban residents' education level can more comprehensively improve their quality of life. According to Engel's law, as residents gain more formal education, their income increases. The proportion of total household expenditures or income spent on food gradually decrease, while the proportion of other consumption expenditures gradually increases. The Theil index (T) (which reflects urban residents' income gap) has a

Table 3. Regression results of the full model.

	Intercept$_1$, λ_{0j}					Slope $Lnc_{(i,t-1)j}^{(k)}$, ψ_{2j}				
Project	Intercept$_2$, γ_{00}	F, γ_{01}	E, γ_{02}	T, γ_{03}	D, γ_{04}	Intercept$_2$, γ_{20}	F, γ_{21}	E, γ_{22}	T, γ_{23}	D, γ_{24}
Food	7.92***	12.39*	−0.08***	−2.00*	0.21**	0.88***	2.07	−0.02	−0.83*	−0.08*
	(40.56)	(1.98)	(−4.75)	(−2.42)	(3.51)	(45.30)	(1.46)	(−1.63)	(−1.79)	(−2.51)
Clothing	7.15***	−5.65	0.05*	−2.16*	−0.03	0.88***	2.02*	−0.02*	−1.61*	−0.11**
	(30.24)	(−0.83)	(2.73)	(−2.14)	(−0.45)	(43.69)	(0.75)	(−1.87)	(−2.84)	(−3.42)
Housing	4.76***	0.74	0.04*	0.28	0.24**	0.76***	5.31**	−0.01	−1.00*	−0.07**
	(7.37)	(0.09)	(1.75)	(0.21)	(3.55)	(25.02)	(1.58)	(−0.91)	(−1.75)	(−2.37)
Home Services	5.83***	−1.25	0.15*	2.66**	0.26**	0.83***	−10.57*	−0.04**	−2.42**	−0.21***
	(15.34)	(−0.22)	(2.26)	(3.01)	(3.33)	(31.82)	(−2.18)	(−2.92)	(−3.11)	(2.08)
Medical Care	5.57***	−8.92	0.17***	−0.62	0.01	0.68***	−7.16*	0.12***	1.73*	−0.08
	(11.43)	(−1.36)	(4.95)	(−0.52)	(0.09)	(16.70)	(−1.80)	(4.22)	(2.19)	(−0.96)
Transportation	5.13***	−11.73*	0.05*	0.67	0.17*	0.73***	−2.29	−0.03*	−0.29	0.09*
	(5.82)	(−2.59)	(1.93)	(0.76)	(2.51)	(12.55)	(−0.52)	(−1.89)	(−0.40)	(−1.73)
Education & Entertainment	6.26***	−34.69**	0.40***	1.93	−0.13	0.79***	0.66	−0.06**	−0.61	−0.09*
	(15.56)	(−3.05)	(5.81)	(1.21)	(−0.45)	(18.96)	(0.16)	(−3.31)	(−0.70)	(−1.82)

Note: t values are in brackets, ***, **, *indicate significance at the 1%, 5%, and 10% significance levels, respectively.
Source: authors' estimations.

significant inhibiting effect on food and clothing but a significant promoting effect on home services. This indicates that deepening the income gap significantly reduces urban residents' autonomous consumption expenditures on food and clothing. Meanwhile, it also increases urban residents' consumption expenditures on home furnishing services. The dummy variables significantly affect food, housing, home services, and transportation, indicating that higher regional economic development is conducive for increasing residents' autonomous expenditures on food, housing, home services, and transportation. The dummy variable (D) (which reflects whether regions are developed) significantly affects food, housing, home services, and transportation. This indicates that higher regional economic development is conducive for increasing residents' autonomous expenditures on food, housing, home services, and transportation.

Digital inclusive finance (F) has a significantly positive moderating effect on clothing and housing and a significantly negative moderating effect on home services and medical care. This indicates that urban residents receive effective alleviation of the mobility constraint problem from the development of inclusive digital finance. Consequently, urban residents' demand for survival-oriented consumption (clothing and housing) rises, and their demand for developing enjoyment-oriented goods (home services and medical care) declines; this in turn leads to an increase in spending on clothing and housing and a decline in spending on home services and medical care. The development of digital finance has led to changes in two areas. On the one hand, it has made it easy for residents to access financial services. Digital borrowing and payment services not only meet residents' financial needs but also significantly stimulate their consumption needs (Li et al., 2023). On the other hand, the digital finance characteristics of low cost and easy access significantly alleviate the problem of a lack of liquidity (Liu et al., 2021). Residents can discount future liquidity to the current period using digital financial services to smooth risk and consumption (Ge et al., 2022), thus changing residents' internal habit formation, that is, prudent consumption behaviour.

The average years of schooling (E) have a positive moderating effect on health care and a significantly negative moderating effect on clothing, household services, transportation, and education and entertainment. This suggests that as the level of education improves, it increases the internal habit effect on health care while weakening the internal habit effect on clothing, household equipment and services, transportation, and education and entertainment. This shows that the level of education has a significant impact on the population's consumption habits. This is consistent with the findings of existing studies in the literature. Education promotes accumulation of consumer human capital (Castelló-Climent & Doménech, 2021) and consumer skills that contribute to consumer habits, consumption levels, and consumption perceptions (Zhang & Cai, 2021). In addition, higher education levels can also reduce household savings rates by increasing income stability (Yi et al., 2017). With an increase in the population's education level, the vulnerability of personal finances is effectively mitigated (Anderloni et al., 2012), thus changing the population's prudent consumption behaviour. As a result of internal habit effects, residents accordingly make selective changes to various types of consumer spending.

The income gap (T) has a negative moderating effect on internal habits related to food, clothing, housing, and household services and a positive moderating effect on

health care. This suggests that widening the income gap strengthens the internal habit effect on health care and weakens the internal habit effect on food, clothing, housing, and household services. This is consistent with the findings of existing studies in the literature. A widening income gap is not conducive for alleviating poverty and inevitably gives rise to many poor people. Residents also feel uneasy and more vulnerable to risk smoothing due to increased uncertainty (Yue et al., 2021), resulting in a more cautious attitude towards consumer spending. In addition, expensive healthcare consumption will consume more savings, resulting in a more severe financial situation for the population (Anderloni et al., 2012), and, eventually, the income gap will widen further (Yang & Zhao, 2022). Under the influence of a widening income gap and mobility constraints, the effect of residents' internal habits becomes larger, that is, past consumption habits increase residents' consumption expenditures on healthcare. Indeed, widening income disparities can also lead to greater mobility constraints for lower- and middle-income groups, directly reducing residents' consumption expenditure on healthcare (Zhang et al., 2022).

The dummy variable (D) that reflects a region's economic level has a positive intra-habits moderating effect on transport and communication and a negative intra-habits moderating effect on food, clothing, housing, household equipment and services, and education and entertainment. This suggests that as a region's economic level increases, it strengthens the internal habit effect on transport while weakening the internal habit effect on food, clothing, housing, household equipment and services, and education and entertainment. This is consistent with the findings of existing studies in the literature. At present, China has yet to cross the middle-income trap completely. Even if residents in economically developed areas can afford to spend more, they are more cautious about spending on transport and communication, which consumes more mobility. Furthermore, the income level and risk smoothing ability of residents in developed regions are higher compared to those in less developed regions (Lv & Cui, 2022), thus effectively improving the prudent consumption behaviour of residents on food, clothing, housing, household equipment and services, and cultural, educational, and entertainment. In other words, consumption expenditures on food, clothing, housing, household equipment and services, and education and entertainment caused by one's past consumption habits will also be reduced.

Based on the absolute value of the slope of $Lnc^{(k)}_{(i,t-1)j}$ (the size of the internal habit formation effect parameter $|\psi_{2j}|$), we find that inclusive digital finance and the income gap have a greater effect on the internal habit parameter. Moreover, the education level and whether a region is developed have a relatively smaller effect on the internal habit effect parameter. The primary influences on internal habits are digital inclusion and the income gap, followed by education and the regional economic level.

5. Conclusions and policy recommendations

5.1. Conclusion

The most outstanding contribution of this study is based on Naik and Moore (1996) multilayer statistical model with internal habit effects, which solves the dilemma of needing to be able to introduce data at different structure levels into the same model.

Moreover, the study analyses the cross-level interactions between macro and micro variables and their paths of action, taking the consumption environment as a starting point. This particular research perspective has significant implications for different countries in terms of how well they can play their consumption policies to stimulate economic recovery. In short, the internal habit effect is significantly present in consumer behaviour and varies across regions. Regarding types of consumption, food, clothing, and household furnishings are more influenced by internal habit effects, while internal habit effects have less influence on housing, health care, transport, and education. At the same time, digital financial inclusion, income disparities, education level, and regional economic differences have different moderating effects on internal habit effects. Specifically, digital financial inclusion has a positive moderating effect on clothing and housing and a negative moderating effect on household services and healthcare. Years of education per urban resident has a positive moderating effect on healthcare and a negative moderating effect on clothing, household services, transport and communication, and education and entertainment. Income disparity has a negative moderating effect on food, clothing, housing and household services and a positive moderating effect on health care. Dummy variables reflecting regional development have a negative moderating effect on food, clothing, housing, household equipment and services, and education and entertainment, and a positive moderating effect on transport. Regarding the strength of the effect on internal habits, digital inclusion and income disparity are more robust, and the effects on education and regional economic level are weaker.

The importance of the internal habit effect on the population's consumption has been well documented. Despite rapid economic growth and rising income levels, China's final consumption rate remains relatively low. Moreover, internal habits are an important influencing factor for the Chinese population's low final consumption rate (Jiang & Shi, 2018; Zhai et al., 2021). Studies have shown that the consumption environment has a clear impact on internal habits (Desbouys et al., 2019), such as digital financial inclusion (Yang et al., 2022), the income gap (Luo et al.,2021), education level (Al-Nuaimi & Al-Ghamdi, 2022), regional development (Wang et al., 2021), and so on. Digital inclusive finance can improve the liquidity constraints residents face through income growth, income vulnerability mitigation, wealth accumulation, and poverty reduction effects (Yang et al., 2022; Zhou &Wang, 2021; Lin & Zhang, 2022; Liu et al., 2022), which can lead to a shift in consumption habits. Instead of reducing poverty, widening the income gap increases income uncertainty and weakens risk smoothing (Chen et al., 2021; Yue et al., 2021). Ultimately, a widening income gap leads residents to adopt more cautious consumption behaviour. Indeed, with increasing levels of education, education not only effectively alleviates income disparities (Panori & Psycharis, 2019) and income levels (Wang et al., 2018) but also transforms the population's consumption attitudes (Al-Nuaimi & Al-Ghamdi, 2022). Meanwhile, a region's degree of development can also influence habit preferences by affecting residents' mobility (Wu & Han, 2021; Wu & Xiong, 2023). The conclusions obtained through the multi-layer model constructed in this study are consistent with those obtained in previous literature. More importantly, the study reveals how environmental variables affect residents' consumption; that is, the consumption

environment affects habit preferences and thus consumption mainly by changing consumer perceptions and mobility constraints.

Although the study conclusions are based on urban consumption data from China, as a developing country, China's economic and social development is similar to that of many other countries. Compared to other developing countries or regions, urban dwellers' consumption habits tend to be more of the same. The consumption structures, consumer attitudes, and consumption psychology of urban residents are also similar. Therefore, the study's findings can be applied to other countries and have implications for other similar countries or regions that wish to understand their residents' consumption.

5.2. Policy recommendations

The following policy recommendations are based on our findings.

First, the government should increase infrastructure for digital inclusive financial services, especially to construct communications, logistics, the Internet of Things, and other related infrastructure in remote areas, to create a good consumption environment for residents. The government should also optimize the digital inclusion service environment and vigorously promote education regarding digital inclusion. The former can be used to enforce the strength and level of regulation through big data processing and technology, such as artificial intelligence, focusing on combating malpractice in the digital payments industry. The latter enables consumers to master the digital payment process and bridge the digital divide and poverty by educating them on digital technology and financial literacy.

Second, the government can implement precise poverty alleviation, especially by providing appropriate assistance to low-income families who were hit hard during the outbreak of COVID-19. Vocational training can also be provided to improve the vocational quality and ability of low-income groups and broaden employment channels, thereby raising residents' income levels. The government can also reduce the income gap by increasing the share of labour income through enhanced income redistribution adjustments.

Third, the government should establish a comprehensive poverty funding system to increase the number of years of education per capita in poor areas, increase access to higher education for the public, and improve equity in education. As education for all increases, it is also important to focus on equity in education quality, increasing the number of higher education groups and achieving higher levels of equity in education.

Fourth, the government should pay attention to the issue of regional economic disparities and dig deeper into the intrinsic influencing factors that cause differences in economic levels between regions. It should formulate relevant policies that are locally suitable and increase the policy and resource tilts for the central and western regions. This involves leveraging policy advantages to compensate for regional disadvantages and promote economic standards in the central and western regions. The government also must ensure that the eastern region continues to rise in economic standards and play its role as an economic leader.

5.3. Limitations and future research

Similar to other studies, this study has limitations. The model derived in this study only applies to macro data, but does not consider microdata, which genuinely reflects individual consumption. On the one hand, this is because using multi-layer statistical models requires data with nested characteristics. On the other hand, the existing micro database needs to be further improved. In addition, external habit effects, an important explanatory variable influencing consumption, is also an essential factor. External habit effects mean that the surrounding group's consumption patterns and consumption levels influence an individual's consumption behaviour. However, this study did not derive a multi-layer statistical model with external habit effects. These limitations also serve as directions for future research.

Disclosure statement

The authors report there are no competing interests to declare.

Funding

This work was supported by the General Project of National Social Science Foundation of China "Research on Consumption Structure of Urban and Rural Residents Based on the Perspective of Habit Formation Embedded Panel ELES Model" [Grant Numbers: No. 19BJL047]

References

Aguiar, M., & Bils, M. (2015). Has consumption inequality mirrored income inequality?. *American Economic Review*, *105*(9), 2725–2756. https://doi.org/10.1257/aer.20120599

Al-Nuaimi, S. R., & Al-Ghamdi, S. G. (2022). Sustainable consumption and education for sustainability in higher education. *Sustainability*, *14*(12), 7255. https://doi.org/10.3390/su14127255

Amoah, A., & Addoah, T. (2021). Does environmental knowledge drive pro-environmental behaviour in developing countries? Evidence from households in Ghana. *Environment, Development and Sustainability*, *23*(2), 2719–2738. https://doi.org/10.1007/s10668-020-00698-x

Anderloni, L., Bacchiocchi, E., & Vandone, D. (2012). Household financial vulnerability: An empirical analysis. *Research in Economics*, *66*(3), 284–296. https://doi.org/10.1016/j.rie.2012.03.001

Ben-David, I., Fermand, E., & Kuhnen, C. M. (2018). Expectations uncertainty and household economic behavior (No. w25336). *National Bureau of Economic Research*.

Byrne, D. P., Goette, L., & Martin, L. A. (2022). *The habit-forming effects of feedback: Evidence from a large-scale field experiment*. SSRN 3974371.

Carroll, C. D., Hall, R. E., & Zeldes, S. P. (1992). The buffer-stock theory of saving: Some macroeconomic evidence. *Brookings Papers on Economic Activity*, *1992*(2), 61–156. https://doi.org/10.2307/2534582

Castelló-Climent, A., & Doménech, R. (2021). Human capital and income inequality revisited. *Education Economics*, *29*(2), 194–212. https://doi.org/10.1080/09645292.2020.1870936

Chan, Y. T. (2020). Optimal emissions tax rates under habit formation and social comparisons. *Energy Policy*, *146*, 111809. https://doi.org/10.1016/j.enpol.2020.111809

Chen, J., Wen, X., & Song, L. (2021). Income gaps, credit constraints, and house price fluctuations. *Journal of Financial Research*, *11*, 79–96. https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2022&filename=JRYJ202111005&uniplatform=NZKPT&v=Dy2OTtraPRxWK3BAsLcbsmJWc5Z064eGzzQDzetRskYoWMoVNOK__F-XCOWNG5NS

Cheng, Z. (2021). Education and consumption: Evidence from migrants in Chinese cities. *Journal of Business Research*, *127*, 206–215. https://doi.org/10.1016/j.jbusres.2021.01.018

Coady, D., & Dizioli, A. (2018). Income inequality and education revisited: Persistence, endogeneity and heterogeneity. *Applied Economics*, *50*(25), 2747–2761. https://doi.org/10.1080/00036846.2017.1406659

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (20th ed.). Lawrence Earlbaum Associates.

Constantinides, G. M. (1990). Habit formation: A resolution of the equity premium puzzle. *Journal of Political Economy*, *98*(3), 519–543. https://doi.org/10.1086/261693

Cui, H. Y., & Fan, J. Z. (2011). Internal and external habit formation and Chinese rural residents consumption behavior: An empirical analysis based on provincial dynamic panel data. *Chinese Rural Economy*, *07*, 54–62. https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFD2011&filename=ZNJJ201107009&uniplatform=NZKPT&v=rXDDfineF3el4hg3_zr4RiD30A4CMTKr0jCl7trh5685FxQDQCOipl3xYPIGvo4H

Deaton, A. (1992). Saving and income smoothing in Cote d'Ivoire. *Research program in development studies*. Woodrow Wilson School, Princeton University.

Deaton, A., & Muellbauer, J. (1980). An almost ideal demand system. *The American Economic Review*, *70*(3), 312–326. http://www.jstor.org/stable/1805222

Desbouys, L., De Ridder, K., Rouche, M., & Castetbon, K. (2019). Food consumption in adolescents and young adults: age-specific socio-economic and cultural disparities (Belgian Food Consumption Survey 2014). *Nutrients*, *11*(7), 1520. https://doi.org/10.3390/nu11071520

Duesenberry, J. S. (1949). *Income, saving, and the theory of consumer behavior*. Harvard University Pres. https://doi.org/10.3390/nu11071520

Gan, L., Zhao, N., & Sun, Y. (2018). Income inequality, liquidity constraints and China's household savings rate. *Economic Research Journal*, *53*(12), 34–50. https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2019&filename=JJYJ201812004&uniplatform=NZKPT&v=BxLVeqjL-S_O9OCLC0e7g17ZXbx5J0A2cRzMlkaCHA7SKol4ZS7iVcI3iuzij7P6

Ge, H., Li, B., Tang, D., Xu, H., & Boamah, V. (2022). Research on digital inclusive finance promoting the integration of rural three-industry. *International Journal of Environmental Research and Public Health*, *19*(6), 3363. https://doi.org/10.3390/ijerph19063363

Geng, Z., & He, G. (2021). Digital financial inclusion and sustainable employment: Evidence from countries along the belt and road. *Borsa Istanbul Review*, *21*(3), 307–316. https://doi.org/10.1016/j.bir.2021.04.004

Goh, T. T., Xin, Z., & Jin, D. (2019). Habit formation in social media consumption: A case of political engagement. *Behaviour & Information Technology*, *38*(3), 273–288. https://doi.org/10.1080/0144929X.2018.1529197

Granovetter, M. (1985). Economic action and social structure: the problem of embeddedness. *American Journal of Sociology*, *91*(3), 481–510. https://doi.org/10.1086/228311

Guo, F., Wang, J. Y., Wang, F., Kong, T., Zhang, X., & Cheng, Z. Y. (2020). Measuring China's digital financial inclusion: Index complication and spatial characteristics. *China Economic Quarterly*, *19*(04), 1401–1418. https://doi.org/10.13821/j.cnki.ceq.2020.03.12

Hang, B. (2009). Rural households 'buffer stock saving with habit formation. *Economic Research Journal*, *44*(01), 96–105. https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFD2009&filename=JJYJ200901007&uniplatform=NZKPT&v=QtMYMFVRhCzAXo7D8z8GGQdwQsCvD__-W74S02YvBzI7WUi2JmSbXI8eBAgfe0Q0

Hang, B., & Shen, C. L. (2008). Buffer-stock saving behavior with habit formation. *Journal of Quantitative & Technological Economics*, *25*(10), 142–152. https://kns.cnki.net/kcms2/article/abstract?v=3uoqIhG8C44YLTlOAiTRKgchrJ08w1e7VSL-HJEdEx09yG0s_hkp-f7RdXHVigA0GqpuZkkymx8wA1_AyTgTXp5R0ShjA63f&uniplatform=NZKPT&src=copy

Hidaka, B. H., Hester, C. M., Bridges, K. M., Daley, C. M., & Greiner, K. A. (2018). Fast food consumption is associated with higher education in women, but not men, among older adults in urban safety-net clinics: A cross-sectional survey. *Preventive Medicine Reports*, *12*, 148–151. https://doi.org/10.1016/j.pmedr.2018.09.005

Huang, Z., Xu, H., Li, J., & Luo, N. (2020). Has highway construction narrowed the urban–rural income gap? Evidence from Chinese cities. *Papers in Regional Science*, *99*(3), 705–723. https://doi.org/10.1111/pirs.12504

Huo, C., & Chen, L. (2022). The impact of the income gap on carbon emissions: Evidence from China. *Energies*, *15*(10), 3771. https://doi.org/10.3390/en15103771

Ji, X., Wang, K., Xu, H., & Li, M. (2021). Has digital financial inclusion narrowed the urban-rural income gap: The role of entrepreneurship in China. *Sustainability*, *13*(15), 8292. https://doi.org/10.3390/su13158292

Jiang, H. L., & Jiang, P. C. (2020). Research on the effect of digital inclusive finance on the improvement consumption level and structure optimization. *Modern Finance and Economics-Journal of Tianjin University of Finance and Economics*, *40*(10), 18–32. https://doi.org/10.19559/j.cnki.12-1387.2020.10.002

Jiang, S., & Shi, J. F. (2018). An empirical analysis on habit formation of consumption with discount recursive least squares method. *Journal of Discrete Mathematical Sciences and Cryptography*, *21*(2), 527–532. https://doi.org/10.1080/09720529.2018.1449335

Li, J., Wu, Y., & Xiao, J. J. (2020). The impact of digital finance on household consumption: Evidence from China. *Economic Modelling*, *86*, 317–326. https://doi.org/10.1016/j.econmod.2019.09.027

Kapteyn, A., van de Geer, S., Van de Stadt, H., & Wansbeek, T. (1997). Interdependent preferences: An econometric analysis. *Journal of Applied Econometrics*, *12*(6), 665–686. AID-JAE437 > 3.0.CO;2-U https://doi.org/10.1002/(SICI)1099-1255(199711/12)12:6 < 665:

Lakshmanasamy, T., & Maya, K. (2020). The effect of income inequality on happiness inequality in India: A recentered influence function regression estimation and life satisfaction inequality decomposition. *Indian Journal of Human Development*, *14*(2), 161–181. https://doi.org/10.1177/0019466220987025

Lei, Q. (2009). Wealth accumulation, habits, preference changes, uncertainty and consumption decisions. *China Economic Quarterly*, *8*(03), 1029–1046. https://kns.cnki.net/kcms2/article/abstract?v=3uoqIhG8C44YLTlOAiTRKgchrJ08w1e75TZJapvoLK3LPzpBq0bYHcmgf7Tb71pCaC4eMRwB0E

Li, M., Feng, S., & Xie, X. (2023). Spatial effect of digital financial inclusion on the urban–rural income gap in China—Analysis based on path dependence. *Economic Research-Ekonomska Istraživanja*, *36*(1), 2999–3020. https://doi.org/10.1080/1331677X.2022.2106279

Lin, H., & Zhang, Z. (2022). The impacts of digital finance development on household income, consumption, and financial asset holding: An extreme value analysis of China's microdata. *Personal and Ubiquitous Computing*, 1–21. https://doi.org/10.1007/s00779-022-01667-z

Lindley, D. V., & Smith, A. F. M. (1972). Bayes estimates for the linear model. *Journal of the Royal Statistical Society: Series B (Methodological)*, *34*(1), 1–18. https://doi.org/10.1111/j.2517-6161.1972.tb00885.x

Liu, H., Wang, C., Tian, M., & Wen, F. (2019). Analysis of regional difference decomposition of changes in energy consumption in China during 1995–2015. *Energy*, *171*, 1139–1149. https://doi.org/10.1016/j.energy.2019.01.067

Liu, L. (2017). Habit formation, retirement and consumption structure of urban households in China. *Journal of Statistics and Information*, *32*(09), 89–97. https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2017&filename=TJLT201709012&uniplatform=NZKPT&v=cQNj2Prczizm99Wi8mo6p0bxPyJfG6BF32eew-UTsua5qmRi2wS-MUFtyOLJcLrL

Liu, Y., Luan, L., Wu, W., Zhang, Z., & Hsu, Y. (2021). Can digital financial inclusion promote China's economic growth?. *International Review of Financial Analysis*, *78*, 101889. https://doi.org/10.1016/j.irfa.2021.101889

Liu, Y., Zhao, H., Sun, J., & Tang, Y. (2022). Digital inclusive finance and family wealth: Evidence from Light GBM approach. *Sustainability*, *14*(22), 15363. https://doi.org/10.3390/su142215363

Long, H., Xie, R., Gao, C., Sun, M., & Su, B. (2022). Analysis of China's regional differences in water consumption based on spatial structural decomposition analysis model. *The Science of the Total Environment*, *848*, 157629. https://doi.org/10.1016/j.scitotenv.2022.157629

Long, Z., Wang, X., & Sun, Y. (2002). An empirical analysis of the formation of consumption habits of urban residents in China. *Economic Science*, *06*, 29–35. https://doi.org/10.19523/j.jjkx.2002.06.004

Luo, C., Li, S., & Yue, X. (2021). An analysis of changes in the extent of income gap in China (2013—2018). *Social Sciences in China*, *01*, 33–54.204–205. https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2021&filename=ZSHK202101003&uniplatform=NZKPT&v=uLQReDzyX4EBzMo93haTLVXwCOWK2GA_LICCohT8-CcovV8KArI2FHyoAhBB-01d

Luo, J., & Li, B. (2022). Impact of digital financial inclusion on consumption inequality in China. *Social Indicators Research*, *163*(2), 529–553. https://doi.org/10.1007/s11205-022-02909-6

Lv, C., & Cui, Y. (2022). China's north-south economic gap and trend forecast. *Journal of Central University of Finance & Economics*, *6*, 116–128. https://doi.org/10.19681/j.cnki.jcufe.2022.06.001

McAdam, M., Crowley, C., & Harrison, R. T. (2019). To boldly go where no [man] has gone before"-institutional voids and the development of women's digital entrepreneurship. *Technological Forecasting and Social Change*, *146*, 912–922. https://doi.org/10.1016/j.techfore.2018.07.051

Naik, N. Y., & Moore, M. J. (1996). Habit formation and intertemporal substitution in individual food consumption. *The Review of Economics and Statistics*, *78*(2), 321. https://doi.org/10.2307/2109934

Ozili, P. K. (2020). Contesting digital finance for the poor. *Digital Policy, Regulation and Governance*, *22*(2), 135–151. https://doi.org/10.1108/DPRG-12-2019-0104

Panori, A., & Psycharis, Y. (2019). Exploring the links between education and income inequality at the municipal level in Greece. *Applied Spatial Analysis and Policy*, *12*(1), 101–126. https://doi.org/10.1007/s12061-017-9234-6

Polanyi, K. (1944). *The great transformation: The political and economic origins of our time*. Bea-con Press.

Pollak, R. A. (1970). Habit formation and dynamic demand functions. *Journal of Political Economy*, *78*(4, Part 1), 745–763. https://doi.org/10.1086/259667

Pollak, R. A. (1976). Interdependent preferences. *The American Economic Review*, *66*(3), 309–320. https://www.jstor.org/stable/1828165

Qi, F., & Wang, Z. (2007). Empirical analysis of consumption habits of rural residents in Beijing. *Chinese Rural Economy*, *07*, 53–59. Jhttps://kns.cnki.net/kcms2/article/abstract?v=3uoqIhG8C44YLTlOAiTRKgchrJ08w1e7aLpFYbsPrqFgMtck6VlsRuo_2M72rMaXRKsMTbDR8qzF-SFtAOW_CReBxqSJMuBM&uniplatform=NZKPT&src=copy

Ryu, D. H., & Kim, K. J. (2022). How do households perceive electricity consumption? Evidence from smart metering and survey data in South Korea. *Energy Research & Social Science*, *92*, 102770. https://doi.org/10.1016/j.erss.2022.102770

Song, Q., Li, J., Wu, Y., & Yin, Z. (2020). Accessibility of financial services and household consumption in China: Evidence from micro data. *The North American Journal of Economics and Finance*, *53*, 101213. https://doi.org/10.1016/j.najef.2020.101213

Song, Y., Zhang, Y., Wang, Y., Zhang, B., & Su, J. (2022). The influence of foreign direct investment on the urban–rural income gap: Evidence from China. *Kybernetes*, *51*(1), 466–484. https://doi.org/10.1108/K-07-2020-0488

Su, C.-W., Liu, T.-Y., Chang, H.-L., & Jiang, X.-Z. (2015). Is urbanization narrowing the urban-rural income gap? A cross-regional study of China. *Habitat International*, *48*, 79–86. https://doi.org/10.1016/j.habitatint.2015.03.002

Sun, L., Zhou, K., & Yang, S. (2018). Regional difference of household electricity consumption: An empirical study of Jiangsu, China. *Journal of Cleaner Production*, *171*, 1415–1428. https://doi.org/10.1016/j.jclepro.2017.10.123

Sun, Y., & Tang, X. (2022). The impact of digital inclusive finance on sustainable economic growth in China. *Finance Research Letters*, *50*, 103234. https://doi.org/10.1016/j.frl.2022.103234

van Bilsen, S., Bovenberg, A. L., & Laeven, R. J. A. (2020). Consumption and portfolio choice under internal multiplicative habit formation. *Journal of Financial and Quantitative Analysis*, *55*(7), 2334–2371. https://doi.org/10.1017/S0022109019000772

Wang, F., Cheng, Z., Reisner, A., & Liu, Y. (2018). Compliance with household solid waste management in rural villages in developing countries. *Journal of Cleaner Production*, *202*, 293–298. https://doi.org/10.1016/j.jclepro.2018.08.135

Wang, J., Li, Q., & Zeng, B. (2021). Multi-layer cooperative combined forecasting system for short-term wind speed forecasting. *Sustainable Energy Technologies and Assessments*, *43*, 100946. https://doi.org/10.1016/j.seta.2020.100946

Wang, S., Sun, S., Zhao, E., & Wang, S. (2021). Urban and rural differences with regional assessment of household energy consumption in China. *Energy*, *232*, 121091. https://doi.org/10.1016/j.energy.2021.121091

Wang, X., & Wang, X. (2022). Digital financial inclusion and household risk smoothing: Chinese household-level evidence. *China Economic Quarterly*, *22*(05), 1679–1698. https://doi.org/10.13821/j.cnki.ceq.2022.05.11

Wang, Y., Geng, Z., & Yang, W. (2019). Do consumption habit and income difference eliminate the risk premium in Chinese capital market?. *The Developing Economies*, *57*(2), 99–124. https://doi.org/10.1111/deve.12195

Waxman, A., Liang, Y., Li, S., Barwick, P. J., & Zhao, M. (2020). Tightening belts to buy a home: Consumption responses to rising housing prices in urban China. *Journal of Urban Economics*, *115*, 103190. https://doi.org/10.1016/j.jue.2019.103190

Wu, X., & Han, J. (2021). Psychological needs, physiological needs and regional comparison effects. *Sustainability*, *13*(16), 9464. https://doi.org/10.3390/su13169464

Wu, X., & Xiong, Y. (2023). Regional differences in urban residents' consumption behaviour in China: From the perspective of the habit formation time effect. *Economic Research-Ekonomska Istraživanja*, *36*(1), 23. https://doi.org/10.1080/1331677X.2022.2117229

Xu, G., Hu, W., Qiao, Y., & Zhou, Y. (2020). Mapping an innovation ecosystem using network clustering and community identification: A multi-layered framework. *Scientometrics*, *124*(3), 2057–2081. https://doi.org/10.1007/s11192-020-03543-0

Yan, W., Yu, C., & Wu, J. (2021). The role of education in expanding domestic demands and promoting the economic growth. *Educational Research*, *42*(05), 12–22. https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2021&filename=JYYJ202105003&uniplatform=NZKPT&v=H5TouIuNHhKI9J2cTcuW8jR6GULebL09UPBUM_5tQX-wzrFlaBfXFV3M7-zFVygt

Yan, X., & Hang, B. (2010). Internal and external habit formation with household consumption structure: An empirical study based on Chinese rural household. *Statistical Research*, *27*(05), 32–40. https://doi.org/10.19343/j.cnki.11-1302/c.2010.05.006

Yang, B., Ma, F., Deng, W., & Pi, Y. (2022). Digital inclusive finance and rural household subsistence consumption in China. *Economic Analysis and Policy*, *76*, 627–642. https://doi.org/10.1016/j.eap.2022.09.007

Yi, X. J., Chen, R. J., Lai, T., & Yang, B. Y. (2017). Whether the increase in the education level of the household head significantly increased the household savings rate. *Shanghai Finance*, *11*, 21–27. https://doi.org/10.13910/j.cnki.shjr.2017.11.003

Yin, Z., Liu, X., & Wang, X. (2020). Does rural income inequality restrain Farmers' Entrepreneurship?. *Chinese Rural Economy*, *05*, 76–95. https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2020&filename=ZNJJ202005006&uniplatform=NZKPT&v=-u9gCMfJuVpA8SPNyDrta5zLLbyhrzSegiPt7pczx280HEgKTyo877PzQhr4P_JB

Yu, C., Jia, N., Li, W., & Wu, R. (2022). Digital inclusive finance and rural consumption structure–Evidence from Peking University digital inclusive financial index and China household finance survey. *China Agricultural Economic Review*, *14*(1), 165–183. https://doi.org/10.1108/CAER-10-2020-0255

Yu, N., & Wang, Y. (2021). Can digital inclusive finance narrow the Chinese urban–rural income gap? The perspective of the regional urban–rural income structure. *Sustainability*, *13*(11), 6427. https://doi.org/10.3390/su13116427

Yue, W., Wang, X., & Zhang, Q. (2021). Health risk, medical insurance and household financial vulnerability. *China Industrial Economics*, *10*, 175–192. https://doi.org/10.19581/j.cnki.ciejournal.2021.10.009

Zhai, T., Long, W., & Si, W. (2021). The evolution of habit formation effect on sugar consumption of urban residents in China. *China Agricultural Economic Review*, *13*(3), 548–568. https://doi.org/10.1108/CAER-07-2020-0170

Zhang, D., Wang, Y., & Jiao, X. (2022). The moderating effect of social security expenditure on multi-dimensional urban-rural gap under the goal of common prosperity. *Journal of Statistics and Information*, *37*(12), 100–111. https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDAUTO&filename=TJLT202212010&uniplatform=NZKPT&v=OJHQcol7UFAJsolZ7xuNDN4sHb8lKc0ByqbQx1wfxoYs8ejU58HLd6b9o66HneF

Zhang, X., & Cai, J. (2021). Educational reform under the sixth scientific and *Technological Revolution. Journal of Northeast Normal University (Philosophy and Social Sciences)*, *02*, 117–127. https://doi.org/10.16164/j.cnki.22-1062/c.2021.02.016

Zhao, H., Zheng, X., & Yang, L. (2022). Does digital inclusive finance narrow the urban-rural income gap through primary distribution and redistribution?. *Sustainability*, *14*(4), 2120. https://doi.org/10.3390/su14042120

Zhao, W. (2019). Does health insurance promote people's consumption? New evidence from China. *China Economic Review*, *53*, 65–86. https://doi.org/10.1016/j.chieco.2018.08.007

Zhao, X., Cheng, H., Zhao, H., Jiang, L., & Xue, B. (2019). Survey on the households' energy-saving behaviors and influencing factors in the rural loess hilly region of China. *Journal of Cleaner Production*, *230*, 547–556. https://doi.org/10.1016/j.jclepro.2019.04.385

Zhou, L., & Wang, H. (2021). An approach to study the poverty reduction effect of digital inclusive finance from a multidimensional perspective based on clustering algorithms. *Scientific Programming*, *2021*, 1–11. https://doi.org/10.1155/2021/4645596

Zhou, S., & Meng, X. (2022). Financial cycle, income gap and consumption: from the view of income sources and income groups. *Chinese Journal of Population Science*, *02*, 46–60 + 127. https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2022&filename=ZKRK202202004&uniplatform=NZKPT&v=BnZaxgmKkmZUM-EO62lSBGi2xcdaWsz8H_B6M4Et7LDiRhVRpRu6KxDC2XbisaD3