Effect of Chinese industrial structure upgrading on household consumption structure: evidence from CHIP data

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Abstract. Based on the data of Chinese Household Income Project (CHIP) and 117 cities in 2007 and 2013, this paper analyzed the effect of industrial structure upgrading on household consumption structure by using the ordinary least square method and quantile regression method. The following conclusions were drawn. Firstly, the upgrading of industrial structure can significantly promote the upgrading of household consumption structure. Secondly, compared with the low-level consumption structure households, the industrial structure upgrading has a stronger impact on households with high-level consumption structure. With the increase of quantile level, the influence of industrial structure upgrading on the upgrading of residents' consumption structure can gradually increase. Therefore, the government should actively promote the supply-side reform and the upgrading of industrial structure, which would be conducive to the upgrading of consumption structure.

1. Introduction

Since the beginning of this century, the final consumption rate of residents in China has declined, and the ratio of consumption to GDP per capita has been lower than the world average. An important reason for the weak demand is that the upgrading of consumption structure of Chinese residents lags behind. The supply-side structural reform is of great significance to the upgrading of consumption structure. This paper attempts to explore the impact of industrial structure upgrading on consumption structure from the perspective of supply side.

Domestic scholars’ research on Chinese consumption structure mainly focuses on two aspects. The first is to study the characteristics and trend of the consumption structure. Most studies found the Chinese consumption structure upgraded in the past years (Qi Tang et al., 2018; Mingming Shi et al., 2019; Huihuang Fu, 2020). The second is to study the influence factors of consumption structure upgrading. The factors include the family size, Internet, social capital, social learning, financial knowledge, industrial innovation, etc. (Xiaonan Li and Rui Li, 2013; Danqing Du, 2017; Xuyang Li et al., 2019; Lei Han and Yang Gu, 2019; Xian Fang and Gang Jin, 2020; Juan Luo, 2020; Zao Sun and Xuelu Xu, 2018).

The existing literature has laid a good foundation for further study of consumption structure, but the analysis of the impact of industrial structure upgrading on consumption structure is relatively few. Therefore, this paper focuses on empirically testing the role of industrial structure upgrading on the upgrading of residents’ consumption structure.
2. Model and data
The following model is constructed:

\[
ecc_{i,j,t} = \beta_0 + \beta_1 ais_{j,t} + \gamma \sum cv1_{i,j,t} + \mu \sum cv2_{i,j,t} + \eta_t + \varepsilon_{i,j,t}
\]  

(1)

In formula (1), The subscript i,j and t denote the family, district and year respectively. \(ecc_{i,j,t}\) is the structure of household consumption. \(ais_{j,t}\) is the industrial structure level. \(\sum cv1_{i,j,t}\) is the family characteristic variable set. \(\sum cv2_{i,j,t}\) is a set of urban characteristic variables. \(\beta_1\) is the core estimation parameter. \(\eta_t\) denotes the time fixed effect. \(\varepsilon_{i,j,t}\) is the random error term. The variables and measurement methods used in the study are shown in Table 1.

| Variable | Connotation | Measurement |
|----------|-------------|-------------|
| Dependent variable | ecc | Household consumption structure | (Household expenditure on culture, recreation and education + Health care expenditure + Transportation communications expenditure) / Total household expenditure |
| Independent variables | ais | Industrial structure | A sum of the product of the labor productivity and the proportion of added value to GDP of each industry |
| Household control variables | income | Net household income | Household annual disposable income |
| | pop | Number of persons of the household | Number of persons working in the non-agricultural sectors |
| | health | Health status of family members | Actual age of household head |
| | nonf | Non-agricultural labour force | Number of years of schooling of the household head |
| | age | Age | | |
| | mar | Marital status | | |
| | edu | Level of education | | |
| | ins | Pension insurance | | |
| Macro control variables | pergdp | Economic development | Regional GDP/ Regional Total Population |
| | invest | Fixed assets investment growth rate (%) | [(fixed assets investment in the current year / fixed assets investment in the previous year)-1]×100 |
| | open | Openness (%) | (Regional actual use of FDI/regional GDP)×100 |
| | intern | Internet development | Principal component analysis |
| | govern | Government education funding intensity (%) | (Expenditure on education of local government/budgetary expenditure of local government)×100 |
| | infrastr | Conditions of recreational infrastructure | Number of regional theaters and opera houses |

The industrial structure level(ais) is:

\[
ais_{j,t} = \sum_{m=1}^{3} y_{i,m,t} \times lp_{i,m,t}, m=1,2,3
\]  

(2)

\(y_{i,m,t}\) is the proportion of the added value of industry m in region i in year t (m=1 for agriculture, m=2 for manufacturing, m=3 for the tertiary industry). \(lp_{i,m,t}\) is the labor productivity of industry m in region i in year t.
\[ p_{i,m,t} = \frac{Y_{i,m,t}}{L_{i,m,t}} \]  

3. Empirical analysis

3.1. OLS regression

First, the model was estimated by ordinary least squares (OLS) method. The VIF test was carried out. The maximum value is 4.51, which is less than the empirical value of 10. This indicates that there is no multiple collinearity problem. The White test results showed that there was heteroscedasticity problem, so we eliminated the effect of heteroscedasticity by adding robust standard error. The regression results are shown in Table 2. After controlling the household characteristic variables and the regional characteristic variables, the influence coefficients of industrial structure upgrading on the household consumption structure is between 0.007 and 0.016, and are statistically significant. This indicates that the industrial structure upgrading has a significant positive effect on the household consumption structure upgrading. Family net income, household size, marital status and years of schooling of household head have a significant positive impact on the upgrading of household consumption structure, while the health status of family members, the number of non-agricultural labor force and the age of household head have a significant negative impact on the household consumption structure upgrading. At the macro level, the coefficients of economic development level and government education funding intensity are significantly positive.
Table 2. OLS estimates results.

|       | (1)    | (2)    | (3)    | (4)    | (5)    |
|-------|--------|--------|--------|--------|--------|
| ais   | 0.016*** | 0.007*** | 0.010*** | 0.012*** | 0.014*** |
|       | (6.72)  | (2.79)  | (4.10)  | (5.31)  | (4.89)  |
| income| 0.027*** | 0.028*** | 0.025*** | 0.022*** |        |
|       | (21.62) | (20.17) | (16.99) | (14.69) |        |
| pop   | 0.007*** | 0.006*** | 0.006*** |        |        |
|       | (9.44)  | (8.23)  | (8.48)  |        |        |
| health| -0.003  | -0.011***| -0.010***|        |        |
|       | (-1.37) | (-5.38) | (-5.16) |        |        |
| nonf  | -0.005***| -0.008***| -0.006***|        |        |
|       | (-5.46) | (-7.79) | (-5.98) |        |        |
| age   | -0.069***| -0.066***|        |        |        |
|       | (-13.09)| (-12.54)|        |        |        |
| mar   | 0.022*** | 0.025*** |        |        |        |
|       | (5.56)  | (6.36)  |        |        |        |
| edu   | 0.009*** | 0.008*** |        |        |        |
|       | (3.58)  | (3.23)  |        |        |        |
| ins   | -0.002  | -0.007***|        |        |        |
|       | (-0.74) | (-3.07) |        |        |        |
| pergdp|        |        |        |        | 0.007***|
|       |        |        |        |        | (2.95)  |
| invest|        | -0.005 |        |        |        |
|       |        | (-0.53) |        |        |        |
| open  |        | 0.024  |        |        |        |
|       |        | (0.49)  |        |        |        |
| internet|        |        | -0.013***|        |        |
|       |        |        | (6.58)  |        |        |
| govern|        |        |        | 0.065** |        |
|       |        |        |        | (2.23)  |        |
| infrastr|        |        |        | 0.002  |        |
|       |        |        |        | (1.51)  |        |
| Time effect | yes | yes | yes | Yes | yes |
| _cons | 0.190*** | -0.065*** | -0.099*** | 0.187*** | 0.107*** |
|       | (16.50) | (-5.33) | (-7.65) | (7.02)  | (3.05)  |
| N     | 15234  | 15234  | 15234  | 15234  | 15234  |
| R2    | 0.004  | 0.033  | 0.039  | 0.057  | 0.059  |

Note: Values within brackets are t statistics.*, ** and *** represent significance at 10%, 5% and 1% respectively.

3.2. Quantile regressions
Considering the imbalance of household consumption structure, the use of ordinary least square estimation may be misleading. Thus we further use quantile regression method to study the impact of industrial structure upgrading on household consumption structure, and the results are shown in Table 3. With the upgrading of household consumption structure, the estimated coefficient of industrial structure upgrading shows a steady increase trend. Specifically, at 0.10 quantile, the estimated coefficient of industrial structure upgrading is small and not significant, while at 0.25, 0.50, 0.75 and 0.90 quantiles, the estimated coefficients of industrial structure upgrading are significantly positive, and the coefficient reaches the maximum at 0.90 quantile. At 0.1 quantile, the income level of the
family group is low and can only meet the basic needs of life. Consumption is concentrated on necessities such as food. When the industrial structure is improved, the consumption of the group is still limited to the necessities. Thus the influence of the industrial structure upgrading on the consumption structure is small. Compared with households with lower consumption structure, industrial structure upgrading has a stronger impact on households with higher consumption structure. The reason may be that families with high-level consumption structure have cutting-edge consumption ideas, pay more attention to the quality of life, and have a stronger willingness to consume new products. With the upgrading of industrial structure, the change of product structure and the continuous development of tertiary industries such as new service industry, families with high-level consumption structure are more willing to accept new products and improve their quality of life.

Table 3. Quantile regressions result.

| Quantiles | 10th  | 25th  | 50th  | 75th  | 90th  |
|-----------|-------|-------|-------|-------|-------|
| ais       | 0.002 | 0.010*** | 0.015*** | 0.019*** | 0.027*** |
|           | (0.64) | (4.37) | (7.53) | (4.34) | (4.18) |
| income    | 0.013*** | 0.019*** | 0.025*** | 0.026*** | 0.030*** |
|           | (7.42) | (13.03) | (8.70) | (5.40) | (7.44) |
| pop       | 0.005*** | 0.008*** | 0.009*** | 0.008*** | 0.004*** |
|           | (8.29) | (12.80) | (8.99) | (21.57) | (2.84) |
| health    | -0.002 | -0.005 | -0.008*** | -0.013*** | -0.021*** |
|           | (-0.98) | (-1.28) | (-2.65) | (-8.47) | (-4.80) |
| nonf      | -0.002** | -0.002** | -0.006*** | -0.010*** | -0.014*** |
|           | (-2.18) | (-2.42) | (-2.87) | (-4.73) | (-20.62) |
| age       | -0.058*** | -0.073*** | -0.083*** | -0.072*** | -0.052*** |
|           | (-14.80) | (-23.40) | (-15.13) | (-6.88) | (-3.29) |
| mar       | 0.015*** | 0.019*** | 0.034*** | 0.032*** | 0.030*** |
|           | (3.28) | (3.12) | (19.90) | (7.33) | (2.87) |
| edu       | 0.006 | 0.007*** | 0.009*** | 0.014*** | 0.006** |
|           | (1.63) | (3.39) | (4.07) | (4.50) | (2.07) |
| ins       | -0.004* | -0.008*** | -0.005 | -0.011*** | -0.014*** |
|           | (-1.85) | (-6.03) | (-1.48) | (-2.97) | (-2.64) |
| pergdp    | 0.009*** | 0.003 | 0.008** | 0.008 | 0.008 |
|           | (4.31) | (1.25) | (2.11) | (1.17) | (0.87) |
| invest    | 0.007 | 0.018*** | 0.002 | -0.031* | -0.030 |
|           | (0.84) | (4.08) | (0.48) | (-1.95) | (-1.32) |
| open      | -0.092*** | -0.014 | -0.002 | 0.035 | 0.055 |
|           | (-2.79) | (-0.27) | (-0.04) | (1.00) | (0.70) |
| internet  | -0.007** | -0.005** | -0.012*** | -0.017*** | -0.026*** |
|           | (-2.45) | (-2.55) | (-4.74) | (-9.67) | (-3.25) |
| govern    | 0.037 | 0.025 | 0.093** | 0.114** | 0.151** |
|           | (1.53) | (0.70) | (2.38) | (2.25) | (2.27) |
| infrastr  | 0.002 | 0.005*** | 0.004*** | 0.001 | 0.000 |
|           | (1.48) | (7.59) | (4.03) | (0.59) | (0.09) |
| Time effect | yes | yes | yes | Yes | yes |
| _cons     | 0.036** | 0.110*** | 0.087** | 0.135 | 0.148*** |
|           | (2.00) | (4.39) | (2.30) | (1.58) | (3.76) |
| N         | 15234 | 15234 | 15234 | 15234 | 15234 |
| Pseudo R2 | 0.0790 | 0.0824 | 0.0841 | 0.0708 | 0.0685 |

Figure 1 shows the estimated industrial structure coefficient at each quantile of the household consumption structure. With the gradual increase of the quantile, the estimated coefficient shows an upward trend.
3.3. Robustness test

3.3.1. Data adjustment

The explained variable may have some extreme values. To eliminate their impact on regression estimates, we adopted the tailing treatment of the explained variables and then the OLS method is used to estimate formula (1) again. The estimated results are shown in columns (1) and (2) of Table 4. In 2007 and 2013, the coefficient estimate for upgrading the industrial structure is positive, and statistically significant, which implies that the upgrading of industrial structure promotes the upgrading of consumption structure.

Table 4. Robustness test result.

|       | 2007  | 2013  | Ecc |
|-------|-------|-------|-----|
| ais   | 0.047*** (7.74) | 0.006* (1.88) | |
| TS    | 0.017*** (3.05) | - | |
| TL    | - | 0.025*** (-4.62) | |
| ais2  | 0.036** (2.01) | 0.037*** (5.30) | |
| control | yes | yes | yes | no | Yes |
| Time Effect | yes | yes | yes | yes | Yes |
| cons  | 0.351*** (5.16) | 0.409*** (14.14) | -0.067* (1.73) | 0.195*** (6.85) | 0.109*** (2.93) | 0.128*** (8.41) |
| N     | 4040 | 11194 | 15234 | 15234 | 15234 | 15234 |
| R2    | 0.045 | 0.047 | 0.063 | 0.058 | 0.058 | 0.003 |

3.3.2. Variable replacement

Firstly, we used the ratio of the value added of the tertiary industry to that of the secondary industry to measure the advanced level of industrial structure (TS). And the industrial structure Theil index is used to measure the rationalization level of industrial structure (TL). The two indices reflect the degree of optimization and upgrading of the industrial structure.
\[ TL_{i,t} = \sum_{m=1}^{3} y_{i,m,t} \times \ln\left( \frac{y_{i,m,t}}{I_{i,m,t}} \right), \quad m=1, 2, 3 \]  

(4)

Where \( y_{i,m,t} \) is the same as that in formula (2). \( l_{i,m,t} \) indicates the proportion of employees in industry \( m \) of the total employees in region \( i \) in year \( t \). If the value is 0, it implies that the industrial structure is at the equilibrium level. The larger the value, the more unreasonable the industrial structure.

Secondly, the industrial structure hierarchy coefficient (ais2) is used as the proxy variable to measure the industrial structure. The index is between 1 and 3.

\[ ais2_{i,t} = \sum_{m=1}^{3} y_{i,m,t} \times m, \quad m=1, 2, 3 \]  

(5)

The regression estimates are shown in columns (3) to (6) of Table 4. In Table 4, the estimated coefficients of industrial structure upgrading are positive. The estimated coefficients of industrial structure rationalization are negative. They are significant at the level of 1%. The estimated coefficient of industrial structure hierarchy is significantly positive. The results indicate that the upgrading of industrial structure is conducive to the upgrading of consumption structure.

4. Conclusions

In this paper, we analyzed the impact of Chinese industrial structure upgrading on household consumption structure by OLS and quantile regression methods based on the CHIP data of 2007 and 2013. We found that: (1) The upgrading of industrial structure can significantly promote the upgrading of household consumption structure. (2) With the increase of quantile level, the influence of industrial structure upgrading on the upgrading of residents' consumption structure can gradually increase. Compared with low-level consumption structure households, industrial structure upgrading has a stronger impact on households with high-level consumption structure. Thus, the government should actively promote the supply-side structural reform, upgrade the industrial structure, establish a long-term mechanism to promote the increase of residents’ income and promote the upgrading of consumption structure.

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