The Evolution of Consumption Structure and Industrial Structure
——Empirical Research Based on VAR Model

WANG Wenjing1, LV Kangyin2
1. College of Urban and Environmental Sciences, Northeast Normal University, Changchun, P. R. China, 130024
2. School of Business, Northeast Normal University, Changchun, P. R. China, 130024
wangwj672@nenu.edu.cn

Abstract: Using data from statistical yearbook from 1978 to 2007, the authors construct a VAR model consist of variables of consumption structure, income level of urban residents, secondary industry and tertiary industry. The empirical method of VAR model is used to study on the dynamic characteristic and interaction relationship between consumption structure and industrial structure. By means of model specification, Granger causality test, variance decomposition and cointegration test, the results indicate that consumption structure can affect secondary industry upgrading. Furthermore, income of urban residents and industrial structure has two-way causality. That indicates in Jilin province, we should raise income level of urban residents to promote industry and consumption upgrading.

Keywords: Industrial structure, consumption structure, VAR model

1. Introduction

The relationship between consumption structure and industrial structure, which is always the significant issue in academy of economy. There is a big controversy whether industrial structure transformation is decided by evolution of consumption structure. Xiang (2007) attributed evolution of industrial structure to three factors, in which consumption structure is most important. Fu (2007) argued that consumption structure is the root cause to industrial structure change. Lots of researches verified the change of industrial structure is guided by consumption structure through income (Yang, Ye and Song, 2009; Xiong, 2009). With the improvement of consumption structure, supply structure need to be adjusted accordingly, which makes process of production more roundabout and industrial structure upgrading (Yang, 2009). Meanwhile, evolution of the consumption structure is also inseparable from the transformation of industrial structure. Lewis (1954) built dual economic model to demonstrate wage gap can attract labor to flow from agricultural sector to high-income sectors. With the income increasement, people can afford more luxury goods, which promotes consumption structure upgrading. Recently, more scholars focus on studying on theoretical framework of consumption structure and industrial structure; the empirical researches are still limited. Moreover, there is little quantitative discussion about interactive relationship of consumption structure and industrial structure to economic growth. Cui (2009) took Shanxi Province as an example to discuss interactive relationship between them; Wen and Ran (2005) established harmony matrix to measure the harmonious degree between consumption and industrial structure.

This study tries to make empirical analysis based on Jilin Province, use VAR model and cointegration test to discuss relationship between consumption and industrial structure, which gives some theoretical basis to guide consumption and optimize the industrial structure.

2. Text

2.1 Theoretical Framework and Data
2.1.1 Theoretical Framework
In this article, Vector Autoregressive (VAR) model is used to analyse two-way mechanism of consumption and industrial structure. VAR model is the dynamic simultaneous equation model proposed
by Sims (1980), which overcomes traditional model subjected to imperfect economic theory, such as division of endogenous and exogenous variables, estimation and inference and other complex issues. In addition, VAR model can take causality test among economic variables, pulse effects and variance decomposition analysis. This text uses the Granger causality test, Johansen cointegration and variance decomposition on the basis of VAR model. Finally, Vector Error Correction model (VEC) is established to analyse urban household consumption and industrial structure of Jilin.

A VAR model with $k$ variables and $p$ lags can be written as

$$\Phi(L)Y_t = u + \varepsilon_t$$

Where, $Y_t = (X_t^*, y_t^*)'$, consists of macroeconomic data, $X_t$, plus the latent variable $y_t^*$; $\Phi(L)$ is a set of $k \times k$ matrices, from $L = 0, \ldots, p$, with the identity matrix at $L = 0$, $\mu$ is a set of intercepts, and $\varepsilon$ are mean-zero normally-distributed disturbances. The covariance matrix of errors is denoted $\Sigma$. The parameters that require conditional distributions for MCMC estimation are $\Phi$—the VAR regression coefficients—the covariance matrix $\Sigma$, and the latent variable $y_t^*$.

2.1.2 Data

According to China’s statistical methods, consumption expenditure of urban residents can be divided into food expenses, clothing expenses, health care expenses etc., the proportion of the expenditure is consumption structure. In order to analyse the characteristic of evolution of the consumption structure, we use Engel Coefficient of urban residents (EC), which is food proportion of expenditure to denote consumption structure of urban residents in Jilin. The proportion of three industries is usually taken to represent industrial structure. In order to avoid multicollinearity risk, we only take the proportion of secondary (written as PSI) and tertiary industry (written as PTI) as proxy variables of industrial structure. As the interaction between consumption and industrial structure conducts through income levels of urban residents, per-capita disposable income of urban residents (written as IMC) is selected as substitute variable of transmission mechanism. Data here is from 1978 to 2007 Statistical Yearbooks of Jilin Province.

An unstructured VAR model is established to express dynamic response of system interaction in the following:

$$y_t = c + \sum_{i=1}^{p} A_i y_{t-i} + \varepsilon_t$$

Where, $y_t = (EC_t, \ln(IMC)_t, PSI_t, PTI_t)'$, $\ln IMC$ is natural logarithm of per-capita disposable income of urban residents, $c$ is constant term, $p$ is autoregression lags.

2.2 Model Estimation

2.2.1 Selection of Optimal Lag Order and Stability Test

![Fig.1 Stability Test Graph (Inverse Roots of AR Characteristic Polynomial)](Fig1.png)

An important aspect of empirical research in the specification of the VAR models is the determination of
the lag order of the autoregression lag polynomial, since all inference in the VAR model depends on the correct model specification. There are the information criteria such as AIC and SC procedures to select adequate lag order. According to corresponding statistics calculated by sample data, we select lag order 2 to establish VAR(2) model. Stability test results show that all the inverse roots of AR characteristic polynomial lie in the unit circle, VAR satisfies the stability condition (Fig.1).

2.2.2 Granger Causality Test

After VAR model specification, in order to discuss whether consumption structure, income level of urban residents and industrial structure exist causality, Granger causality test is introduced, the results of which are shown in Tab.1.

### Tab.1 Results of Granger Causality Test

<table>
<thead>
<tr>
<th>Parameters</th>
<th>EC</th>
<th>log(IMC)</th>
<th>PSI</th>
<th>PTI</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC</td>
<td>0.998 (0.607)</td>
<td>5.213 (0.074)</td>
<td>0.099 (0.952)</td>
<td></td>
</tr>
<tr>
<td>Ln(IMC)</td>
<td>0.052 (0.974)</td>
<td>—</td>
<td>3.335 (0.189)</td>
<td>1.495 (0.474)</td>
</tr>
<tr>
<td>PSI</td>
<td>1.206 (0.547)</td>
<td>4.932 (0.031)</td>
<td>—</td>
<td>1.735 (0.420)</td>
</tr>
<tr>
<td>PTI</td>
<td>2.575 (0.276)</td>
<td>4.365 (0.086)</td>
<td>3.142 (0.208)</td>
<td>—</td>
</tr>
</tbody>
</table>

Note: the results are Chi-square value, probabilities are shown in the parenthesis.

Based on the analytic results (in Tab.1), we draw two conclusions:

First, there isn’t two-way causality between consumption and industrial structure, that is to say, change in consumption structure is only the cause of change in secondary industry (the probability of EC is not the Granger causality of PSI is 0.074, which can refuse this hypothesis at 10% significance). Meanwhile, change in industrial structure is not the cause of change in consumption structure. This shows that in Jilin Province, structure of consumption can’t go with that of industry. Enterprises in Jilin Province can’t arrange production according to market demand promptly, which led to lack of pulling function of consumption structure to industrial structure.

Second, as shown in Tab.1, the probability of “lnIMC is not Granger causality of industrial structure” is 0.189 (secondary industry) and 0.474, which means we can’t refuse the hypothesis at 10% significance. That is to say, the effect of consumption structure in Jilin conducts industrial structure (through income of urban residents) is not obvious. On the contrary, industrial structure upgrading promotes income increase. That means industrial structure in Jilin is not reasonable, state-owned enterprises take up a large proportion. The process of industrial structure upgrading iron out high salaries in monopoly enterprises, moreover, income of urban residents increase can not be sure that is caused by industrial restructuring.

2.2.3 Variance Decomposition

Granger causality test can only show whether endogenous variables have causality but effects of shocks to the dependent variables. Variance decomposition can calculate contribution of every endogenous variable in VAR model. The variance decomposition measures the percentage of variation in secondary industry (PSI) induced by shocks emanating from its relevant determinants.

### Tab.2 Variance Decomposition of PSI

<table>
<thead>
<tr>
<th>Period</th>
<th>S.E.</th>
<th>EC</th>
<th>LNIMC</th>
<th>PSI</th>
<th>PTI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.182810</td>
<td>3.042628</td>
<td>10.75462</td>
<td>86.20275</td>
<td>0.000000</td>
</tr>
<tr>
<td>2</td>
<td>1.505941</td>
<td>3.077749</td>
<td>8.070854</td>
<td>87.62512</td>
<td>1.226274</td>
</tr>
<tr>
<td>3</td>
<td>1.799634</td>
<td>3.367749</td>
<td>8.702141</td>
<td>85.92013</td>
<td>2.009980</td>
</tr>
<tr>
<td>4</td>
<td>2.105895</td>
<td>5.209984</td>
<td>9.813721</td>
<td>81.11052</td>
<td>3.865771</td>
</tr>
<tr>
<td>5</td>
<td>2.370810</td>
<td>6.394845</td>
<td>10.81238</td>
<td>77.63040</td>
<td>5.162374</td>
</tr>
<tr>
<td>6</td>
<td>2.563577</td>
<td>6.713125</td>
<td>10.85198</td>
<td>76.58542</td>
<td>5.849478</td>
</tr>
</tbody>
</table>
The estimates of variance decomposition are shown in Tab.2. The results indicate that an average of 3.04-6.713 percent variability contributed by consumption structure (EC), an average of 8.071-10.852 percent variability contributed by income level (lnIMC), that of 0-6.162 percent variability contributed by tertiary industry (PTI). That shows that income of urban residents is the most important factor that affects industrial structure in Jilin Province, but we can’t ignore the impact of consumption structure.

2.2.4 Cointegration Test and Vector Error Correction Models

As cointegration test is only effective on non-stationary series, stationary test must be taken before cointegration test. The results of ADF test show that the series are all first step integration at 5% significance. Johansen maximum likelihood estimation is used to test cointegration of series, the results are shown in Tab.3.

We can know from Tab.3 that there is one cointegrating equation at 5% significance, the endogenous variables are $EC_t$, $\ln(IMC_t)$, $PSI_t$, and $PTI_t$. The cointegrating equation is written after standardizing cointegration vectors as follows:

$$ecm_t = EC_t - 32.90 \ln(IMC_t) - 61.06 PSI_t + 10.58 PTI_t + 5.328$$

A unit root test is taken to confirm the four variables is stationary, with its value fluctuated around zero. That means the results of cointegration test is correct, VEC model is received as follows:

$$[\Delta EC_t, \quad \Delta \ln(IMC)_t, \quad \Delta PSI_t, \quad \Delta PTI_t] = [-0.04, \quad -0.02, \quad 0.002, \quad 0.001] \cdot [\Delta EC_{t-1}, \quad \Delta \ln(IMC)_{t-1}, \quad \Delta PSI_{t-1}, \quad \Delta PTI_{t-1}] + \varepsilon$$

From the VEC model, we can draw some conclusions: First, considering EC equation, the one-lag coefficients of EC, ln(IMC), PSI and PTI to EC equation are -0.203, 5.913, -3.832 and -28.72, in which that of ln(IMC) and PTI are significant. Second, considering ln(IMC) equation, the one-lag coefficients of EC and PSI are significant (0.002 and 1.267 respectively). Third, considering PSI equation, the one-lag coefficients of ln(IMC) is significant (-0.036). Last, considering PTI equation, the one-lag coefficients of EC is significant (-0.006). That means income of urban residents increase promotes transformation of consumption and industrial structure, change in consumption structure can bring
transformation of industrial structure, industrial structure can also lead transformation of consumption structure.

3. Conclusion

The paper explores the relationship between consumption structure and industrial structure of Jilin Province. After testing the dynamic effects between the variables, we can draw the following three conclusions about long-term relationship between consumption structure and industrial structure:

First, there isn’t two-way causality between consumption and industrial structure, that is to say, change in consumption structure is only the cause of change in secondary industry. It indicates that enterprises in Jilin Province can’t arrange production according to market demand promptly, which led to lack of pulling function of consumption structure to industrial structure.

Second, the results of variance decomposition shows that income of urban residents is the most important factor that affects industrial structure in Jilin Province, but we can’t ignore the impact of consumption structure.

Third, the impact of income of urban residents on industrial structure is significant. With the income increase, structure of secondary industry can be improved, which promotes income increase in turn. VEC model indicates that income of urban residents’ increases by 1% will cause Engel Coefficient to decrease by 0.002%, and proportion of secondary industry increases by 1.267%.

In conclusion, income of urban residents in Jilin must be increased to promote consumption upgrading and industrial structure optimization. As income level increase, consumption structure will change accordingly. At the same time, with the change in income level, industrial structure will change correspondingly, especially the tertiary industry. Furthermore, from the perspective of Jilin enterprises, especially that of secondary industry and tertiary industry, we should adjust production scale, investment orientation and production structure according to demand trend. That would enhance supply ability of enterprises and promote evolution of industrial structure and consumption structure upgrading.

References


